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RATIONAL® CLEARCASE®

ADMINISTRATOR'S GUIDE

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IMPORTANT NOTICE

Technical Acknowledgments

This software and documentation is based in part on BSD Networking Software Release 2, licensed from the Regents of the University of California. We acknowledge the role of the Computer Systems Research Group and the Electrical Engineering and Computer Sciences Department of the University of California at Berkeley and the Other Contributors in its development.

This product includes software developed by Greg Stein <gstein@lyra.org> for use in the mod_dav module for Apache (http://www.webdav.org/mod_dav/).

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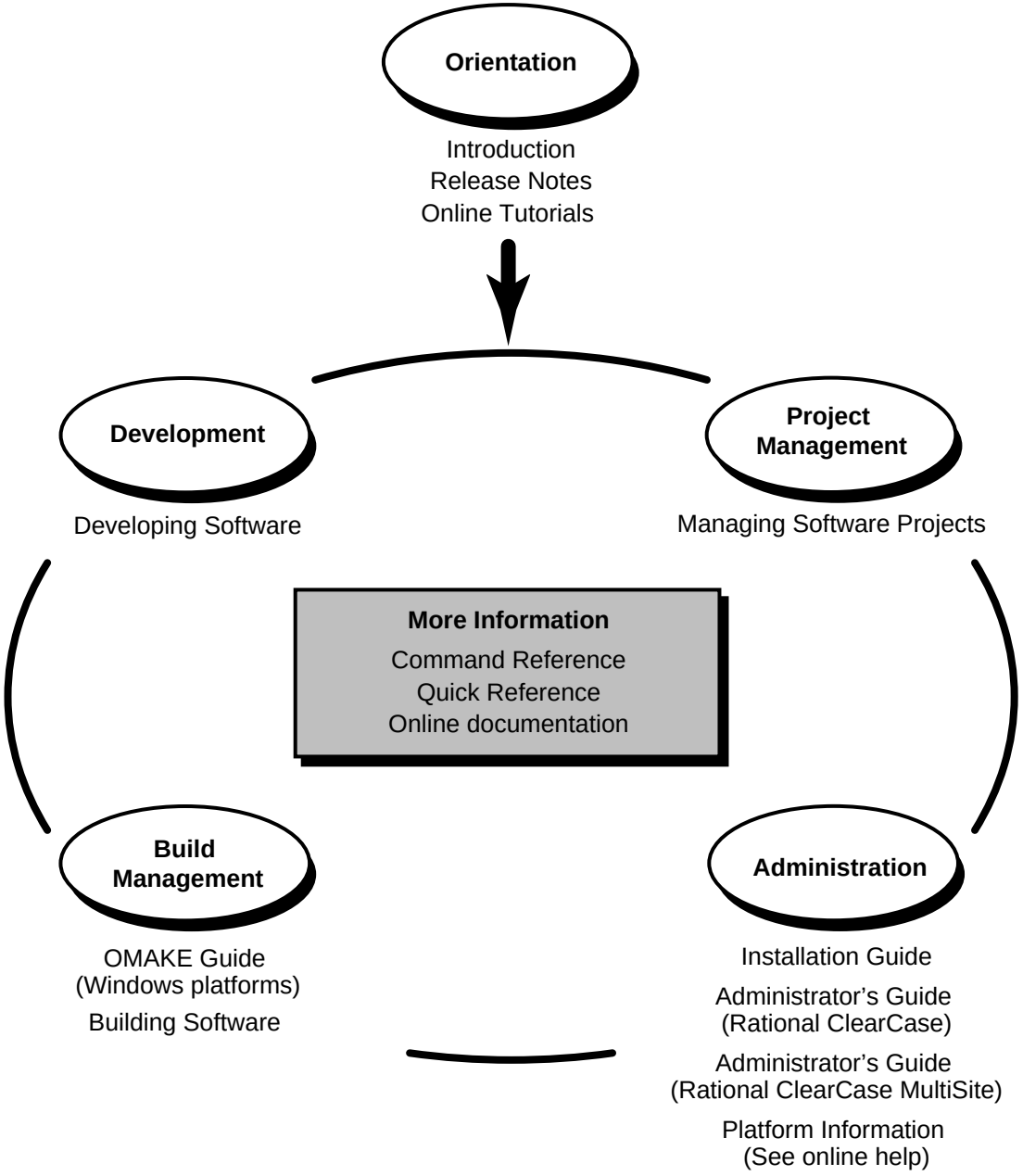
About This Manual

This manual is for ClearCase users or administrators who are responsible for tasks such as creating and maintaining data repositories, managing servers, and administering user and group accounts. This *Administrator's Guide* discusses these subjects in depth:

- Managing ClearCase client and server hosts and user and group accounts
- Administering a network of UNIX and Windows computers running Rational ClearCase
- Creating ClearCase VOBs, or data repositories, and managing their storage requirements
- Creating ClearCase views, or user workspaces, and managing their storage requirements
- Administering ClearCase licenses
- Administering the ClearCase registry, a central directory of VOBs, views, and related information
- Managing the ClearCase scheduler, which runs jobs periodically
- Setting up Web servers for the ClearCase Web interface and integrations with Web authoring tools
- Tuning VOB and view servers and ClearCase client hosts for better performance
- Troubleshooting problems with ClearCase

ClearCase Documentation Roadmap



Online Documentation

The ClearCase graphical interface includes an online help system.

There are three basic ways to access the online help system: the **Help** menu, the **Help** button, or the F1 key. **Help** > **Contents** provides access to the complete set of ClearCase online documentation. For help on a particular context, press F1. Use the **Help** button on various dialog boxes to get information specific to that dialog box.

ClearCase also provides access to full "reference pages" (detailed descriptions of ClearCase commands, utilities, and data structures) with the **cleartool man** subcommand. Without any argument, **cleartool man** displays the **cleartool** overview reference page. Specifying a command name as an argument gives information about using the specified command. For example:

cleartool man *(display the cleartool overview page)*

cleartool man man *(display the cleartool man reference page)*

cleartool man checkout *(display the cleartool checkout reference page)*

ClearCase's **–help** command option or **help** command displays individual subcommand syntax. Without any argument, **cleartool help** displays the syntax for all **cleartool** commands. **help checkout** and **checkout –help** are equivalent.

cleartool uncheckout –help

```
Usage: uncheckout | unco [-keep | -rm] [-cact | -cwork ] pname ...
```

Additionally, the online *ClearCase Tutorial* provides a step-by-step tour through ClearCase's most important features. To start the tutorial:

- On Windows, choose **Tutorial** in the appropriate ClearCase folder off the **Start** menu.
- On UNIX, type **hyperhelp cc_tut.hlp**.

Technical Support

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Administering the ClearCase Network

1 Understanding the ClearCase Network

This chapter presents a system administrator's overview of a local area network of computers running Rational ClearCase and Rational ClearCase MultiSite. It also serves as a roadmap to other chapters in this manual and to detailed reference information in the *Command Reference*.

This manual is intended for use by experienced UNIX or Windows administrators who also have administrative responsibility for a ClearCase network. Many of the procedures we describe in this manual assume that the reader is familiar with the scripting and command-line conventions, file system access controls, networking protocols, and system administration tools for UNIX and Windows computers.

In this manual, the term *Windows* refers to any of these operating systems:

- Windows XP Professional
- Windows 2000
- Windows NT

References to Windows Me or Windows 98 refer only to the specific operating system. References to UNIX refer to all UNIX and Linux platforms supported by Rational ClearCase.

1.1 Network Overview

A ClearCase administrator has three principal concerns:

- **ClearCase hosts.** ClearCase can be installed and used on any number of hosts in a network. Different hosts use ClearCase software in different ways. For example, one host may be

used only to store version-controlled data; another may be used only to run ClearCase software development tools.

- **ClearCase data storage.** ClearCase data is stored in *versioned object bases* (*VOBs*) and *views*, which can be located on any host where ClearCase is installed. A VOB or view hosted on UNIX can have auxiliary data storage on other UNIX hosts where ClearCase is not installed; such storage is accessed through UNIX symbolic links, which are not a feature of Windows. It is also possible to locate VOB or view storage on certain Network Attached Storage (NAS) devices.

  For many organizations, the set of all VOBs constitutes a central data repository, which you may need to administer as a unit. Most views are created and used by individuals; however, it is likely that one or more shared views will be created, requiring some central administration.

- **ClearCase users.** ClearCase users are identified by the user name and group memberships established when they log on to either UNIX or Windows. Any number of people can use ClearCase on any number of hosts; the floating license scheme limits the number of concurrent users, but not the number of hosts.

1.2 ClearCase Hosts

ClearCase is a distributed application with a client/server architecture. Any development task (for example, execution of a single ClearCase command) may involve programs and data on several hosts. Every host in a ClearCase network plays one or more of the following roles.

- **Client host.** Each ClearCase user works at a ClearCase client host, running programs such as **cleartool**, **clearmake**, and various ClearCase graphical user interfaces (GUIs), as well as other software (for example, development tools, a Rational Suite, and operating system utilities). ClearCase must be installed on each client host. A client installation can include the multiversion file system (MVFS), which provides support for dynamic views. If a client uses only snapshot views, it does not need the MVFS.

- **Server host**. Any host on which a VOB or view is created is a server host. Some hosts may be dedicated servers on which client software rarely used (and may not even be installed). Other server hosts double as clients. ClearCase must be installed on each server host.

- **Registry server host.** One host in the network acts as the ClearCase *registry server* host. Each host is assigned to a particular registry server host at ClearCase install time. This host stores access-path information for all the VOBs and views in the network. ClearCase client and server programs on all hosts communicate with the registry server host to determine the

actual storage location of ClearCase data. You may also designate a **backup registry server host** that can assume the ClearCase registry server role if the primary registry server host fails.

- **License server host.** One or more hosts in the network act as *license server hosts*, authorizing and limiting ClearCase use according to the terms of your license agreement. Each host on which ClearCase is installed is assigned to a particular license server host and communicates with that host periodically.

- **Networkwide release host.** One host in the network acts as the networkwide *release host*. A directory on this host stores an entire ClearCase release that has been extracted from the distribution CD. When necessary, ClearCase patches can be applied to a release area to update the entire release with the latest enhancements and defect fixes. Certain installation options allow ClearCase hosts running UNIX to access ClearCase programs and data through symbolic links to the release area instead of having the programs and data installed on local storage. ClearCase hosts running Windows do not access the networkwide release host after installation is complete. The networkwide release host does not need to run ClearCase.

- **ClearCase Web server host.** If you want to use the ClearCase Web interface, you'll need at least one ClearCase Web server host. See Chapter 29, *Configuring a Web Server for the ClearCase Web Interface*, for more detail.

- **Non-ClearCase UNIX hosts.** ClearCase may not be installed on every host in your network. In fact, it is not possible to install it on hosts whose architectures ClearCase does not yet support. Such hosts cannot run ClearCase programs, but they can access ClearCase data, through standard UNIX network file system facilities. You administer these export (or share) mechanisms using standard UNIX tools.

- **Network Attached Storage Devices.** Certain Network Attached Storage (NAS) devices are supported for use with ClearCase. These devices can be used to store any ClearCase programs or data, including VOBs and views. NAS devices do not run ClearCase. They simply provide storage that ClearCase hosts access over the local area network. The *Release Notes* for Rational ClearCase and ClearCase MultiSite contain the most current information about supported NAS devices.

1.3 ClearCase Data Storage

All ClearCase data is stored in VOBs and views. VOBs and views reside on one or more VOB or view server hosts in the ClearCase network. A networkwide registry of VOB-tags and view-tags

allows users to access VOBs and views without having to know the name of the host where they reside. VOB and view maintenance is a critical aspect of ClearCase administration.

Versioned Object Bases (VOBs)

The ClearCase network's permanent data repository consists of one or (usually) more VOBs located on multiple hosts. Each VOB occupies a *VOB storage directory*, which holds file system objects and an embedded database.

VOB administration responsibilities include the following:

- **Registration and tagging.** Access information for all VOBs is kept in a networkwide registry. In a typical network, registry maintenance is minimal; ClearCase commands that create VOBs and VOB-tags update the registry automatically, though you may need to change a tag if you move a VOB. In addition, you may need to copy and modify tags to enable VOB access in mixed networks of UNIX and Windows computers.

- **Backup.** VOBs have special backup and recovery requirements, and must be backed up frequently and reliably. ClearCase does not include data-backup tools. You will have to select appropriate operating system backup and archive utilities or third-party backup tools for this critical task. VOB backup and restore procedures are described in Chapter 10, *Backing Up and Restoring VOBs*.

- **Periodic maintenance.** VOB administration requires that you balance the need to preserve important data with the need to conserve disk space. ClearCase includes tools for collecting data on disk space used and for occasional *scrubbing* of unneeded data. You can specify what data is unneeded on a per-VOB basis.

  ClearCase includes a job scheduler that manages periodic execution of various administrative tasks, including disk-space data collection and VOB scrubbing. The job scheduler is installed with a predefined schedule of these maintenance operations, which you can change as needed. For more information on creating and managing scheduled jobs, see Chapter 28, *Managing Scheduled Jobs*.

- **Access control.** Each VOB has an *owner*, a *primary group*, a supplemental *group list*, and a *protection mode*. Together, they control access to VOB data. Understanding and managing VOB access controls is an important task for the ClearCase administrator. For more information, see Chapter 3, *Understanding ClearCase Access Controls*.

- **Growth.** As new projects begin or existing projects are placed under ClearCase control, you may need to create new VOBs and incorporate them into your data backup and periodic maintenance schedule.
- **Reformatting**. Occasionally, a major new ClearCase release may include a feature that requires reformatting of your existing VOBs. This process updates the *schema* of the embedded VOB database.

Views

ClearCase *views* provide

- Access to VOB data
- Short-Term storage for other data created during the development process

A view stores checked-out versions of file elements, *view-private files* that have no counterpart in the VOB (for example, text editor backup files), and newly built derived objects.

ClearCase supports two types of views:

- Snapshot views, which contain copies of versions of specified elements, along with view-private objects. The view never updates itself with new versions created from other views. Instead, the **update** command reevaluates the view's config spec and loads the newly selected versions into the view.
- Dynamic views, which provide transparent access to versions of elements in the VOB and to view-private objects. Each time you access an element through a dynamic view, the view's **view_server** process evaluates the view's config spec and selects a particular version of the element. Thus, such a view updates itself with new versions created in other views.

  NOTE: Rational ClearCase LT does not support dynamic views.

Unlike VOBs, which are long-lived artifacts created by an administrator, views tend to be shorter lived and are usually created by individual developers. View administration is simpler than VOB administration, involving little more than occasional backups, periodic maintenance, and attention to access control issues.

1.4 ClearCase Users

ClearCase does not maintain a database of its users. Any user who is logged in to a ClearCase host and can acquire a license is able to use the software. Because ClearCase relies on a host's operating system to establish a user's identity (user ID, principal group ID, and optional supplementary group IDs), you must make certain that user identities are consistent on every ClearCase host. This consistency is usually achieved by using networkwide databases maintained by the operating system such as the NIS **passwd** and **group** maps on UNIX or, on Windows, Windows NT or Active Directory domains.

NOTE: In environments where users access a common set of VOBs and views from UNIX and Windows hosts, we strongly recommend that each user's user name, password, and group memberships be the same whether the user is logged in to UNIX or Windows.

Most **cleartool** commands check the user's identity before granting access to particular objects—element, version, and so on. See Chapter 3, *Understanding ClearCase Access Controls*, for detailed information on this topic. In addition to these checks, non-ClearCase commands and programs that access ClearCase data in a dynamic view must also go through the MVFS, which also checks file system access rights.

1.5 The ClearCase Registry

ClearCase maintains a networkwide registry of VOBs and views so that users and programs can access these objects without having to know the details of where they are stored.

The ClearCase registry database is maintained on the registry server host. Because access to the registry and the information it contains is critical for nearly every ClearCase operation, this host should be robust, accessible, and highly available. It should also be backed up regularly.

Your ClearCase network must have at least one registry server host. You may have additional registry server hosts if needed. Consider setting up an additional ClearCase registry host to accommodate disjoint user communities who need not (or must not) access each others VOBs and views. Otherwise, we recommend configuring a single ClearCase registry host per site to minimize registry administration overhead.

Objects and Tags

The ClearCase registry contains two types of information for every VOB and every view:

- A single object entry that describes where the VOB or view is stored on the network (a host name and storage directory, for example) and includes other information needed by ClearCase.
- One or more tag entries that define the name by which the VOB or view is referenced by other programs and provide a global path, expressed using network file naming conventions, to the VOB or view storage directory.

NOTE: ClearCase administrators in charge of mixed networks of UNIX and Windows hosts must be aware of several issues regarding VOB and view access in this environment. See Chapter 7, *Configuring VOB and View Access in Mixed Environments*, for more on this topic.

Registry Regions

Because network file naming conventions are different on UNIX and Windows, a VOB-tag or view-tag that works for a UNIX host does not work for a Windows host. For example, a network file name in a UNIX network is typically expressed, using the naming conventions of the UNIX Network File System (NFS) protocol, in terms of a mount point, host name, and exported directory name:

```
/net/mercury/usr1
```

On Windows, a network file name takes the form of a Universal Naming Convention (UNC) path, expressed as a host name and a share name

```
\\mercury\usr1
```

Because of these and other differences in network naming, any VOB or view that has to be accessed by both UNIX and Windows clients has to have two tags: each with the network path to the VOB or view storage expressed using the appropriate syntax. To accommodate this requirement, the ClearCase registry can include multiple regions, each of which includes tags appropriate for use by either UNIX or Windows hosts (but not both).

In addition to the differences in the network file names they contain, tag names themselves are usually different between UNIX and Windows. Because a VOB has to be mounted (using the NFS

mount command) on UNIX, a UNIX VOB tag usually has two components: a mount point and a tag name:

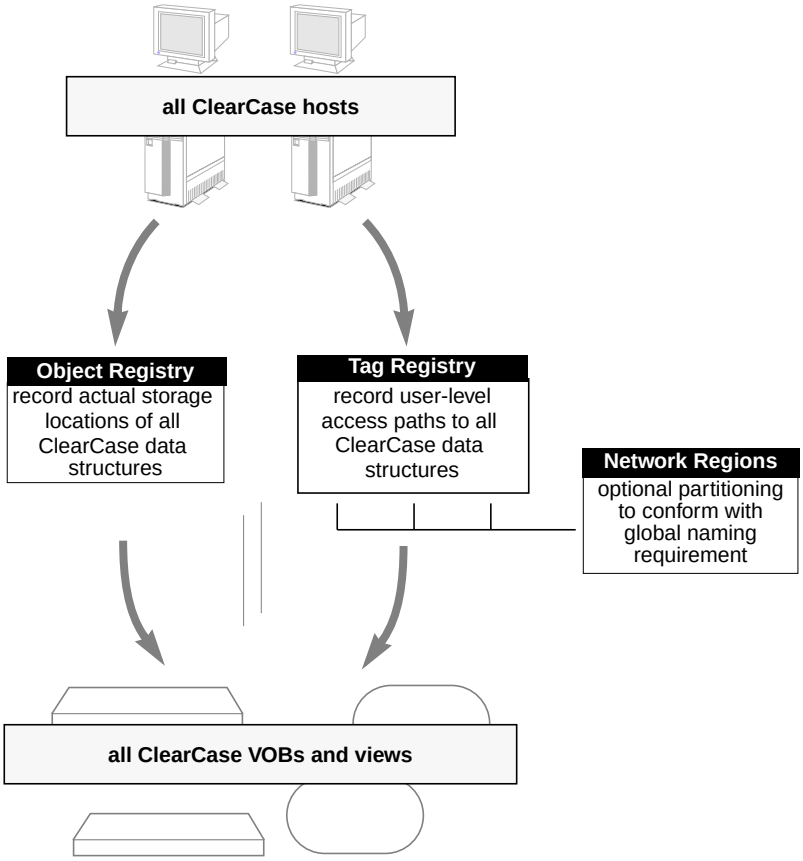
```
/vobs/sources
```

The mount point is not required by ClearCase, but using it conserves resources in the UNIX client's root partition and simplifies use of the NFS automounter to mount VOBs when a host starts up. Windows VOB tags only have a single component, for example:

```
\sources
```

Figure 1 illustrates how registries mediate access to VOBs and views.

Figure 1 ClearCase Storage Registries.



Server Storage Locations

In addition to VOB and view tag and object entries, the ClearCase registry records the names and network paths for server storage locations that can be created to provide a standard or default storage location for newly created VOBs and views. Because they include network file names, server storage locations are specific to a UNIX or Windows registry region.

Creating server storage locations on appropriate devices—a Network Attached Storage (NAS) device or a dedicated VOB or view server host—can simplify the creation, management, and maintenance of VOBs and views.

1.6 ClearCase Server Processes

Two server processes—the **albd_server** and **admin_server**—run on every ClearCase host that has been configured to support local VOBs and views, regardless of whether any VOBs or views have been created on the host. Other server processes are started as necessary to manage any VOBs and views that reside on the host. This section provides brief descriptions of these servers.

NOTE: A ClearCase host running Windows can be configured with no support for local VOBs and views. Hosts configured this way do not run any ClearCase server processes.

albd_server

The Atria location broker daemon or **albd_server** handles a variety of tasks on hosts configured to support local VOBs and views:

- Manages the operation of all ClearCase services on a ClearCase VOB or view server host.
- Helps set up network communications between ClearCase client and server programs.
- Manages execution of tasks run by the ClearCase **schedule** service.
- Fields license-verification requests on the ClearCase license server host.
- Fields requests for registry information on a ClearCase registry server host.
- On UNIX platforms, fields load-balancing queries from a remote **clearmake** process. See **bldserver.control** for details.

When you start ClearCase (using the ClearCase control panel on Windows or the **atria_start** script on UNIX), the **albd_server** starts first. It then starts other servers as needed.

When you stop ClearCase, the **albd_server** stops all running ClearCase servers and then exits.

NOTE: On a ClearCase Windows client host configured with no support for local VOBs and views, no **albd_server** is installed, and there are no other ClearCase services to stop or start.

In addition to starting and stopping services, the **albd_server** helps client programs like **cleartool** and ClearCase GUIs use remote procedure calls (RPCs) to connect with ClearCase servers. When a client program wants to access a service on a ClearCase host, it uses an RPC to send a request to the **albd_server** process on that host. The **albd_server** starts the requested service if it is not already started, then issues a response telling the client the service's port number (socket

address). Thereafter, the client communicates directly with the specific service, without involving the **albd_server**.

Port Assignment

The **albd_server** listens for RPCs on a well-known port (port 371) that has been reserved for it by the Internet Assigned Numbers Authority. ClearCase installation verifies that no other service registered in the UNIX services database or NIS services map uses this port for UDP or TCP communications. If a conflict is detected, we recommend modifying the conflicting service to use another port. If you cannot reconfigure or remove the conflicting service, you can configure the **albd_server** to use any free UDP port.

- On UNIX, edit the local host's services database and/or the NIS services map.
- On Windows, create the appropriate entry in the file **%SystemRoot%\System32\drivers\etc\services**. (If there is no entry for the **albd_server** in this file, it will use port 371.)

NOTE: All **albd_server**s in a ClearCase network must use the same port number. If you change the port assignment for the **albd_server** on any ClearCase host, you must change it for the **albd_server** on every ClearCase host.

The **albd_server** reads configuration file **albd.conf** during startup to determine which services to provide. Do not modify this file.

admin_server

The ClearCase administration server **admin_server** is invoked as needed by the **albd_server** process. This short-lived server performs miscellaneous administrative support functions:

- Retrieving server log files for display by the **getlog** command and the ClearCase Administration Console.
- Retrieving and changing the local host's ClearCase properties when requested by the ClearCase Administration Console.
- **rgy_switchover** processing—moving registry files and reconfiguring clients

view_server

A **view_server** is a long-lived process that manages activity in a particular view. It interprets the rules in the view's config spec, and (for dynamic views) tracks modifications to view-private files for other ClearCase software.

For each view, a long-lived **view_server** process runs on the view host. The **view_server** is started by the host's **albd_server** process when necessary. On UNIX systems, it runs with the identity of the owner of the view storage directory (usually, the user who created the view). On Windows systems, it runs with the identity of the **albd_server** (typically, user **clearcase_albd** and group **clearcase**) A **view_server** remains active until it is terminated by a **cleartool endview –server** command, a system shutdown, or an operating system command that terminates the **view_server** process.

For a dynamic view, a **view_server** handles MVFS file system requests (such as create, delete, and rename) by querying one or more VOB databases and comparing them against the view's own database. Using the view's config spec, it selects versions of file elements and directory elements to be in the view. It also handles requests from **cleartool**, **clearmake**, and **clearaudit** to look up VOB-database objects and/or names.

The **view_server** and the MVFS use caching techniques to reduce the computational requirements of this scheme. For information about managing view cache sizes for best performance, see *View Caches* on page 512.

When it begins execution, a **view_server** reads configuration information from the **.view** file in the view-storage directory. Values in this file are established by **mkview**, **chview**, and similar commands. Do not edit this file yourself.

vob_server

For each VOB, a long-lived **vob_server** process runs on the VOB host. The **vob_server** runs with the identity of the VOB owner and manipulates data in the VOB's storage pools in response to requests from client processes.

The **vob_server** is the only process that ever creates or deletes data containers; the VOB owner is the only user who can modify data containers and storage pools. These severe restrictions protect VOB data against careless or malicious users.

A **vob_server** process is started as needed by **albd_server**. It remains active until any of the following events occurs:

- The operating system is restarted.

- The VOB is deleted with the **rmvob** command.
- ClearCase is stopped (UNIX only, see the **init_ccase** reference page).

When it begins execution, the **vob_server** reads configuration information from the file **vob_server.conf** in the VOB storage directory. Values in this file are established by the **vob_snapshot_setup** utility and similar commands. Do not edit this file yourself.

db_server

A host's **db_server** processes handle VOB database transactions on that host in response to requests from client programs. Because client programs cannot access VOB databases directly, they must send database transaction requests to a **db_server** process. Typical requests include:

- Creating and modifying metadata (such as attaching a label to a version)
- Reading metadata (such as finding the labels attached to a version)
- Writing event records (such as the one that records a **checkout** command)
- Writing configuration records
- Reading event records and configuration records

Each **db_server** process services a single client at a time, but can operate on any number of VOBs. A client establishes a connection to a **db_server** with the help of the **albd_server** on the VOB host. If necessary, the **albd_server** starts a new **db_server** process to handle a request. The connection is broken when the client exits or becomes idle (stops requesting database transactions for an extended period). At that point, the **db_server** becomes available for use by another client; eventually, an unconnected **db_server** is terminated by **albd_server**.

vobrpc_server

Each VOB host runs up to five **vobrpc_server** processes for each of its VOBs. Each process handles requests from **view_server** processes throughout the network. The request can generate both metadata (VOB database) and file system data (storage pool) activity. The **vobrpc_server** accesses the VOB database in exactly the same way as a **db_server**. It forwards storage pool access requests to the **vob_server**.

Multiple server processes are started by **albd_server**, which also routes new requests to the least-busy servers and terminates unneeded **vobrpc_server** processes when the system is lightly loaded.

lockmgr

Each VOB host runs one database lock manager process, **lockmgr**. This process arbitrates transaction requests to all VOB databases on that host from ClearCase client programs throughout the network. The calling program polls **lockmgr**, which either grants or prohibits access to the requested data. If the data is available, the transaction proceeds immediately: the data is read or written, and output is returned to the calling program. If the data is unavailable (locked because another caller has been granted write access to the data), the caller waits until **lockmgr** grants it access to the data.

Unlike most other ClearCase services, the **lockmgr** is not started by the **albd_server**. Instead, it is started when the VOB host starts. On UNIX systems, the **lockmgr** is started by the **atria_start** script. On Windows, the **lockmgr** is started by the Service Control Manager.

NOTE: On UNIX systems, the **lockmgr** communicates with other processes through **var/adm/atria/almd**, which is a shared-memory file on some platforms and a socket on others. To reduce the likelihood of accidental deletion, **/var/adm/atria/almd** is owned by **root**.

Lock manager startup options can be changed if necessary to improve VOB server performance for certain configurations. See *Lock Manager Startup Options* on page 499 for more information on this topic.

Server Error Logs

Each ClearCase server process maintains an error log on the host where it executes. ClearCase has a distributed architecture, so an error resulting from a command entered on one host can generate an error log entry on another host. In such cases, the user is directed to the appropriate log file on the appropriate host. For details on the error logs and how to display them, see the **getlog** reference page in the *Command Reference*. In addition, Windows hosts can access error logs for all ClearCase hosts (Windows and UNIX) using the ClearCase Administration Console.

Error Logging on UNIX

On ClearCase hosts running UNIX, log files are located in the directory **/var/adm/atria/log**. Log files record error and status information from various server programs and user programs. These files include the following:

abe_log	Used by the audited build executor (**abe**) during parallel clearmake builds
albd_log	Used by the **albd_server**
db_server_log	Used by the **db_server**

error_log	General-purpose error log. Used by user programs such as **cleartool**
event_scrubber_log	Used by the **event_scrubber** program
export_mvfs_log	Used by the **export_mvfs** program
install_log	Used by **install_release** (installation script)
lockmgr_log	Used by the **lockmgr** program
mntrpc_server_log	Used by **mntrpc_server** program, which performs MVFS-file-system mounts requested by **cleartool** subcommand **mount**
msadm_log	Used by the MultiSite administrative server, which handles requests for mastership
promote_log	Used by the **promote_server**
scrubber_log	Used by the **scrubber** program
view_log	Used by the **view_server**
vob_log	Used by the **vob_server**
vob_scrubber_log	Used by **vob_scrubber** program
vobrpc_server_log	Used by **vobrpc_server**

Error log files are ordinary text files. A typical entry includes the date and time of the error, the software module in which the error occurred, the current user, and an error-specific message.

As errors accumulate, the error log files grow. By default, the scheduler periodically runs a job that renames error log files to *logfile_name*`.old`, and creates empty template files in their place. See the **schedule** reference page for information on describing and changing scheduled jobs.

Error Logging on Windows

On ClearCase hosts running Windows, ClearCase server processes and other ClearCase programs write informational, warning, and error messages to the Windows application event log. The source of these messages is displayed as **ClearCase**. A typical event log entry includes the date and time of the error, the software module in which the error occurred, the current user, and an error-specific message.

As errors accumulate, the error log files grow. Use the Event Viewer to save or delete logs.

On Windows, the MVFS logs status messages to the file **`C:\mvfslogs`**. You can use the MVFS tab in the ClearCase Control Panel to change this pathname. By default, the scheduler periodically runs a job that deletes MVFS log files more than seven days old. See the **schedule** reference page for information on describing and changing scheduled jobs.

1.7 ClearCase Client/Server Processing

Because ClearCase is a distributed client/server application, multiple processes, often running on multiple hosts, can play a role in the execution of ClearCase commands. For example, this is what happens when a user checks out a file element:

1. The user's *client* process—**cleartool**, for example, or a GUI—issues a checkout request, in the form of a remote procedure call.

2. The checkout procedure requested in the RPC is handled by several *server processes*, which run on the host serving the VOB in which the requested element resides.

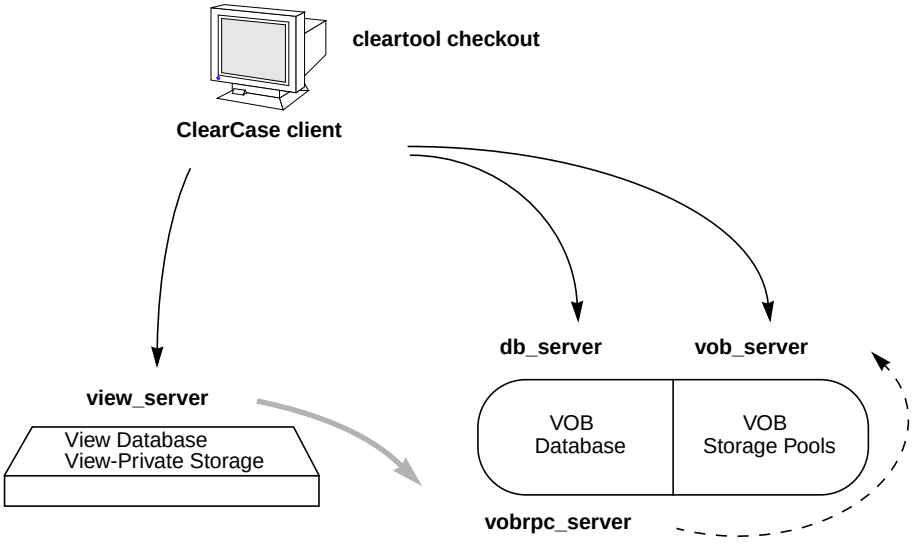
3. A view-private copy is made of the version being checked out. Making this copy involves the **view_server** process that manages the user's view. It can also involve other hosts:

   - The user's client process and the view may be on different hosts.
   - The VOB storage pool that holds the version being checked out may be located on a different host from the VOB storage directory.
   - On UNIX, the view may have a private storage area that is located on a different host from the view storage directory.

ClearCase server processes handle all this automatically and reliably. Users need not be concerned with server-level processing. As an administrator, your responsibilities require a good understanding of the client and server process distribution across your local network.

Figure 2 shows the communications paths that connect a client process with server processes.

Figure 2 Client/Server Processing



1.8 ClearCase Startup and Shutdown

ClearCase is normally started and stopped when a ClearCase host starts up or shuts down, using the startup and shutdown conventions for the platform type. Starting and stopping ClearCase starts and stops ClearCase server processes.

On UNIX

When UNIX is bootstrapped, the ClearCase startup script is executed by **init(1M)**. The startup script does the following:

- Starts the host's **albd_server** process.
- Starts a **lockmgr** process if there are any VOBs on the host.
- Performs additional file-system setup tasks, such as mounting *public* VOBs.

You can also run the **atria_start** script manually, as *root*. For example:

ccase-home-dir/**etc/atria_start stop**

Stops ClearCase.

ccase-home-dir/**etc/atria_start start**

Starts (or restarts) ClearCase.

See the **init_ccase** reference page for pointers to system-specific variants of these commands.

On Windows

Unless explicitly configured to be started manually, the **lockmgr** and **albd_server** services, as well as the MVFS if it is installed, are started when a ClearCase host starts. You can also start and stop ClearCase services manually from the **ClearCase** program in Control Panel. To stop and restart the MVFS, you must shut down and restart the computer.

NOTE: On a ClearCase Windows client host configured with no support for local VOBs and views, no **albd_server** is installed, and there are no other ClearCase services to stop or start.

Administering ClearCase Hosts

2

This chapter discusses a variety of general issues related to ClearCase host administration. Other chapters of this book discuss administration issues that are specific to hosts that function as servers for VOBs, views, licenses, and the ClearCase registry.

NOTE: Sections 2.4 through 2.7 of this chapter apply only to ClearCase on UNIX hosts.

2.1 ClearCase Administration Console

Rational ClearCase on Windows has an administration console that centralizes administration of views, VOBs, scheduled jobs, server logs, and the ClearCase registry for UNIX and Windows hosts. Because the ClearCase Administration Console is based on Microsoft Management Console technology, the user interface runs only on Windows. But because it uses standard ClearCase communication protocols to access data on other ClearCase hosts, it is an effective tool for administering ClearCase on all platforms, and it provides a single point from which most ClearCase administration functions can be managed even in a large, complex network.

The ClearCase Administration Console manages VOB and view storage, scheduled jobs, and server logs for all ClearCase hosts known to the ClearCase registry server for the local host or to any other accessible ClearCase registry server. It also manages registry information on the registry server host and provides easy access to the ClearCase customer Web site. To start the ClearCase Administration Console on a Windows host, click **Start** > **Programs** > **Rational ClearCase Administration** > **ClearCase Administration Console**.

A restricted version of the console, ClearCase Host Administration, manages VOB and view storage, scheduled jobs, and server logs for the local host. To start ClearCase Host

Administration on a Windows host, click **Start** > **Programs** > **Rational ClearCase Administration** > **ClearCase Host Administration**.

In this document, we usually suggest using the ClearCase Administration Console to perform any administrative operation of which it is capable. We also provide information on using the **cleartool** command line to perform administrative tasks. Any procedure described in this book that uses ClearCase Administration Console can also use ClearCase Host Administration if the procedure is confined to operating on the local host.

NOTE: Because the Administration Console is implemented as an MMC snap-in, ClearCase users can create customized administration consoles by adding or removing snap-ins using the MMC model. At ClearCase installation, two **.msc** files (ClearCase snap-in configuration files) are installed in *ccase-home-dir***bin**. Users gain access to the new administration tools by using MMC and these **.msc** files.

Because these files are modified by MMC to store user preferences and can change over time, the installation also places copies of the installed versions of both files in *ccase-home-dir***config\ui\preferences**. Users who need to restore the default version of one or both files can copy the versions in *ccase-home-dir***config\ui\preferences** to *ccase-home-dir***bin.**

Controlling Remote Administration

The ClearCase Administration Console is a powerful tool for remote administration of ClearCase on Windows and UNIX. You may want to prevent remote administrative access to certain hosts (for example, critical VOB servers), because it is possible for an inexperienced or malicious user to impair or disrupt ClearCase operations by changing various host properties.

Every ClearCase host that supports local VOBs and views can be configured to allow or disallow remote administration, whether or not any VOBs or views exist on the host. If a host allows remote administration, a user who is a member of the ClearCase administrators group can use the host node of the ClearCase Administration Console to change some ClearCase properties of the host. These properties include registry regions, license server, registry server, and MVFS cache sizes. If the host does not allow remote administration, only a user who is logged on to that host can change these properties. (This setting also affects use of ClearCase Host Administration for local administration.)

NOTE: A ClearCase Windows client host configured with no support for local VOBs and views cannot be administered remotely.

A host is normally configured to allow or disallow remote administration at the time ClearCase is installed. To change this configuration after ClearCase is installed on a Windows host:

1. Click **Start** > **Settings** > **Control Panel**.
2. In the ClearCase program, click the **Options** tab and select the **Allow ClearCase Remote Administration** check box. Then click **OK**.

To change this configuration after ClearCase is installed on a UNIX host:

1. As the **root** user, make the file **/var/adm/atria/config/admin.conf** writable.
2. Edit **/var/adm/atria/config/admin.conf** with a text editor and find the line containing the `DISALLOW_REMOTE_ADMIN` parameter.
3. To enable remote administration, change the value of `DISALLOW_REMOTE_ADMIN` to **0**.
4. To disable remote administration, change the value of `DISALLOW_REMOTE_ADMIN` to **1**.
5. Save **/var/adm/atria/config/admin.conf** and make the file read-only.

2.2 Using DHCP with ClearCase

The Dynamic Host Configuration Protocol (DHCP) is an Internet standard protocol that allows a host to use a temporary, dynamically assigned IP address. This standard is widely implemented on Windows computers and is also available on some UNIX computers. Because ClearCase caches IP addresses for an extended period of time, you must understand potential interactions between DHCP and ClearCase if the computers at your site that run ClearCase use DHCP.

It is possible to configure DHCP in a variety of ways. In some configurations, the IP address of a computer may change at boot time, which can present problems for ClearCase. Fortunately, in most common scenarios (for example, when the DHCP lease time is set to be at least a few days, and no computers that run ClearCase are down for more than half the lease time), IP addresses do not change when the computer is rebooted, and you should have no problems running ClearCase in a DHCP-based environment.

2.3 ClearCase Data and Non-ClearCase Hosts

A host on which ClearCase has not been installed can still access VOB data. There are several ways to provide this access, some more restrictive than others:

- **Use a snapshot view on a ClearCase host.** You can use this method when the non-ClearCase host can use a remote file access facility, such as NFS or Microsoft Windows networking, to access files in the snapshot view directory.

  This method offers good performance because it uses native software for remote file access. However, you are restricted to those element versions that the snapshot view selects, you cannot use version-extended or view-extended pathnames, and you cannot run ClearCase tools such as **clearmake** on the non-ClearCase host.

  To use this method:

  a. On a ClearCase host, create a snapshot view and load into it the files you want to access from a non-ClearCase host.

  b. On this host, make the files accessible to other hosts on your network. For a UNIX host, export the file system on which the snapshot view directory resides. For a Windows host, share the drive or directory on which the snapshot view directory resides.

  c. On a non-ClearCase host, use remote file access to read and write files in the snapshot view directory.

  d. To modify VOB data, check out and check in versions in the snapshot view on the ClearCase host.

- **Use the ClearCase Web interface.** You can use this method when the non-ClearCase host has a browser that the ClearCase Web interface supports and when a ClearCase host is configured as a Web server for the ClearCase interface. You can use the Web interface to modify VOB data without running ClearCase tools on the non-ClearCase host. For information about setting up the Web interface, see Chapter 29, *Configuring a Web Server for the ClearCase Web Interface*.

- **Use non-ClearCase access** (UNIX only). On UNIX hosts, you can use this method when the non-ClearCase host implements the NFS client protocol. Performance is slower than accessing a snapshot view through NFS because the MVFS, a view server, and the disk-based file system take part in each file access. It also cannot faithfully implement some parts of the NFS protocol. Because of these limitations, snapshot views and the ClearCase Web interface, when available, are preferable methods for accessing VOB data. For information on non-ClearCase access, see *Using Non-ClearCase Access on UNIX Hosts*.

2.4 Using Non-ClearCase Access on UNIX Hosts

A UNIX host on which ClearCase has not been installed can use non-ClearCase access to read VOB data from a UNIX VOB server. Typically, the technique is as follows:

- A UNIX host running ClearCase must export a view-extended pathname to the VOB mount point (for example, **/view/exportvu/vobs/vegaproj**). Edit the file **/etc/exports.mvfs** to specify this pathname.
- One or more non-ClearCase hosts access the VOB through a view-extended pathname. For example, a host may have an entry in its file-system table that begins

  ```
  mars:/view/exportvu/vobs/vegaproj /usr/vega nfs ...
  ```

For information on setting up an export view, see *Setting Up an Export View for Non-ClearCase Access* on page 344.

Restrictions on Use

Non-ClearCase access is restricted to UNIX computers, and carries several restrictions:

- **VOB access:** Users on the non-ClearCase host can only read data from VOBs on UNIX VOB server hosts configured for non-ClearCase access; they cannot modify the VOB in any way. They are also restricted to using the element versions selected by the specified view. They cannot use version-extended or view-extended pathnames to access other versions of the VOB's elements.
- **Building:** Although users cannot modify VOBs that are mounted through a view, they can write to view-private storage. Users can modify these view-private files with an editor and build them with a native **make** program or with scripts, though not with **clearmake**. Files created by such builds do not become derived objects; they are view-private files, unless developers take steps to convert them. (For more on this topic, see *Building Software*.)

  Because **clearmake** does not run on the non-ClearCase host, configuration lookup and derived object sharing are not available on these hosts.

Using automount with Non-ClearCase Access

After a ClearCase view/VOB pair has been exported from a ClearCase system using NFS, any properly authorized NFS client system can access the files within that view/VOB pair. If the NFS client can mount the view/VOB pair directly with a **mount** command, you can also put that view/VOB pair (explicitly or implicitly) into a map used by the NFS client's **automount** daemon. Explicit entries name the exported view/VOB pair directly. Implicit entries may arise from wildcard syntax or other advanced **automount** features.

For example, using the typical **automount** wildcard syntax, suppose an indirect map is configured at **/remote/***viewname* with a map file listing **server:/view/***viewname***/vobs/&**. This means that when a process on the NFS client accesses a subdirectory of **/remote/***viewname*, the automount process performs an NFS mount from the corresponding subdirectory of **server:/view/***viewname***/vobs**.

NOTE: Listing the directory **/remote/***viewname* usually shows only active mounts, not all possible mounts. This is similar to the result of listing **/net** for a hosts map.

If this type of map does not work correctly, verify that an explicit **mount** command works properly. If it does, then it is likely that the problem lies in the client automounter. Please consult your NFS client's documentation for full details on map syntax.

NOTE: Using the **–hosts** map for automount access does not work properly if the root file system and a view/VOB pair are exported on a ClearCase server. Suppose an NFS client host tries to access **/net/***cchost***/view/***viewname***/vobs/***vobpath*. The automounter mounts the server's root directory on **/net/***cchost*, then tries to mount the view/VOB on **/net/***cchost***/view/***viewname***/vobs/***vobpath*. However, **/net/***cchost***/view** has no subdirectories, because NFS exports do not follow local file-system mounts such as **/view**. This mount fails because the local client is unable to find a directory on which to mount the view/VOB pair.

For more information on automounting, see *Using automount with ClearCase on UNIX* on page 26.

Problems with Non-ClearCase Access: NFS Client Caching

Most NFS client implementations include caches to speed up access to frequently used file data and metadata. Newer client implementations typically cache more aggressively than older ones. When the NFS client believes its cache is valid, but something in the view or VOB has changed so that it is inconsistent with the cached data, the client may access the wrong file from the VOB.

A common inconsistency arises when a file is checked in from another view, or when the exporting view's config spec is changed. If, as a result, the view selects a new version of a file, the NFS client may not notice the change. The NFS client expects that any change in the name-to-file binding changes the time stamp of the directory that contains the file. In this case, the directory in the exporting view has not changed, but the file cataloged in that directory has changed versions. The NFS client may not revalidate its cached name-to-file binding (the association of the name with a certain version of the file) until it believes the directory has changed or the entry is pushed out of the cache because of capacity constraints.

Most NFS clients consider a cache to be valid for only a short period, typically 60 seconds or less. If the cache is not updated in a short time, you can use one of the following methods to work around this restriction:

- Create and remove a dummy file from the containing directory. This changes the directory time stamp, which invalidates the client's cache and forces the client to look up the new file version.
- Disable the client's attribute cache (usually with the **noac** mount option). However, our testing indicates that this works only for some NFS V2 clients, and that it will increase the network traffic between the NFS client and the exporting view server. If your client uses NFS V3 by default, and you want to use **noac**, we recommend that you edit the mount options to request NFS V2.
- As **root** user, unmount the file system, and then mount it. This flushes the NFS client cache for the file system. (Even if the unmount fails, it flushes the cache.)

We also recommend that you limit the dynamic nature of non-ClearCase access by using config specs that do not continually select new versions of files. For example, you can change the config spec for an exported view to contain a label-based rule rather than the **/main/LATEST** rule.

Problems with Non-ClearCase Access: NFS Locking

Because non-ClearCase access does not support NFS file locking for its files, application packages that use and require file locking do not work properly on files accessed with non-ClearCase access. Though file locking may work for view-private files on some UNIX operating systems running the MVFS, it may not work for VOB files and it does not work at all on some operating systems. An application package can hang if it insists on retrying lock requests until it can obtain a lock, and it can also be subject to file corruption if it continues when it cannot obtain a lock and multiple clients are modifying the same file. If your application requires file locking, use snapshot views or the ClearCase Web interface for access to VOB data. (See *ClearCase Data and Non-ClearCase Hosts* on page 22.)

2.5 Support for Multiple Network Interfaces on UNIX Hosts

If any ClearCase host (client or server) running UNIX has two or more network interfaces (two or more separate lines in the **/etc/hosts** file or the **hosts** NIS map), you must create a file on that host, **/var/adm/atria/config/alternate_hostnames**, which lists each of its host names. For example, suppose that the **/etc/hosts** file includes these entries:

```
 .
 .
159.0.10.16 widget sun-005 wid
 .
159.0.16.103 widget-gte sun-105
 .
```

In this case, the **alternate_hostnames** file on this host must contain these entries:

```
widget
widget-gte
```

Note that only the first host name in each **hosts** entry must be included in the file. In general, the file must list each alternative host name on a separate line. There is no commenting facility; all lines are significant. If a host does not have multiple network interfaces, this file must not exist on that host.

2.6 Using automount with ClearCase on UNIX

This section discusses use of the standard UNIX **automount(1M)** program with ClearCase. Implementations of the facility vary from architecture to architecture; consult the documentation supplied by your hardware vendor.

For information on automounting and access to ClearCase from non-ClearCase hosts, see *Using automount with Non-ClearCase Access* on page 24.

Automounter Maps

You can use any **automount** maps, including both direct and indirect maps, to access remote disk storage where VOB storage areas reside. Keep in mind that within each *network region*, VOB mount points must be consistent across all of the region's hosts.

Using the –hosts Map

ClearCase looks for symbolic links to the mount points created through the **–hosts** map in any of these directories:

/net *(the automount default)*
/hosts
/nfs

If your site uses another directory for this purpose (for example, **/remote**), create a UNIX symbolic link to provide access to your directory through one of the expected pathnames. For example:

```
# ln –s /remote /net
```

Not Using the –hosts Map

If a host does not use the **–hosts** map to make remote VOB and view storage directories accessible, you must be careful when executing **mkvob** and **mkview** on that host. The heuristics that these commands use to guess a networkwide pathname for the new storage directory will fail. (See *Ensuring Global Access to the VOB—Special Cases for UNIX* on page 151.) On such hosts, you must use the **–host**, **–hpath**, and **–gpath** options to **mkvob** and **mkview** to ensure that valid information is recorded in the ClearCase storage registries.

Specifying a Nonstandard Mount Directory

By default, **automount** mounts directories under **/tmp_mnt**. If a ClearCase host uses another location for a host's automatic mounts (specified on some platforms using the **-M** option to **automount**), you must specify it in the file **/var/adm/atria/config/automount_prefix**. For example, if your automatic mounts take place within directory **/autom**, place this line in the **automount_prefix** file:

```
/autom
```

2.7 Administering Networkwide Release Areas

Networkwide release areas for ClearCase, which are described in detail in the *Release Notes* for Rational ClearCase and ClearCase MultiSite, are supported on both UNIX and Windows platforms. On Windows, these release areas require no special administrative attention. On UNIX, which supports use of symbolic links to the release area, some release area administration may be necessary.

Changing the Location of the Release Area

To change the location of the release area:

1. **Reload the distribution medium.** Create a new release area, using the procedure in the *Installation Guide* for the ClearCase Product Family.
2. **Reinstall hosts, as appropriate.** Reinstall any host whose previous installation involved one or more symbolic links to the networkwide release area. (The standard installation model copies some files and links others.) Use the procedure in the *Installation Guide* for the ClearCase Product Family.
3. **Remove the old release area.** When all hosts have been reinstalled, you can remove the old release area.

Renaming a Release Area Host

Because UNIX installations sometimes include symbolic links to the release area—links that include the name of the release host—renaming the release host may make such installations inoperable. If you rename the networkwide release host, reinstall any host whose previous installation involved one or more symbolic links to the networkwide release area.

3 Understanding ClearCase Access Controls

This chapter describes how Rational ClearCase controls access to the data it maintains.

3.1 Fundamentals of ClearCase Access Control

ClearCase implements access controls that determine which users can create, read, write, execute, and delete data in ClearCase. Access control depends on the interaction of users and the groups they belong to, ClearCase objects, and user processes or application programs that access ClearCase data on behalf of the users.

Users and Groups

ClearCase does not have its own implementation of user and group accounts. Instead, it relies on the operating system to authenticate users at login time and to provide the details of user identity and group membership that determine a user's rights to execute various ClearCase operations. Both UNIX and Windows provide networkwide databases of user and group names that are well suited to the needs of a distributed application like ClearCase. On UNIX, this database is part of the Network Information System (NIS, NIS+). On Windows, it is part of the Active Directory or Windows NT Domain system.

On both operating systems, a user logs on with a unique user name, which ClearCase uses as the user's identification or *user ID*. A user ID can be a member of one or more groups, one of which is distinguished as the user's *primary group*. On UNIX, the primary group is part of the user's

entry in the NIS *passwd* database. On Windows, a primary group can be specified when the user's domain account is created, although each user should also set the user environment variable **CLEARCASE_PRIMARY_GROUP** to the name of that group (see *Setting the ClearCase Primary Group* on page 52). ClearCase considers both the user ID and primary group when determining a user's access rights to ClearCase objects.

In this document, the term *community* refers to a set of users and computers that access a common set of VOBs and views. A typical ClearCase community includes two classes of user:

- **Privileged users** have rights to create, modify, and delete all artifacts under ClearCase control. Access to privileged user accounts should be restricted to a few ClearCase administrators and the ClearCase server process.
- **Ordinary users** have rights to modify VOBs and views that they create, or that have been created by a member of their primary group. We recommend that all ClearCase users in a community be members of the same primary group. This can be a group that already exists, or one that you create expressly for use by the ClearCase community.

NOTE: ClearCase on Windows has a few special requirements for creation of users and groups in Windows domains. See *Domain User and Group Accounts* on page 51.

Privileged Users and Groups

Some users and groups have special importance for ClearCase access control. For example, each ClearCase object has an *owner*, usually the creator of the object, who often has special access rights to the object. If the object is a container object, such as a VOB that contains elements, or a view that contains view-private files, the ownership of the container object may in part determine who has access to the objects it contains.

ClearCase has a general notion of the *privileged user*, a term used throughout this book to describe a user who is authorized to perform certain critical operations.

- On UNIX hosts, the privileged user is the **root** user logged in to the local host. Several limitations apply to the privileges of a **root** user logged in to a remote host. These limitations are described in detail in *Restricted Privileges for Remote root* on page 31.
- On Windows hosts, the privileged user is a member of the ClearCase administrators group, described in *Users and Groups* on page 29.

On either UNIX or Windows, the privileged user has the right to create, delete, and modify VOBs and the objects that VOBs contain. Access to the privileged user account should be restricted to ClearCase administrators.

Restricted Privileges for Remote root

Although many ClearCase operations on UNIX hosts treat a remote **root** user (one who is not logged in to the local host) as a privileged user, there are several exceptions to this rule.

- When a user logged in as **root** on a UNIX host attempts to access a view on another UNIX host, the user's identity is interpreted as **nobody.nobody** (unidentified user, unidentified group). This interpretation is typical of NFS implementations on UNIX, and provides a level of security comparable to that provided by NFS. ClearCase does not support any mount option that controls how requests for access by a remote **root** user are treated, so it will not allow view access by a remote **root** user unless the view has been created to be usable by **nobody.nobody**.
- Operations that change the user or group ownership of an object in a VOB (**cleartool protect -chown** or **-chgrp**) will not succeed if they are requested by a remote **root** user.

User Processes

Any user request to read or write ClearCase data causes a user process (such as a ClearCase GUI or command-line program, or a non-ClearCase program such as a text editor that accesses ClearCase data in a dynamic view) running with that user's identity to request access to the data.

A user process has several properties that ClearCase evaluates to determine whether to grant the process access to the requested data:

- **User.** This is the user who starts the process.
- **Primary group.** This is the primary group of the user who starts the process.
- **Supplemental group list.** These are any other groups of which the user who starts the process is a member.

This chapter refers to a process's primary group and other groups together as the process's groups.

ClearCase Objects

The following ClearCase objects are subject to access control:

- VOBs
- Elements and versions
- Types and instances of types, such as labels, branches, and attributes
- Unified Change Management objects, such as projects, folders, activities, and streams
- VOB storage pools
- Views
- In dynamic views, view-private files, view-private directories, and derived objects

NOTE: The ClearCase scheduler maintains its own access control mechanism. See *Managing the Scheduler Access Control List* on page 452.

Each of these objects has one or more of these properties, which are important for access control:

- **Owner.** The owner is a user. The initial owner is the user identity of the process that creates the object. For some objects, the initial owner can be changed.

- **Group.** The initial group is the primary group of the process that creates the object. For some objects, the initial group can be changed.

- **Protection mode.** Some objects also have a protection mode. The mode consists of three sets of permissions, one for each of these user categories:

  - The object's owner
  - Any member of the object's group
  - All other users

  Each set of permissions consists of three Boolean values for a user in its category. Each value determines whether the user has one of these permissions to act on the object:

  - Read permission, or permission to view the object's data.

  - Write permission, or permission to modify the object's data. For an object that contains other objects, such as a VOB or a directory, write permission generally means permission to create or delete objects within the containing object.

  - Execute permission. For a file object, execute permission is permission to run the file as an executable program. For a directory object, execute permission is permission to search the directory.

The protection mode for a ClearCase object is summarized in Table 1. Information about an object's protection mode usually takes the form of a single-character abbreviation of each Boolean value in the protection mode; these abbreviations appear in Table 1.

Table 1 Protection Mode for a ClearCase Object

User Category	Read Permission?	Write Permission?	Execute Permission?
Object's Owner	Yes (`r`) or No (`-`)	Yes (`w`) or No (`-`)	Yes (`x`) or No (`-`)
Member of Object's Group	Yes (`r`) or No (`-`)	Yes (`w`) or No (`-`)	Yes (`x`) or No (`-`)
Other	Yes (`r`) or No (`-`)	Yes (`w`) or No (`-`)	Yes (`x`) or No (`-`)

For example, suppose you are working in a view and want to see the protection mode for the directory element **myproj** in the **projects** VOB. Suppose the owner and group of **myproj** have read, write, and execute permission, but other users have only read and execute permissions. The **cleartool describe** command displays the mode, along with the elements's owner (**sue**) and group (**clearusers**), as follows:

cleartool describe myproj

```
...
  Element Protection:
    User : sue         rwx
    Group: clearusers  rwx
    Other:             r-x
...
```

In addition to these single-character abbreviations, ClearCase sometimes uses integers to display object permissions in a compact form. For each user category (owner, group, and others), a single digit from 0 through 7 represents the permissions for that category, as described in Table 2.

Table 2 Protection Mode Digits for a ClearCase Object (Part 1 of 2)

Digit	Read Permission?	Write Permission?	Execute Permission?
0	No	No	No
1	No	No	Yes
2	No	Yes	No
3	No	Yes	Yes

Table 2 Protection Mode Digits for a ClearCase Object (Part 2 of 2)

Digit	Read Permission?	Write Permission?	Execute Permission?
4	Yes	No	No
5	Yes	No	Yes
6	Yes	Yes	No
7	Yes	Yes	Yes

A sequence of three digits in a row expresses the protection mode for an object, in this order: owner's permissions, group's permissions, others' permissions. For example, the protection mode 750 for an object means that it has these permissions:

Digit	User Category	Permissions
7	Owner	Read, Write, Execute
5	Group	Read, Execute
0	Others	None

Access to ClearCase Data

Whether a process has access to a ClearCase object depends on these factors:

- The user and groups of the process
- The owner and group of the object
- The protection mode of the object, if any

When a process seeks access to a protected object, the following algorithm usually determines whether access is granted:

1. Does the process have the user ID of the owner of the object?
   - Yes: grant or deny access according to the object's protection mode for the **Owner** category.
   - No: go to Step #2.
2. Does the process have the group ID of the group of the object

- Yes: grant or deny access according to the object's protection mode for the **Group** category.
- No: go to Step #3.

3. Grant or deny access according to the object's protection mode for the **Other** category.

If an object has no protection mode, ClearCase determines whether to grant access by using rules that depend on the type of object. See the descriptions in *Access Control for VOBs and VOB Objects* on page 35 and *Access Control for Views and View Objects* on page 41.

Sometimes ClearCase grants a process access to an object only if the process has access to one or more containing objects as well. For example, suppose that a user wants to use a text editor to create a view-private file in a dynamic view. The text editor process must have write permission for both the directory in which the user wants to create the file and also for the view itself.

3.2 Access Control for VOBs and VOB Objects

VOBs are the principal repositories for ClearCase data. Both VOBs themselves and objects within VOBs participate in access control. These objects include the following:

- Elements and versions
- Types and instances of types, such as labels, branches, and attributes
- Unified Change Management objects, such as projects, folders, activities, and streams
- VOB storage pools

Access Control for VOBs

These VOB properties are important for access control:

- **Owner.** The initial owner is the user of the process that creates the VOB.
- **Group.** The initial group is the primary group of the process that creates the VOB.
- **Supplemental group list**. The initial supplemental group list is empty for a Windows VOB. For a UNIX VOB, it contains the group list of the VOB owner.

A VOB has no protection mode. This chapter refers to a VOB's primary group and other groups as the VOB's groups.

You can use the **cleartool describe** command to display the owner, group, and supplemental group list for a VOB.

After a VOB is created, a privileged user can use the **cleartool protectvob** command to change the VOB's owner, group, or supplemental group list.

NOTE: You cannot use **protectvob** to add the ClearCase administrators group to a VOB's supplemental group list. Members of this group already have full access rights to all VOB objects.

Permission to Create VOBs

Any user can create a VOB.

Permission to Delete VOBs

Only the VOB owner or a privileged user can delete a VOB.

Permission to Read VOBs

You cannot read a VOB directly. Read operations on a VOB are read operations on objects within the VOB. See *Access Control for Elements* and *Access Control for Other VOB Objects*.

Permission to Write VOBs

You cannot write a VOB directly. Write operations on a VOB include creating and deleting objects within the VOB. See *Access Control for Elements* and *Access Control for Other VOB Objects*.

Permission to Execute VOBs

You cannot execute a VOB directly. Execute operations on a VOB are execute operations on objects within the VOB. See *Access Control for Elements* and *Access Control for Other VOB Objects*.

Access Control for Elements

An element has these properties that are important for access control:

- **Owner.** The initial owner is the user ID of the process that creates the element.
- **Group.** The initial group is determined differently on UNIX and Windows hosts.

- On UNIX, it is the primary group ID of the process that creates the element.
- On Windows, it is the primary group ID of the process that creates the element if that group is on the VOB's group list. Otherwise, it can be any group that appears on the group list of process that creates the element and also on the group list of the VOB.

The group of an element must be one of the VOB's groups.

- **Protection mode.** The initial protection mode for a file element is determined differently on UNIX and Windows hosts.
  - On UNIX, if you create the element from an existing view-private file, the element has the same protection mode as the view-private file, except that no user category has write permission. If you create a file element any other way, the element has only read permission for all user categories. If your **umask** is 0, a directory element initially has read, write, and execute permission for all user categories. Otherwise, the initial read, write and execute permissions are determined by the value of your **umask**.
  - On Windows, a file element initially has only read permission for all user categories. You must explicitly add execute permission for an element by using the **cleartool chmod** command. A directory element initially has read, write, and execute permission for all user categories.

An element's owner, group, and protection mode are the same for all versions of the element.

You can use the **cleartool describe** command or, on Windows, the **Properties of Element** dialog box to display the owner, group, and protection mode for an element.

After an element is created, the element owner, the VOB owner, or the privileged user can use the **cleartool protect** command to change the element's owner, group, or protection mode.

Permission to Create Elements

When you create a VOB, ClearCase creates an initial element, the VOB root directory. This element is the top-level container for other elements in the VOB. Its initial owner is the owner of the VOB, and its initial group is the group of the VOB.

Only a process whose primary group is one of the VOB's groups can create any other element. That process must also have permission to check out a version of the directory element that contains the new element. See *Permission to Write Elements*.

Permission to Delete Elements

Only the element owner, the VOB owner, or the privileged user can delete an element. Deleting an element, using the **cleartool rmelem** command, is not the same as removing the element from a directory version. See *Permission to Write Elements*.

The creator of a version, the element owner, the VOB owner, or the privileged user can delete the version.

Permission to Read Elements

An algorithm that considers the process's user and group and the element's owner, group, and protection mode determines whether to grant read permission for an element. See *Access to ClearCase Data* on page 34.

Permission to Write Elements

A process cannot write elements directly. You modify an element by checking out a version of it and checking in a new version.

The element's protection mode is not considered when determining whether a process can check out or check in a version. A process can check out a version if any of these conditions exist:

- The process has the user identity of the element's owner.
- Any of the process's group identities is the same as the element's group.
- The process has the user identity of the VOB owner.
- The process has the user identity of the privileged user.

A process can check in a version if any of these conditions exist:

- The process has the user identity of the user who checked out the element.
- The process has the user identity of the element's owner.
- The process has the user identity of the VOB owner.
- The process has the user identity of the privileged user.

When a directory element is checked out, you can modify the directory by creating elements or by removing elements from it. Removing an element's name from a directory, using the **cleartool rmname** command, is not the same as deleting the element itself. See *Permission to Delete Elements*.

Permission to Execute Elements

An algorithm that considers the process's user and group and the element's owner, group, and protection mode determines whether to grant execute permission for an element. See *Access to ClearCase Data* on page 34. In addition, two special cases can restrict permission to execute an element:

- On Windows, a file element does not have execute permission until you add it by using the **cleartool chmod** command. For example:

  cleartool chmod +x command.exe

  If you add an executable program to source control, you will not be able to execute it until you take this step.

- On UNIX, a VOB mounted with the **nosuid** mount option will not allow setuid executables to run.

Access Control for Other VOB Objects

In addition to elements and versions, a VOB contains other kinds of objects that are subject to access control:

- *Metadata* types, such as label types, branch types, and attribute types
- Unified Change Management objects, such as projects, activities, folders, and streams
- Storage pools
- Derived Objects

In general, each of these objects has two properties that are important for access control:

- **Owner.** The initial owner is the user of the process that creates the object.

- **Group.** The initial group is the primary group of the process that creates the object.

You can use the **cleartool describe** command to display the owner and group of an object. After the object is created, the object's owner, the VOB owner, or the privileged user can use the **cleartool protect** command to change the object's owner or group. The group of the object must be one of the VOB's groups.

Permission to Create Other VOB Objects

Any user can create a type or a UCM object. Only the VOB owner or the privileged user can create a storage pool.

Instances of types, such as labels, branches, and attributes, are usually associated with element versions. To create an instance of one of these types, one of the following conditions must exist:

- The process has the user identity of the element's owner.
- Any of the process's group identities is the same as the element's group.
- The process has the user identity of the VOB owner.
- The process has the user identity of the privileged user.

Permission to Delete Other VOB Objects

The owner of the object, the owner of the VOB, or the privileged user can delete a type, a UCM object, or a storage pool.

Instances of types, such as labels, branches, and attributes, are usually associated with element versions. In general, if you can create an instance of a type, you can also delete the instance. See *Permission to Create Other VOB Objects*. In addition, the creator of a branch can delete the branch.

Permission to Read Other VOB Objects

Any user can display information about a type, a UCM object, or a storage pool.

Permission to Write Other VOB Objects

Any user can change a UCM object. The owner of the object, the owner of the VOB, or the privileged user can change a type or a storage pool.

Locks on VOB Objects

The ClearCase permissions scheme is intended for use as a long-lived access-control mechanism. ClearCase also provides for temporary access control, through explicit *locks* on individual VOB objects. You can use the **lock** command to restrict or prohibit changes at various levels. At the lowest level, you can lock an individual element, or even an individual branch of an element. At the highest level, you can lock an entire VOB, preventing all modifications to it.

When an object is locked, it cannot be modified by anyone, even the privileged user or the user who created the lock. (But these users have permission to unlock the object.) The **lock** command accepts an exception list that specifies which users can modify the object despite the lock.

Locking Type Objects

You can lock type objects; this prevents changes to the instances of those types. For example:

- You can lock the branch type **main** to all but a select group of users. This group can then perform integration or release-related cleanup work on the **main** branches of all elements. All other users can continue to work, but must do so on subbranches, not on the **main** branch.
- Locking a label type prevents anyone from creating or moving that label. Labeling all the element versions used in a particular release, and then locking that label, provides an easy way to re-create the release later.

3.3 Access Control for Views and View Objects

Views mediate user access to ClearCase elements and versions. Like VOBs and objects within VOBs, views participate in access control. In a dynamic view, permissions on elements and versions interact with permissions on views and view-private files or directories to control access to both VOB and view data.

For example, you must check out a version of an element to modify the element. The element must grant permission to check out a version. In a dynamic view, checking out a version creates a view-private file. You must have permission to create the view-private file in both the view and the directory that contains the file. The containing directory, in turn, can be either an element version or a view-private directory.

In general, access to ClearCase data in a dynamic view requires a process to pass a series of tests:

- It must have access to the view.
- It must have access to the containing directory.
- It must have access to the element.

In a snapshot view, native file-system permissions on the snapshot view directory tree determine access to files and directories in the snapshot view, including copies of element versions. Creating, deleting, and modifying elements in a snapshot view require the process to have the appropriate permissions for those elements.

NOTE: On UNIX hosts, ClearCase treats view access requests from a remote **root** user as requests from the user **nobody.nobody**. See *Restricted Privileges for Remote root* on page 31 for details.

Access Control for Dynamic Views

A dynamic view has these properties that are important for access control:

- **Owner.** The initial owner is the user of the process that creates the view.
- **Group.** The initial group is the primary group of the process that creates the view.
- **Protection mode.** The initial protection mode for a view is determined one way on UNIX hosts and another way on Windows hosts.
  - On Windows, a view initially has read, write, and execute permission for the owner and group, and it has read and execute permission for others. You can use the **Properties of View** dialog box to display the owner, group, and protection mode for a view. You cannot change the owner and group after the view is created. You can use the **chview** command to change the protection mode to read/write or read-only.
  - On UNIX, the initial protection mode depends on the umask of the user who creates the view. A umask is a UNIX setting that specifies that some permissions are *not* granted when the user creates a file. (For details, see the **umask(1)** reference page.) When a user creates a view, ClearCase begins with read, write, and execute permissions for all users and then removes the permissions specified by the user's umask. For example, if the user's umask is 002, ClearCase removes write permission for others.

    To locate the view storage directory and display the owner, group, and protection mode for a view, use the **cleartool lsview** command with the **-properties** and **-full** options:

    cleartool lsview -properties -full my_view

    ```
    * my_view          /net/myhost/views/myview.vws
    .
    .
    .
    Owner: sue        : rwx (all)
    Group: clearusers : rwx (all)
    Other:            : r-x (read)
    ```

    Use the UNIX **ls** command to list the view storage directory:

```
cd /net/myhost/views
ls –ld myview.vws
drwxrwxr-x  6  sue  clearusers  512  Nov 10 11:29 myview.vws
```

The output of this command shows the view's owner (`sue`), group (`clearusers`), and protection mode (`drwxrwxr-x`). Depending on your UNIX system, you may need to use **ls -g** to view the group.

Permission to Create Views

Any user can create a view.

Permission to Delete Views

Only the view owner or the privileged user can delete a view.

Permission to Read Views

A process must have read permission for both a dynamic view and a file or directory in the view to read the file or directory. To read a version of a file or directory element, the process must have read permission for the element. See *Permission to Read Elements* on page 38. To read a view-private file or directory, the process must have read permission for the view-private file or directory. See *Permission to Read View-Private Files* on page 46.

ClearCase uses an algorithm that considers the process's user and group and the view's owner, group, and protection mode to determine whether to grant read permission for a view. See *Access to ClearCase Data* on page 34.

Permission to Write Views

A process must have write permission for a view to perform some operations that change the view itself, such as setting its config spec.

A process must have write permission for both a dynamic view and a containing directory in the view to create or delete a file or directory in the containing directory. If the containing directory is an element version, the process must have write permission for the element. See *Permission to Write Elements* on page 38. If the containing directory is a view-private directory, the process must have write permission for the view-private directory. See *Permission to Write View-Private Files* on page 46.

ClearCase uses an algorithm that considers the process's user and group and the view's owner, group, and protection mode to determine whether to grant read permission for a view. See *Access to ClearCase Data* on page 34.

Permission to Execute Views

A process must have execute permission for both a dynamic view and a file or directory in the view to execute the file or directory. To execute a version of a file or directory element, the process must have execute permission for the element. See *Permission to Execute Elements* on page 39. To execute a view-private file or directory, the process must have execute permission for the view-private file or directory. See *Permission to Execute View-Private Files* on page 46.

ClearCase uses an algorithm that considers the process's user and group and the view's owner, group, and protection mode to determine whether to grant execute permission for a view. See *Access to ClearCase Data* on page 34.

Access Control for View-Private Files

This section discusses access control for view-private files in dynamic views. In a snapshot view, native file-system permissions on directories and files in the snapshot view directory tree determine access to those directories and files.

In a dynamic view, the initial owner, group, and protection mode for a view-private file are determined differently on UNIX and Windows.

Initial Owner, Group, and Protection Mode on UNIX

On UNIX, the initial owner, group, and protection mode for a view-private file are determined using the following rules:

- **Owner.** The initial owner is the user of the process that creates the file or directory.
- **Group.** The initial group is the primary group of the process that creates the file or directory.
- **Protection mode.** The initial protection mode for a view-private file depends on the umask of the user who creates the file or directory. A umask is a UNIX setting that specifies that some permissions are *not* granted when the user creates a file. (For details, see the **umask(1)** reference page.) When a user creates a view-private file or directory, ClearCase begins with a set of permissions that depend on how the file or directory is created. ClearCase then

removes the permissions specified by the user's umask. For example, if the user's umask is 002, ClearCase removes write permission for others.

You can use the **cleartool describe** command or the UNIX **ls** command to display the owner, group, and protection mode for a view-private file or directory. You can use the UNIX **chown** command to change the owner, the **chgrp** command to change the group, and the **chmod** command to change the protection mode.

Initial Owner, Group, and Protection Mode on Windows

On Windows, the initial owner, group, and protection mode for a view-private file are determined using the following rules:

- **Owner.** The initial owner is the user of the process that creates the file or directory.
- **Group.** The initial group is assigned in one of two ways based on the group of the process that creates the file or directory:
  - **a.** If the process's primary group is the same as the VOB's group, that group is assigned.
  - **b.** Otherwise, the process's group list is compared with the VOB's supplementary group list and the first group that appears on both lists is assigned.
- **Protection mode.** A view-private file or directory initially has read, write, and execute permission for all users.

  You can use the **cleartool describe** command to display the owner, group, and protection mode for a view-private file or directory. The **ClearCase** > **Properties of File** or **ClearCase** > **Properties of Directory** dialog box displays the owner and group. The **Read-only** check box in either dialog box indicates whether all users have write permission.

  You cannot change the owner or group of a view-private file or directory. You can use the **Read-only** check box in the **ClearCase** > **Properties of File** or **ClearCase** > **Properties of Directory** dialog boxes or the **attrib +R** and **attrib –R** commands to specify whether all users have write permission. You cannot change any other permissions.

Permission to Create View-Private Files

A process must have write permission for both the view and a containing directory in the view to create a file or directory in the containing directory. For view permissions, see *Permission to Write Views* on page 43.

If the containing directory is an element version, the process must have write permission for the element. See *Permission to Write Elements* on page 38. If the containing directory is a view-private directory, the process must have write permission for the view-private directory. See *Permission to Write View-Private Files*.

Permission to Delete View-Private Files

A process must have write permission for both the view and a containing directory in the view to delete a file or directory in the containing directory. For view permissions, see *Permission to Write Views* on page 43.

If the containing directory is an element version, the process must have write permission for the element. See *Permission to Write Elements* on page 38. If the containing directory is a view-private directory, the process must have write permission for the view-private directory. See *Permission to Write View-Private Files*.

Permission to Read View-Private Files

A process must have read permission for both the view and a view-private file or directory in the view to read the file or directory. For view permissions, see *Permission to Write Views* on page 43.

ClearCase uses an algorithm that considers the process's user and group and the view-private file or directory's owner, group, and protection mode to determine whether to grant read permission for the file or directory. See *Access to ClearCase Data* on page 34.

Permission to Write View-Private Files

A process must have write permission for both the view and a view-private file or directory in the view to write the file or directory. For view permissions, see *Permission to Write Views* on page 43.

ClearCase uses an algorithm that considers the process's user and group and the view-private file or directory's owner, group, and protection mode to determine whether to grant write permission for the file or directory. See *Access to ClearCase Data* on page 34.

Permission to Execute View-Private Files

A process must have execute permission for both the view and a view-private file or directory in the view to execute the file or directory. For view permissions, see *Permission to Write Views* on page 43.

ClearCase uses an algorithm that considers the process's user and group and the view-private file or directory's owner, group, and protection mode to determine whether to grant execute permission for the file or directory. See *Access to ClearCase Data* on page 34.

Access Control for Derived Objects

A *derived object* (DO) is a file created in a dynamic view by **clearmake** or during a **clearaudit** session. These commands do not create derived objects in snapshot views.

A derived object is at first like a view-private file. You must have the same permissions to create a DO as to create a view-private file. A DO has an owner, group, and protection mode, determined initially in the same way as those of a view-private file. See *Access Control for View-Private Files* on page 44.

A shareable derived object is one that other dynamic views can use by *winking in* the DO. When a shareable DO is winked in for the first time, it is *promoted* from the view in which it was created to become an object in the containing VOB. This VOB object is a shared DO.

A shared DO has an owner, group, and protection mode. The owner and group are initially those of the shareable DO at the time it is promoted to the VOB. The group of a shareable DO must be one of the VOB's groups for the DO to be promoted to the VOB.

A shared DO's owner, the VOB owner, or the privileged user can use the **cleartool protect** command to change the DO's owner, group, or protection mode.

A process that winks in a shared DO to a dynamic view must have read permission for the DO. ClearCase uses an algorithm that considers the process's user and group and the DO's owner, group, and protection mode to determine whether to grant read permission for the DO. See *Access to ClearCase Data* on page 34.

A winked-in DO is like a copy-on-write view-private file in the dynamic view that winks it in. It has the owner, group, and protection mode of the shared DO. If you change a winked-in DO in the view, such as changing its permissions or writing it, ClearCase converts the DO to a view-private copy.

3.4 ClearCase and Native File-System Permissions

ClearCase maintains data for VOBs and views in special directory trees in the native file system on each VOB and view host. These special directory trees are the *VOB storage directory* and the *view storage directory*. ClearCase creates the VOB storage directory when you create a VOB and the view storage directory when you create a view.

ClearCase manages all access to the VOB and view storage directories; users never read from or write to these directories directly. The VOB and view storage directories have native file-system permissions, but ClearCase itself creates and maintains these permissions. Although ClearCase stores objects subject to access control in these directories, you must manage ClearCase access control using the mechanisms described in this chapter.

WARNING: **Never change native file-system permissions on the directories and files in any VOB storage directory or view storage directory tree.**

If you have inadvertently changed permissions on a VOB or view storage directory, you may be able to repair the damage using ClearCase tools. See Chapter 35, *Repairing VOB and View Storage Directory ACLs on Windows*.

A snapshot view directory is a native file-system directory tree that contains copies of ClearCase versions and file-system objects that are not under ClearCase control. The owner of a snapshot view can manage native file-system permissions on these files. For example, the view owner can add or remove group write permission for files in a snapshot view directory that are not under ClearCase control.

Like a dynamic view, a snapshot view also has a view storage directory, which may or may not be located within the snapshot view directory. ClearCase creates and maintains the view storage directory for a snapshot view, just as it does for a dynamic view. Never change native file-system permissions on the view storage directoryfor a snapshot view.

ClearCase and Windows Domains

4

Rational ClearCase relies on the operating system to establish a user's identity. On Windows computers, user and group identity are established when the user logs in to a Windows NT or Active Directory domain. This chapter describes what a domain administrator needs to know about the user, group, and resource accounts that ClearCase requires, and about the effect of domain trust relationships on ClearCase.

This chapter is intended for domain administrators who have experience with Windows NT domains, Active Directory domains, or both, and are familiar with Microsoft's domain administration and account maintenance tools.

4.1 Domain Configurations Compatible with ClearCase

ClearCase is compatible with a wide variety of domain configurations. The simplest configuration—a single domain that includes all users, groups, and computers—entails the least administrative overhead, but other common configurations work equally well:

- Master and multi-master Windows NT domain configurations in which user and group accounts are created in a master domain and host (computer) accounts are created in one or more resource domains that trust the master domain.
- Active Directory domains that are part of a single forest.
- Domain upgrade and domain migration environments that support a combination of Windows NT and Active Directory domains.

What ClearCase Requires from Any Domain

ClearCase imposes a few simple requirements on any domain environment in which it operates:

- All members of a ClearCase community (all users who access the same VOBs and views) must have domain accounts and have at least one group membership in common.
- All ClearCase hosts must be members of a domain. If the hosts are not members of the same domain in which the user and group accounts are created, they must be members of a domain that trusts that domain.
- If members of the ClearCase community access VOBs and views on UNIX hosts, user and group names for their domain accounts must be identical to those in UNIX account database. (Some cross-platform file access solutions require the passwords to be the same as well.)
- A special domain account must be created to provide a user identity for the **albd_server** process.
- Additional steps must be taken to enable users from multiple domains to access a common set of VOBs and views.

ClearCase on Nondomain Hosts

Windows computers that are not in a domain can be ClearCase hosts, though with severely limited functionality:

- They cannot host ClearCase VOBs or views used by other ClearCase hosts.
- They cannot access VOBs and views hosted on other Windows computers.

Nondomain systems can function as ClearCase clients in networks in which all VOB and view storage resides on UNIX hosts.

Nondomain systems can also function as stand-alone systems on which all VOBs and views are used locally. This situation typically arises when you are evaluating ClearCase software. For more information, see *Installation Guide* for the ClearCase Product Family.

For information about administering nondomain systems, see Chapter 5, *Configuring ClearCase in a Mixed Network*.

4.2 Domain User and Group Accounts

Any ClearCase community must define a group to which all users who perform routine ClearCase operations using a common set of VOBs and views belong. We refer to this group as the ClearCase users group. It can be an existing domain global group or one created specifically for this purpose. In examples throughout this document, the ClearCase users group is named **clearusers**.

The ClearCase users group must have the following characteristics:

- It must be a domain global group or an Active Directory universal group. We recommend using a domain global group unless the group needs to include other groups.
- Its name must be the same as the name of the ClearCase users group on UNIX if members of the group must access VOBs or views on a UNIX host. UNIX and Windows place different restrictions on the length of group names, as well as on the characters that are allowed in them. Be sure that the ClearCase users group name is acceptable in both environments.

NOTE: If your ClearCase community includes multiple groups that share VOBs and views among their members but do not share these VOBs and views with members of other groups, you must designate a different ClearCase users group for each of these groups.

In addition to the ClearCase users group, a ClearCase community requires two additional domain accounts:

- A **ClearCase administrators group**. Members of this group can perform all ClearCase operations, including those that permanently destroy data. Membership in this group should be restricted to the ClearCase server process user and a few ClearCase administrators. In examples throughout this document, the ClearCase administrators group is named **clearcase**.
- A **ClearCase server process user**. The **albd_server** program runs with this identity. In examples throughout this document, the ClearCase server process user is named **clearcase_albd**. The ClearCase server process user must be a member of the ClearCase administrators group. On UNIX, the ClearCase server process user is the **root** user.

The ClearCase server process user and ClearCase administrators group can be created by the installation process if they do not already exist. They can also be created manually. See *Defining the Accounts Manually* on page 53.

Setting the ClearCase Primary Group

Although you can designate a user's primary group using various Windows domain account maintenance tools, this group name is not always returned when an application requests the name of a user's primary group. We strongly recommend that you ask each user to set the user environment variable **CLEARCASE_PRIMARY_GROUP** to the domain-qualified name of the ClearCase users group. For example:

MYDOMAIN\clearusers

This setting guarantees an unambiguous definition of the group that ClearCase considers the user's primary group.

The **CLEARCASE_PRIMARY_GROUP** assignment has no security or access-control implications outside the context of VOB access. Users who have not set **CLEARCASE_PRIMARY_GROUP** correctly are likely to have problems creating elements or otherwise accessing VOBs, especially in complex domain configurations.

Users must set the value of **CLEARCASE_PRIMARY_GROUP** as a user environment variable on each Windows platform from which they will access any VOB or view.

NOTE: Members of the ClearCase users group who are also members of the ClearCase administrators group must set **CLEARCASE_PRIMARY_GROUP** to the name of the ClearCase users group, not the name of the ClearCase administrators group.

On a computer running Windows Me or Windows 98, you must set the **CLEARCASE_PRIMARY_GROUP** variable in the **AUTOEXEC.BAT** file.

To verify that **CLEARCASE_PRIMARY_GROUP** has been properly set.

1. Click **Start** > **Programs** > **Rational ClearCase Administration** > **ClearCase Doctor.**
2. Click **Start Analysis**.
3. When the analysis is finished, click the **Topics** tab and open the **User Login Account** folder.
4. Double-click **Primary Group**, read the user's primary group, and verify that it is correct.

Defining the Accounts Manually

The ClearCase Site Preparation Wizard attempts to create the ClearCase administrators group and ClearCase server process user accounts if they do not exist. The account and group names specified during site preparation are presented as the defaults when users run the ClearCase Installation program on individual hosts. In addition, the account names and the ClearCase server process user's password are used as the default when you rerun the wizard to create a new release area on a host.

If the user running the ClearCase Site Preparation Wizard does not have Domain Administrator privileges, the wizard cannot create these accounts. A domain administrator must create them manually using the following procedure:

1. Log on as a user with domain administrator privileges.
2. Run the appropriate management tool:
   - On Windows NT, use the **User Manager for Domains** (**Start** > **Programs** > **Administrative Tools** > **User Manager for Domains**). Click **User** > **New Global Group**, and enter the group name.
   - On Windows 2000, open Control Panel. Open **Administrative Tools**, and then open the **Active Directory Users and Computers** MMC snap-in. In the console tree, open the **Users** node, click **Action** > **New** > **Group**, and enter the group name.
3. Create a new **global** group called **clearcase** (or another group name the community has chosen). In the **Description** box, type the following text:

   Used exclusively by the ClearCase server process user and ClearCase administrative users.
4. Create a new user, **clearcase_albd** (or another user name the community has chosen), and put the group name defined in Step #3 in the new user's group list.
   - Select the **Password never expires** check box.
   - In the **Description** box, type the following text:

     Used exclusively by ClearCase servers
   - On each ClearCase host that is configured to support local VOBs and views, give the **clearcase_albd** user the right to **Log on as a service**.

On Windows NT, start the **User Manager for Domains** and click **Policies** to open the User Rights Policy editor. Click **Add**, and select **clearcase_albd** from the list of users in the **Add Users and Groups** dialog box. Select the **Show Advanced Rights** check box and select **Log on as a service** from the list of rights. Click **OK** to grant the **clearcase_albd** user the right to log on as a service.

On Windows 2000, click **Control Panel** > **Administrative Tools** and run the **Local Security Policy** management console. Click **Local Policies** > **User Rights Assignment**. From the list displayed, right-click **Log on as a service** and select the **Security** task to open the local security policy setting dialog box. Click **Add** and select the **clearcase_albd** user from the list of users displayed. Click **OK** to grant the **clearcase_albd** user the right to log on as a service.

4.3 Multiple User Account Domain Support

If your existing domain configuration requires it, you can enable ClearCase access for users and computers in multiple domains. Because this configuration can be more complicated to set up and administer, we recommend that you avoid using it unless organizational or security concerns require you to do so.

Using Active Directory Universal Groups

When a ClearCase community includes users from multiple Active Directory domains that are part of the same forest, you can use an Active Directory universal group to provide users logged on to different domains with access to a common set of VOBs and views.

To create an Active Directory universal group that can be used as the ClearCase primary group by users from multiple Active Directory domains in a single forest:

1. Verify that the Active Directory environment is operating in native mode. (Universal groups cannot be created in an Active Directory domain that is operating in mixed mode.)
2. Create the ClearCase users group as an Active Directory universal group.
3. Make each domain global group whose members are part of the ClearCase community a member of the ClearCase users group. We do not recommend adding individual user accounts to a universal group. Instead, group the users from each Active Directory domain

into a domain global group defined in that domain, and make each of those domain global group a member of the universal group.

4. Require each user in each of the domain global groups that are members of the ClearCase users group to set **CLEARCASE_PRIMARY_GROUP** to the domain-qualified name of the (universal) ClearCase users group. (You cannot use Active Directory account management tools to specify a universal group as a user's primary group.)

NOTE: If you are upgrading a multi-master Windows NT domain environment to Active Directory, use the procedure described in *Converting Proxy Groups* on page 62 to convert the proxy groups to members of an Active Directory universal group.

Using Proxy Groups and Domain Mapping in Windows NT Domains

When a ClearCase community includes users from multiple Windows NT domains, you must enable the ClearCase domain mapping feature as described in this section to provide all users with access to a common set of VOBs and views.

Suppose that ClearCase users have accounts in domains named **ATLANTA**, **BOSTON**, and **CUPERTINO**, and that the primary group of each VOB they need to share is **ATLANTA\clearusers**. To use ClearCase in this environment, create *proxy groups* and enable the domain mapping feature as follows:

1. Ensure that each ClearCase host is a member of a resource domain that trusts the **ATLANTA**, **BOSTON**, and **CUPERTINO** domains.

2. Create the ClearCase users group in one of the user account domains. In this example, the domain is Atlanta and the group is **ATLANTA\clearusers**. VOBs to be shared by users taking advantage of domain mapping must be owned by the **ATLANTA\clearusers** group.

3. Configure the Atria Location Broker service on every ClearCase host in each of these domains to log in as the **clearcase_albd** user in the primary ClearCase domain (in this case, **ATLANTA\clearcase_albd**).

4. Create two more domain global groups, one in each of the other domains:

   - In the Boston domain, create the group **BOSTON\clearusers_Boston**.
   - In the Cupertino domain, create the group **CUPERTINO\clearusers_Cupertino**.

   When creating these groups, make sure their description strings contain the following substring:

```
ClearCaseGroup(Atlanta\clearusers)
```

This string must be case-correct and contain no spaces. When this text string is present in a group description, ClearCase recognizes the group as a proxy group for the group whose name is delimited by the parentheses (in this case, the group **ATLANTA\clearusers**). When evaluating VOB access rights, ClearCase treats members of a proxy group as though they were members of the group named in the **ClearCaseGroup** substring. In this example, a member of **BOSTON\clearusers_Boston** will have the same VOB access rights as a member of **ATLANTA\clearusers** if the description of **BOSTON\clearusers_Boston** includes the string **ClearCaseGroup(ATLANTA\clearusers).**

5. Make ClearCase users members of the appropriate groups:

   - Make users whose accounts are in domain Atlanta members of **ATLANTA\clearusers**.
   - Make users whose accounts are in domain Boston members of **BOSTON\clearusers_Boston**.
   - Make users whose accounts are in domain Cupertino members of **CUPERTINO\clearusers_Cupertino**.

6. Enable domain mapping on each ClearCase host. To do so, edit the Windows registry on that host using the following procedure:

   a. Using a Windows registry editor, navigate to **HKEY_LOCAL_MACHINE\SOFTWARE\Atria\ClearCase\CurrentVersion**.

   b. Click **Edit** > **Add Value**.

   c. In the **Add Value** dialog box, enter **DomainMappingEnabled** in the Value Name and select **REG_DWORD** as the value type.

   d. Click **OK** to start the DWORD editor

   e. In the DWORD editor, enter 1 in the **Data** box. Make sure that the Radix is set to Hex (the default).

   f. Click **OK** to add the value.

   NOTE: To enable domain mapping for a Windows 98 or Windows Me computer, enable it on the Windows host that is designated as the credentials mapping server; then shut down and restart the Windows Me or Windows 98 computer.

7. Require each ClearCase user to set the user environment variable **CLEARCASE_PRIMARY_GROUP** to the value **ATLANTA\clearusers**. See *Setting the ClearCase Primary Group* on page 52.

Setting VOB Element Permissions

All elements in any VOB that will be accessed by users who are members of proxy groups must allow **Read** rights for **Other**. Newly created elements grant this right by default. You can examine an element's protection from Windows Explorer:

1. Right-click the element to display the shortcut menu.
2. Click **ClearCase** > **Properties of Element**.
3. In the **Properties of Element** dialog box, click the **Protection** tab. The **Read** check box in the **Other** group must be selected.

To reprotect a large number of elements, use the **cleartool protect** command.

Setting VOB Storage ACLs

If necessary, you can restrict access to world-readable elements to a smaller set of users by setting the access control list (ACL) on the share that contains the VOB storage directory. For example, if a VOB is registered with the global path **\\myserver\vobstorage\src_vob**, you can set the ACL on the **vobstorage** share to restrict access to members of the ClearCase administrators group, **ATLANTA\clearusers**, **BOSTON\clearusers_Boston**, and **CUPERTINO\clearusers_Cupertino**.

4.4 Conversion to Active Directory

Like any enterprise-scale application in a Windows network, ClearCase is affected when the network is converted from Windows NT domains to Active Directory domains. This section and the following sections describe how this conversion affects ClearCase, and how to manage ClearCase users, groups, hosts, and data during and after the conversion.

NOTE: If you are using ClearCase in an environment that is already running Active Directory, these sections do not apply to you.

Understanding Active Directory

Microsoft provides tools and documentation to facilitate conversion of a Windows network from Windows NT domains to Active Directory. In this section, we assume you have read the

applicable documents from Microsoft and are familiar with the terminology they use and the procedures they describe. In particular, we assume you have read the Microsoft white paper entitled *Planning Migration from Microsoft Windows NT to Microsoft Windows 2000.* (It is distributed as part of the Windows 2000 Support Tools and is also available on Microsoft's Web site.) That document and related documents introduce several key concepts— including *native mode, mixed mode, domain upgrade, domain migration, SID history,* and *cloning* of principals—that we use throughout this chapter.

How Active Directory Affects ClearCase

In an Active Directory environment, some details of user and group identity are handled differently than they are in a Windows NT domain environment. Depending on how your Windows NT domain environment is configured, where your ClearCase user and group accounts exist in this domain structure, and how your organization plans to convert Windows NT domains to Active Directory domains, you may need to take steps during and after the conversion process to maintain user access to artifacts under ClearCase control.

Conversion to Active Directory affects ClearCase in several ways:

- In Active Directory, trust relationships between domains are created and maintained differently than they are in Windows NT domains. During and after the conversion to Active Directory, these differences will affect ClearCase communities in which users from multiple domains access a common set of VOBs and views.
- Windows Security Identifiers (SIDs) for users and groups can change in some conversion scenarios. Because ClearCase stores SIDs in VOB databases (to represent owners of objects), VOBs must be updated with new SIDs in these scenarios.

In general, sites that have the simplest domain structure (all ClearCase users and hosts in a single domain) will encounter very few problems during the conversion process. Sites with more complex domain structures (users from multiple domains accessing a common set of VOBs and views) can benefit from Active Directory's improved interdomain security features after they modify some existing user and group account information.

Planning Your Active Directory Upgrade or Migration Strategy

Microsoft provides tools and documentation to facilitate conversion of domains from Windows NT to Active Directory. The conversion can take one of two forms:

- An upgrade (often referred to as an in-place upgrade), in which a Windows NT domain controller is converted to an Active Directory domain controller operating in mixed or native mode. After an upgrade, all users, groups, and resources have the same SIDs as they had in their original Windows NT domain.

- A migration, in which user, group, and resource accounts migrate (using a process referred to as *cloning*) from a Windows NT domain to an Active Directory domain. After a migration is complete, all users, groups, and resources have new SIDs. Because a native mode Active Directory maintains information about each principal's current and former SIDs (referred to by Microsoft as the principal's SID history), both types of domains can be used together for as long as needed.

We recommend that a knowledgeable ClearCase administrator who has reviewed this chapter and applicable documents from Microsoft, and who understands the impact of various conversion or migration strategies on ClearCase, be familiar with (and if possible help plan) your organization's conversion from Windows NT domains to Active Directory.

CAUTION: Microsoft supplies tools for converting the SIDs stored in NTFS ACLs. Never use these tools (or any tools that change native file system protection information) on a VOB or view storage directory. Only ClearCase utilities should be used to convert SIDs in VOB or view storage directories. See *Migrating Multiple Domains* on page 63 for details.

Preparing ClearCase Hosts

Before you begin the conversion process, your ClearCase hosts must be configured for use in an Active Directory environment.

- All ClearCase hosts must be running ClearCase version 5.0 or later.

  NOTE: Hosts running earlier releases of ClearCase can be converted to Active Directory, although various restrictions apply. For more information, see the ClearCase customer site at **www.rational.com**. This chapter does not apply to hosts running earler releases.

- All VOBs on Windows hosts must be at schema version 54. Schema version 54 stores Windows user and group identity information in SID form to better support Active Directory's improved handling of user and group authentication.

- All views must be reformatted. A view is reformatted automatically the first time it is started after ClearCase version 5.0 has been installed on the view host. You can also reformat a view manually using the **reformatview** command.

- The user environment variable **CLEARCASE_PRIMARY_GROUP** must be defined for all users. We recommend that the value of this variable be a domain-qualified group name of the form *DOMAIN_NAME\group_name*.

Verify that all ClearCase hosts have been configured as described in this section and that ClearCase is operating normally for all users and hosts before you proceed with the conversion to Active Directory.

4.5 Domain Upgrade Scenarios

This section describes several scenarios in which one or more Windows NT domains are upgraded to Active Directory domains using the in-place upgrade procedure defined by Microsoft. If your site is not using this procedure, see *Domain Migration Scenarios* on page 63.

NOTE: In this section, references to upgrading a domain refer to upgrading the primary domain controller of that domain.

Upgrading a Single Domain

Use this procedure if all ClearCase users, groups, and hosts are members of a single Windows NT domain:

1. Prepare ClearCase hosts as described in *Preparing ClearCase Hosts* on page 59.
2. If you do not have a backup domain controller online during the upgrade, stop ClearCase on all ClearCase server hosts to prevent ClearCase operations during the upgrade process.
3. Use the procedures defined by Microsoft to perform an in-place upgrade of the Windows NT domain to an active directory domain.
4. After the upgrade of the primary domain controller is complete, shut down and restart all ClearCase hosts.

Upgrading a Master Domain and Its Resource Domains

Use this procedure if all ClearCase users and groups are members of a single Windows NT domain (the master domain) that is trusted by one or more Windows NT resource domains to which ClearCase hosts belong.

To upgrade a master domain and its resource domains:

1. Upgrade the master domain as described in *Upgrading a Single Domain* on page 60.
2. Upgrade each resource domain as described in *Upgrading a Single Domain* on page 60. Configure the upgraded resource domain as a child of the upgraded master domain.
3. After the upgrade of a resource domain is complete, shut down and restart all ClearCase hosts in that resource domain.

Upgrading Multiple Master and Resource Domains

Use this procedure if ClearCase users and groups are members of more than one Windows NT domain and you are using proxy groups to enable users from these domains to access a common set of VOBs and views. The domains can include resources as well as users and groups or can be master domains trusted by resource domains.

After the upgrade is complete, we recommend converting the Active Directory domains to native mode so that you can use an Active Directory universal group to eliminate the need for proxy groups and domain mapping.

To upgrade multiple master and resource domains:

1. Prepare ClearCase hosts as described in *Preparing ClearCase Hosts* on page 59.
2. If you do not have a backup domain controller online for each of the master and resource domains during the upgrade, stop ClearCase on all ClearCase server hostst to prevent ClearCase operations during the upgrade process.
3. Use the procedures defined by Microsoft to perform an in-place upgrade of the first Windows NT master domain to an Active Directory domain. Upgrade the domain in which the ClearCase users group is defined before upgrading the domains in which the proxy groups are defined.
4. Upgrade the remaining master domains.

5. After the master domains have been upgraded, you may begin to upgrade the resource domains. As long as you do not alter existing trust relationships between domains that have been upgraded and those that have not, you may upgrade the resource domains in any order and on any schedule that is appropriate for your organization. We recommend making all of the upgraded domains members of the same forest, which will allow you to take advantage of Active Directory universal groups, as described in *Converting Proxy Groups*.

6. After the upgrade of a resource domain is complete, shut down and restart all ClearCase hosts in that resource domain.

7. After all domains have been upgraded and the Active Directory domain has been converted to native mode, follow the procedure described in *Converting Proxy Groups* on page 62 to eliminate proxy groups and domain mapping.

Converting Proxy Groups

Use the following procedure to replace the proxy groups required in a Windows NT domain environment with a ClearCase users group that is an Active Directory universal group. The universal group includes the groups formerly used as proxy groups.

NOTE: You can only use this procedure in an Active Directory domain that is operating in native mode. The ClearCase users group and the proxy groups must all exist in the same forest.

1. Use Active Directory management tools to rename the ClearCase users group in the primary ClearCase domain. For example, the **ATLANTA\clearusers** group created in the procedure described in *Using Proxy Groups and Domain Mapping in Windows NT Domains* on page 55 could be renamed to **ATLANTA\clearusers_Atlanta**.

2. Use Active Directory management tools to create a new (universal) ClearCase users group. We suggest keeping the name the same (**ATLANTA\clearusers** in our example), so that users do not have to change the value of their **CLEARCASE_PRIMARY_GROUP** environment variable.

3. Use Active Directory management tools to add the former proxy groups (**BOSTON\clearusers_Boston** and **CUPERTINO\clearusers_Cupertino** in our example) and the group you renamed in Step #1 of this procedure as members of the new (universal) ClearCase users group.

4. Disable domain mapping on all ClearCase client and server hosts. To disable domain mapping on a ClearCase host, use a registry editor to navigate to the registry key **HKEY_CURRENT_USER\SOFTWARE\Atria\ClearCase\CurrentVersion**, and then remove the DWORD value **DomainMappingEnabled**. (Some ClearCase hosts may store this value in **HKEY_LOCAL_MACHINE\SOFTWARE\Atria\ClearCase\CurrentVersion**.)

5. Shut down and restart all ClearCase client and server hosts.

4.6 Domain Migration Scenarios

Sites for which a domain upgrade is impossible can use a domain migration process. This process uses Microsoft tools to populate a native-mode Active Directory domain with user, group, and resource accounts that have been cloned from existing accounts in a Windows NT domain. Both types of domain can operate in parallel and, if the appropriate trust relationships exist between the Windows NT and Active Directory domains, users and groups in either type of domain have equivalent ClearCase access rights.

Migration can take place over an extended period, if necessary. When all user and group accounts have been migrated to the Active Directory domain, the migration process can be completed and the Windows NT domains decommissioned. After a migration, all users, groups, and hosts have new SIDs. This has several implications for ClearCase:

- After a host has become a member of an Active Directory domain, you must reconfigure the host's **albd_server** process to log on using the ClearCase server process user (typically called **clearcase_albd**) and ClearCase administrators group (**clearcase**) that exist in the Active Directory domain. The names of the accounts are still the same, but their SIDs have changed.
- VOB storage directories must be re-protected so that they include the new SIDs of the VOB owner in the directory ACL.
- VOB databases must be updated with the new SIDs. The ClearCase utility program **vob_sidwalk** replaces old SIDs with new ones. See *Using vob_sidwalk to Change or Update VOB Users and Groups* on page 68 and the **vob_sidwalk** reference page for more information on this program.

Detailed instructions for performing these procedures are included in the remainder of this section.

Migrating Multiple Domains

All migration scenarios are essentially the same, differing only in their level of complexity as measured by the number of domains being migrated and the trust relationships among them.

The procedure defined in this section can be used whether you are migrating a single domain or multiple master and resource domains.

NOTE: Before you begin any migration process, prepare all ClearCase hosts as described in *Preparing ClearCase Hosts* on page 59. Even though the hosts may not be migrating right away, they will not be accessible by migrated users and groups until you have taken this step.

Migrating Users and Groups

We recommend that you begin any domain migration by migrating users and groups from the Windows NT domains in which they were created to new Active Directory domains. Follow these steps to migrate ClearCase users and groups:

1. Use the procedures defined by Microsoft to migrate users and groups from the Windows NT domains to the Active Directory domains. Be sure to include the ClearCase users group, ClearCase administrators group, and **clearcase_albd** account in the migration.

2. In many migration scenarios, there will be a period when users logged in to the Active Directory domain will share a VOB with users logged in to a Windows NT domain. To ensure access to VOBs by users in either type of domain, do one of the following:

   - Add the domain-qualified name of the ClearCase users group that has been migrated to the Active Directory domain to the VOB's supplemental group list. For example, you can use the **cleartool protectvob** command as shown here to add the **clearusers** group in the Active Directory domain **AD-DOMAIN** to the group list of the VOB with storage on the VOB server host at **C:\vobsvr\vobstg\srcs.vbs**:

     cleartool protectvob -add_group AD-DOMAIN\clearusers C:\vobstg\srcs.vbs

   - Ask users logged in to an Active Directory domain to set their **CLEARCASE_PRIMARY_GROUP** environment variable to the string representation of the SID of the ClearCase users group in the Windows NT domain. To find the SID string, run the **creds** command—on a computer that is a member of the Windows NT domain or a domain that trusts the Windows NT domain—as shown in this example:

     *ccase-home-dir***etc\utils\creds –g NT-DOMAIN\clearusers**

     ```
     .
     .
     .
     ClearCase group info:
     Name: NT-DOMAIN\clearusers
     GID:  0x100423
     SID credentials NT:S-1-5-21-103034363-981818062-1465874335-1064
     ```

In this case, the user should set **CLEARCASE_PRIMARY_GROUP** to the value **NT:S-1-5-21-103034363-981818062-1465874335-1064**

3. Because migrated accounts include SID history, user accounts in the Active Directory domain include twice as many group memberships as they had in the Windows NT domain. (Each user's group list includes groups from both domains.) Users who are members of multiple groups in a Windows NT domain may find that their group list includes more than 32 groups after migration. Because ClearCase only recognizes 32 groups, these users should set their **CLEARCASE_GROUPS** environment variable to include the SID string that represents the ClearCase users group in the Windows NT domain, as well as the name of the ClearCase users group in the Active Directory domain. See Step #2 of this procedure for information on how to use **creds** to obtain the SID string.

   If the user environment variable **CLEARCASE_GROUPS** exists for any user, ClearCase will consider the semicolon-separated list of groups specified in the value of this variable first when determining (or displaying) which groups a user belongs to. This example includes the name of the ClearCase users group from the Active Directory domain and the SID of the ClearCase users group from the Windows NT domain.

   CLEARCASE_GROUPS=AD-DOMAIN\clearusers;NT:S-1-5-21-103034363-981818062-1465874335-1064

If You Must Add a New User While Migration Is In Progress

If a new ClearCase user must be created while a domain migration is in progress, use either of the following methods:

- Create the user's account in the Active Directory domain and ask the user to set **CLEARCASE_PRIMARY_GROUP** environment variable to the domain-qualified name of the ClearCase users group that has already been cloned and exists in the Active Directory domain.
- Create the user in the Windows NT domain, and then migrate the user account.

These users may also need to change their **CLEARCASE_PRIMARY_GROUP** and **CLEARCASE_GROUPS** environment variables as described in *Migrating Users and Groups*.

Migrating Individual ClearCase Hosts

When all users and groups have been migrated and no users are required to log in to the Windows NT domain, take the following steps to migrate ClearCase hosts to the Active Directory domain. If you cannot migrate all your ClearCase hosts at the same time, we

recommend migrating VOB servers first. (Registry and license servers can migrate at any time, because they do not store SIDs in their databases.)

NOTE: The procedures in this section require you to use the **vob_sidwalk** utility. Before executing any of these procedures, review the **vob_sidwalk** reference page to get a better understanding of the capabilities of **vob_sidwalk**.

To migrate an individual ClearCase host:

1. Stop ClearCase on the host.
2. Use the procedures defined by Microsoft to migrate the host to the Active Directory domain.
3. After you migrate the host, reconfigure its **albd_server** to log on as the (migrated) ClearCase server process user in the Active Directory domain. You can do this by reinstalling ClearCase on the host and specifying the new account, or you can do it manually as described in *Defining the Accounts Manually* on page 53.
4. If the host is a VOB server that will also be accessed by UNIX clients, reset the credentials mapping domain in the **Options** tab of the ClearCase Properties application in Control Panel. The credentials mapping domain should be one in which user and group account names match those of UNIX users that will access VOBs on this server.
5. Restart ClearCase on the host.
6. Reprotect any VOB and view storage on the host by running the ClearCase **fix_prot** utility on each VOB or view storage directory as shown in this example:

   *ccase-home-dir***etc\utils\fix_prot –replace** *storage-dir-pname*

   where *storage-dir-pname* is the pathname to the VOB or view storage directory.
7. Use the following procedure to update VOB databases with the new SIDs representing the cloned user and group accounts.
   a. Log on to the VOB server host as the VOB owner or privileged user
   b. Lock the VOB for all users but yourself (**–nusers** *your-user-name*).
   c. Replace the old SIDs with the new ones. Use the **vob_sidwalk** utility as shown in the following example, where *vob-tag* is the VOB-tag of the VOB you are updating and *SIDfile-path* is the name of a file where **vob_sidwalk** will log the changes it makes:

      *ccase-home-dir***etc\utils\vob_sidwalk -s -execute** *vob-tag SIDfile-path*

For additional details on how **vob_sidwalk** remaps SIDs, see *Remapping Historical SIDs After Domain Migration* on page 69.

d. Unlock the VOB.

NOTE: If you had been using proxy groups to enable users from multiple domains to access a common set of ClearCase artifacts, we recommend using an Active Directory universal group to eliminate the need for proxy groups and domain mapping. Follow the procedure described in *Converting Proxy Groups* on page 62

If VOB Servers Cannot Migrate When Clients Do

If any VOB server cannot migrate when its clients do and you need to preserve the clients' ability to access VOBs on that server, you must use **vob_siddump** to establish the mapping between new SIDs and old ones. After the mapping has been established, you can use **vob_sidwalk** to update the VOB database with the new SIDs.

1. Log on to a client that has been migrated to the Active Directory domain.
2. Lock the VOB for all users but yourself (**–nusers** *your-user-name*).
3. Run **vob_siddump** to generate a map file. (You must use **vob_siddump** because you cannot run **vob_sidwalk** from a remote host.) In the following example, *vob-tag* is the VOB-tag of a VOB on a server that is still in the Windows NT resource domain, and *SIDfile-path* is the pathname to the map file that **vob_siddump** will generate. (If *SIDfile_path* cannot be created on a drive that is accessible to the VOB server host, you must copy it to the VOB server host before you perform Step #4 of this procedure.)

   vob_siddump -sidhistory *vob-tag SIDfile-path*
4. Log on to the VOB server that hosts the VOB whose tag you used in Step #3 of this procedure. With the VOB still locked for all users but yourself, run **vob_sidwalk** to update the SID information stored in the VOB

   vob_sidwalk -execute -map *mapfile-path vob-tag SIDfile-path*

   In this example, *mapfile-path* is the map file you generated in Step #3 of this procedure and *SIDfile-path* is the name of a file in which **vob_sidwalk** will log the changes it makes. For more information, see *Using vob_sidwalk to Change or Update VOB Users and Groups* on page 68.
5. Unlock the VOB.

NOTE: Unless the VOB remains locked from the time you begin Step #3 until the time you complete Step #4, users may create new objects in the VOB between the steps. If they do, you will have to perform both steps again.

4.7 Using vob_sidwalk to Change or Update VOB Users and Groups

Any time you move a VOB to a host in a domain that does not trust the domain in which the VOB's original host exists, all SIDs stored in the VOB database become invalid, because they do not resolve to an account in the new domain. This scenario occurs during domain migration (the host moves to a different domain, but the VOB stays on the host). It also occurs when a VOB is moved from a host in one domain to a host in a different domain.

The **vob_sidwalk** command provides a flexible means of reassigning ownership of objects in a VOB, updating the SIDS that represent the groups in a VOB's group list, and correcting VOB storage directory protections. Common uses for **vob_sidwalk** include:

- Migrating a VOB from a Windows NT domain to an Active Directory domain
- Moving a VOB to a host in a domain that does not trust the original domain
- Moving a VOB from a Windows host to a UNIX host or vice versa
- Moving a VOB server host to a domain that does not trust the original domain

This section provides several examples of procedures that use **vob_sidwalk** and **vob_siddump**. There are additional examples of procedures that use **vob_sidwalk** in Chapter 12, *Moving VOBs*. The **vob_sidwalk** reference page provides complete information on all **vob_sidwalk** and **vob_siddump** options.

Regardless of the procedure you are using, we recommend that you run **vob_siddump** (or **vob_sidwalk** without the **-execute** option) and then examine the output to determine which objects in the VOB would have new owners. After you are sure that the changes in ownership are the ones you want, run **vob_sidwalk** with the **-execute** option to actually remap the SIDs. The output SID file is written in comma-separated-value (.csv) form, so it can be viewed and changed with any text editor or any spreadsheet program that can read a file of this format.

NOTE: On Windows, **vob_sidwalk** can only be used on VOBs formatted with schema version 54. It is only installed on hosts that are configured to support local views and VOBs and support VOB schema version 54.

Remapping Historical SIDs After Domain Migration

In a domain migration scenario, a VOB database includes additional SIDs that represent the SID histories of the security principals (users and groups) who own objects in the VOB. These historical SIDs were associated with the security principals before migration and are stored in the principal's **sIDHistory** attribute in an Active Directory domain.

To replace the historical SIDs stored in the VOB database with new ones that resolve to the appropriate security principals in the Active Directory domain, use a command like this one:

vob_sidwalk -sidhistory -execute *vob-tag SIDfile-path*

When invoked with the **-sidhistory** option, **vob_sidwalk** uses the following algorithm to determine SID history:

1. Look up a SID to find the account name.
2. Look up the account name found in Step #1 to find its SID.
3. If the SID returned in Step #2 is different from the SID used in Step #1, the SID used in Step #1 is assumed to be an historical SID, and the SID returned in Step #2 is written to the new-SID field of the current line of *SIDfile-path*.

If **vob_sidwalk** was invoked with the **-execute** option, the SID used in Step #1 is replaced with the SID returned in Step #2.

Remapping Current SIDs When Moving a VOB to a New Domain

When you move a VOB to another domain, you must use **vob_sidwalk** to retrieve and store (in the VOB database) the new SIDs for all security principals who own objects in the VOB. The procedure is essentially the same whether you are moving the VOB to a host in another domain or simply moving a VOB server host to another domain and leaving the VOB on the host. *Moving a VOB to a Different Domain* on page 223 provides a detailed description of the procedure for remapping SIDs as part of a VOB move.

Reassigning Ownership to the VOB Owner

To reassign ownership of objects in the VOB by mapping all existing SIDs to the new SIDs of the VOB owner and group, use a command line like this one:

vob_sidwalk -unknown -execute *vob-tag SIDfile-path*

When invoked with the **-unknown** and **-execute** options, **vob_sidwalk** maps unresolvable user SIDs to the SID of the VOB owner and maps unresolvable group SIDs to the SID of the VOB's group.

NOTE: If you are using UCM, you may not want to reassign ownership with **-unknown**. Reassigning an open activity to the VOB owner makes it unusable by its creator (unless it was created by the VOB owner).

Resetting VOB Storage Directory Protections

If VOB storage directory ACLs have been damaged during a migration (or by any other event), you can use **vob_sidwalk** as shown here to correct the ACLs on the VOB storage directory and container files:

vob_sidwalk -recover_filesystem *vob-tag SIDfile-path*

When used with the **-recover_filesystem** option, **vob_sidwalk** also corrects the SIDs for the VOB's supplementary group list.

Using -delete_groups With Ownership-Preserving Replicas

Rational ClearCase MultiSite customers who use ownership-preserving replicas (created with **mkreplica -preserve**) must take several additional steps when they migrate those replicas' hosts from Windows NT domains to Active Directory.

Because the changes in SIDs made by **vob_sidwalk** are not therefore not propagated by replication, the MultiSite administrator must run **vob_sidwalk** on each ownership-preserving replica in a replica family when the server that hosts the replica is migrated to Active Directory. When it is run on an ownership-preserving replica, **vob_sidwalk** preserves the original SIDs on VOB's group list, so that operations which require container creation continue to succeed

whether or not all ownership-preserving replicas in a family have been updated. After all ownership-preserving members of a replica family have been updated, the administrator must run **vob_sidwalk** again using the **-delete_groups** option to remove these historical group SIDs. We recommend removing historical SIDs because a VOB has a limit of 32 groups on its group list. Keeping unused historical SIDs on the list may cause the list to overflow as new groups are added.

NOTE: This procedure assumes that you have already migrated user and group accounts for all users of all replicas to Active Directory, and that all users have set their **CLEARCASE_PRIMARY_GROUP** environment variable to the name of the ClearCase users group in the Active Directory domain.

1. Synchronize all replicas in the family to be sure that each replica includes the same set of user and group SIDs.

2. Follow the procedure in *Migrating Individual ClearCase Hosts* on page 65 to migrate hosts. All ownership-preserving replicas in a family must be processed using the same **vob_sidwalk** options. If the **-map** option is used, you can save time by generating one mapping file and using it on all ownership-preserving replicas in a family.

3. After the replica has been synchronized again with other replicas whose SIDs have been updated as described in Step #2 of this procedure, run the command

   vob_sidwalk -sid_history *vob-tag SIDfile-path*

   and examine the resulting SID file to see whether any new SID mappings are needed (because new user or group identities have been added to the replica). If new SID mappings are required, run **vob_sidwalk** again using the options you used in Step #2 of this procedure.

4. After all ownership-preserving replicas have been updated as described in Step #2 of this procedure and the SID file generated in Step #3 of this procedure shows that no new SID mappings are needed, run **vob_sidwalk -execute -delete_groups** on each of the replicas. This deletes historical group SIDs from the VOB's group list.

Administering a UNIX/Windows Network

5 Configuring ClearCase in a Mixed Network

If your network environment includes a mixture of hosts running Windows and UNIX operating systems, you can share ClearCase data across these platforms. In general, ClearCase hosts on Windows can access VOBs and views that are stored on ClearCase hosts running either Windows or UNIX. ClearCase hosts on UNIX can access VOBs stored on Windows hosts, but only from snapshot views. Dynamic view access from a ClearCase host on UNIX to a VOB on Windows is not supported. UNIX computers can also use the ClearCase Web interface to access data stored on Windows computers.

This chapter describes how you can share ClearCase data across platforms and describes a few constraints that must be considered when implementing cross-platform access.

5.1 When to Use ClearCase in a Mixed Network Environment

Working across platforms provides flexibility and may save time and development resources. It also requires extra planning and maintenance. The scenarios that follow represent situations in which it is beneficial to use Rational ClearCase in a mixed environment:

- A group of Windows developers and a group of UNIX developers work on the same source code.

  To allow users on both Windows and UNIX to access the source code, the Windows developers use UNIX VOBs. However, the Windows developers have no need to see view-private changes to the UNIX source code, so they use Windows views for optimal performance.

- One group of developers maintains a code base for both UNIX and Windows.

  In this scenario, developers on Windows use the UNIX VOB in which the source code resides. They also use their UNIX views from their Windows computers so they have access to the same view-private files on both platforms.

- A group of Windows developers works primarily on a separate source code base but keeps the source code on a UNIX VOB for administrative purposes (for example, the backup procedure resides on UNIX).

  In this case, the developers use UNIX VOBs and Windows views.

When Not to Use a Mixed Environment

When you run ClearCase on Windows, you can access views and VOBs on both Windows and UNIX. If your developers do not need to access ClearCase data from UNIX computers, and you have no administrative reasons to maintain UNIX VOBs and views (for example, backup requirements), we recommend that you use Windows views and VOBs. This strategy yields better performance than does accessing UNIX VOBs and views from Windows computers

5.2 ClearCase Capabilities in a Mixed Environment

This section describes the access to ClearCase data that is possible between Windows and UNIX computers. The description assumes that you have configured the computers and your network to support cross-platform access to ClearCase data structures. Specifically:

- You have configured your ClearCase installation to enable all view- and VOB-access capabilities possible for that computer's operating system.

  The view- and VOB-access capabilities of a given ClearCase host often are a function of how the computer was configured during ClearCase installation. This is especially true of ClearCase on Windows hosts. For more information, see the *Release Notes* for Rational ClearCase and ClearCase MultiSite.

- You have installed a cross-platform file access product where necessary.

  If you are using snapshot views on either UNIX or Windows, you can enable ClearCase File Service (CCFS) to allow these views to access VOBs on either UNIX or Windows. You need not install a third-party file access product.

If you are using Windows dynamic views to access files and directories in UNIX VOBs or want to access UNIX dynamic views, you must install a third-party file-access product, such as an NFS client product or an SMB server product.

See Chapter 6, *Cross-Platform File Access* for details about CCFS and third-party file-access products.

Windows

Windows computers can access Windows snapshot and dynamic views and UNIX dynamic views. They cannot access UNIX snapshot views.

Windows computers can access Windows VOBs using Windows snapshot and dynamic views. They can access UNIX VOBs using Windows snapshot and dynamic views, and also using UNIX dynamic views.

NOTE: Although Windows computers can access UNIX dynamic views, they cannot use those UNIX views to access Windows VOBs.

Windows Me and Windows 98 computers can access Windows snapshot views whose view storage directories are located on Windows computers. They cannot access Windows dynamic views or UNIX snapshot or dynamic views.

Windows Me and Windows 98 computers can access Windows and UNIX VOBs using Windows snapshot views.

UNIX

Using dynamic views, UNIX computers can access UNIX VOBs. Using snapshot views, UNIX computers can access UNIX VOBs or Windows VOBs. UNIX computers cannot access Windows snapshot or dynamic views.

UNIX computers can also use the ClearCase Web interface to access VOBs on Windows. For more information, see Chapter 29, *Configuring a Web Server for the ClearCase Web Interface*.

Constraints in a Mixed Environment

This section lists specific constraints to consider when using ClearCase in a mixed network environment:

- To access UNIX views, Windows computers must be configured to support *dynamic views*.
- ClearCase supports dynamic views only on UNIX and Windows computers; you cannot create or access dynamic views on a Windows Me or Windows 98 computer.
- To avoid incompatibilities caused by differences in the way the Windows and UNIX operating systems address case-sensitivity, you may need to perform some additional configuration steps. See *Case-Sensitivity* on page 82 for details.
- You cannot create a UNIX VOB or view from a Windows computer. You cannot create a Windows VOB or view from a UNIX computer.
- You cannot use the **cleartool relocate** command to move elements between UNIX VOBs and Windows VOBs.
- A Windows computer cannot use a UNIX view that has symbolically linked view-private storage (**mkview –ln**).
- Various characters that are legal in UNIX file names are illegal in Windows file names. File names that include these characters are not recognized by the MVFS on Windows and cannot be loaded into a Windows snapshot view. VOB element names that include these characters are not visible in Windows views. Table 3 lists these characters.

Table 3 Characters Not Allowed in Windows File Names

?	*	/	\	|	<	>

5.3 Managing User Accounts

On UNIX, ClearCase relies on user and group IDs to maintain access control. For details, see Chapter 3, *Understanding ClearCase Access Controls*. To access UNIX VOBs and views correctly:

Each Windows user's user name and primary group name must match that user's user name and primary group name on UNIX.

NOTE: UNIX and Windows place different restrictions on the length of user and group names, as well as on the characters that are allowed in them. Be sure the user and group names you create are acceptable in both environments.

Creating a ClearCase Server Process User Account on UNIX

Domain User and Group Accounts on page 51 describes a special domain account, called the ClearCase server process user account, that ClearCase requires on Windows. ClearCase does not require a ClearCase server process user account on UNIX (it uses the **root** account for this purpose), but many of the cross-platform file access strategies described in Chapter 6 will be easier to administer and use of you create a UNIX user account that has the same name and password as the ClearCase server process user account on Windows. ClearCase processes that run on UNIX computers do not use this account in the same way that ClearCase processes that run on Windows computers do, but some ClearCase operations on Windows computers require the ClearCase server process user to be authenticated on a UNIX host.

If you create a ClearCase server process user account on UNIX, it should be a member of any group that owns a VOB or view hosted on UNIX, and its primary group should be the group you have defined as the **CLEARCASE_PRIMARY_GROUP**. See *Setting the ClearCase Primary Group* on page 52 for more information about this topic.

Credentials Mapping and the Credentials Server

Whenever a user on one type of a computer tries to access an object under ClearCase control on another type of computer (for example, when a user logged in to a Windows computer tries to access a VOB or view on a UNIX computer), a credentials mapping server (**credmap_server**) authenticates the user in the other environment. The **credmap_server** is started automatically by the **albd_server** when the first such access occurs.

NOTE: Because Windows 98 and Windows Me computers cannot be members of a domain, they must explicitly specify a credentials server running on a Windows computer that is a member of a domain and is running ClearCase. This credentials server host name is usually specified during ClearCase site preparation. It can be confirmed or overridden by the user during the client install. If a Windows 98 or Windows Me computer is not configured with the name of a valid credentials server host, most ClearCase operations will fail on that computer.

Credentials mapping will not work for any user who has a different user name in the Windows domain and the NIS **passwd** map, or who logs on to Windows 98 or Windows Me with a name

that is not valid in the domain in which the credentials server is running. See *Users and Groups* on page 29 for more on this topic.

Checking User and Group Assignments

Individual users can check the validity of their current user and group assignments with the **credmap** and **creds** utilities in *ccase-home-dir***etc\utils**. If the primary group is incorrect, follow the procedure described in *Setting the ClearCase Primary Group* on page 52 to set the **CLEARCASE_PRIMARY_GROUP** environment variable.

After your Windows primary group is established, you can verify that it matches the corresponding UNIX user and group IDs with *ccase-home-dir***etc\utils\credmap**. The **credmap** utility takes one argument: a target UNIX computer that is running the VOB or view server. The following command checks the user and group IDs for user **anne** on Windows against their counterparts on UNIX computer **saturn**:

ccase-home-dir\etc\utils> **credmap saturn**

```
Identity on local Windows system:
  User: anne (0x1003f2)
  Primary group: user (0x1003ff)
  Groups:
    Administrators (0x20220)
    Domain Users (0x100201)

Identity on host "saturn":
  User ID: 1149 (0x47d)
  Primary group ID: 20 (0x14)
  Group ID list:
    -2 (0xfffffffe)
```

In this example, if Anne is unsure whether the UNIX user ID and primary group ID values are correct (they must correspond to UNIX user **anne** and group **user**), she can use the **id** command on a UNIX system:

id

```
uid=1149(anne) gid=20(user)
```

UNIX VOB Group Lists and Registered User Groups

As it manages VOB access, ClearCase must routinely resolve VOB group list entries on both Windows and UNIX computers. Therefore, a domain administrator must use the **User Manager for Domains** program to add the primary and additional group names stored with each applicable UNIX VOB to the Windows domain.

For example, the following command, run on a UNIX host, displays the group names stored with UNIX VOB **/vobs/libvob2**:

cleartool describe vob:/vobs/libvob2

```
versioned object base "/vobs/libvob2"
  created 01-Feb-96.10:54:35 by vobadm.user@saturn
  "runtime libraries"
  VOB storage host:pathname "venus:/usr1/vobstore/libvob.vbs"
  VOB storage global pathname "/net/venus/usr1/vobstore/libvob.vbs"
  VOB ownership:
    owner: vobadm
    group: user
  Additional groups:
    devel
    gui
```

If the VOB is accessible from Windows, all three groups—**user**, **devel**, and **gui**—must be valid Windows domain groups, and Windows users must belong to at least one of these groups.

Note the following about group and user access between Windows and UNIX:

- Although you can define an unlimited number of groups on Windows, only the first 32 Windows domain-level groups for each user are considered by UNIX.
- In a Windows domain, user and group names are in the same namespace. Therefore, if a VOB on UNIX uses the same name for both a user and group name, a ClearCase host running Windows has trouble accessing this VOB.

5.4 ClearCase Access Control on UNIX and Windows

This section presents the differences between the UNIX and Windows implementations of ClearCase security features. For more information on ClearCase access control, see Chapter 3, *Understanding ClearCase Access Controls*.

- **View protection mode**—A Windows view always has read, write, and execute permission for the view's owner and group, and it has read and execute permission for others. On UNIX, a view's protection mode is determined by the umask of the view's creator.

- **View-private file protection mode**—In a Windows dynamic view, view-private files (including checked-out files) initially have read, write, and execute permission for all users. You can later specify whether all users have write permission, but you cannot change any other permissions. On UNIX, a view-private file's initial protection mode is determined by the umask of the file's creator, and you can change it later.

- **Reporting protection modes for elements**—On Windows, you cannot use standard operating system commands to view ClearCase protection modes for elements. Instead, in Windows Explorer, click **ClearCase** > **Properties of Element** on an element's shortcut menu, and then click the **Protection** tab.

- **Adding executable files to source control**—When you add an executable file to source control on Windows, ClearCase makes the file read-only by setting its protection to 0444. To make the file executable, run the following command:

  cleartool protect –chmod +x *filename*

  Alternately, from Windows Explorer, select the executable, and click **ClearCase** > **Properties of Element** on the shortcut menu. On the **Protection** tab, select **Execute** under **Owner**, **Group**, or **Other**, as appropriate.

5.5 Case-Sensitivity

In general, you can work with ClearCase on either operating system with little consideration for case-sensitivity issues. In the event you encounter unexpected behavior, read this section carefully.

This section applies only to the ClearCase multiversion file system (MVFS), and thus applies only to dynamic views.

General Recommendations

To avoid common problems, follow these general recommendations:

- Click **Start** > **Settings** > **Control Panel**. Start the **ClearCase** program. On the **MVFS** tab, verify that ClearCase is using **Case-Insensitive MVFS** file lookup. This is the default setting.
- Disable automatic case conversion for your NFS client or SMB server product.
- Do not rely on case-sensitive names (names that differ only character case) for elements that you store in a VOB.
- Consider enabling the **Case Preserving** option (on the **MVFS** tab of the **ClearCase** Control Panel program), especially if you are using a Java compiler or other application that expects object file names in mixed case.

  WARNING: If you change the setting of the **Case Preserving** option, you may encounter problems when you write new versions of files that were created when the previous setting was in effect. For example, conflicts may arise if a development environment automatically generates files with mixed-case and uppercase names.

The remainder of this section explains the pertinent case-sensitivity issues on both UNIX and Windows and discusses each recommendation in more detail.

Case Considerations on UNIX

On UNIX, the native file system and all ClearCase components (MVFS, **cleartool**, and so on) are case-sensitive. The MVFS uses case-sensitive file lookup and performs no automatic case conversion of any kind.

Case Considerations on Windows

Regardless of how you configure ClearCase, all ClearCase applications that refer to pathnames in VOBs, including **cleartool** and **clearmake**, are case-sensitive on both UNIX and Windows.

The remainder of this section discusses issues of case-sensitivity for dynamic views on Windows. Snapshot views use native Windows file systems (FAT, NTFS, and so on) to read and write files.

These file systems perform case-insensitive file lookup and generally preserve case when writing files. We recommend that when using snapshot views, you avoid using VOB elements whose names differ only in capitalization.

Because native Windows file systems perform case-insensitive file lookup, the MVFS is configure by default to perform case-insensitive file lookup on Windows.

By default, native Windows file systems preserve case on file-creation operations. The default MVFS behavior is to convert file names to lowercase.

On Windows, the MVFS options for file name case (on the **MVFS** tab in the **ClearCase** Control Panel program) are as follows:

- When you select the **Case Insensitive MVFS** check box (the default and recommended setting), the MVFS looks up files without regard to case. With this setting, when the MVFS writes view-private files, capitalization of file names depends on the setting of the **Case Preserving** check box:
  - When you select the **Case Preserving** check box, the MVFS preserves the case of the names of new view-private files.
  - When you clear the **Case Preserving** check box, the MVFS converts the names of new view-private files to lowercase. This is the default setting.
- When you clear the **Case Insensitive MVFS** check box, the MVFS uses case-sensitive file lookup. With this setting, the MVFS preserves the case of the names of all files it creates.

NOTE: If you change any MVFS options, the new settings do not take effect until you restart your computer.

In the default mode (**Case Insensitive MVFS** enabled, **Case Preserving** disabled), the MVFS converts to lowercase the names of view-private files it creates using non-ClearCase commands, tools, and utilities (for example, **.obj** files and editor backup files). This behavior can combine with **cleartool** case-sensitivity to produce results such as the following:

```
cl –c util.c                                    (Compiler creates util.OBJ)
dir
...
02/24/95  12:52p    12,765   util.obj           (The MVFS uses lowercase for util.OBJ)
...
cleartool checkin util.OBJ                      (cleartool is case-sensitive; checkin fails)
cleartool checkin util.obj                      (Correct; checkin succeeds)
```

Keep this example in mind when coding complex sequences of file-processing commands in makefiles. Make sure that any **cleartool** commands that are run from a **makefile** and that operate on derived objects use names in the correct case.

If you clear **Case-Insensitive MVFS** and select **Case-Preserving**, the results are as follows:

```
cl –c util.c                                    (Compiler creates util.OBJ)
dir
...
02/24/95  12:52p    12,765   util.OBJ           (The MVFS preserves uppercase for util.OBJ)
...
cleartool checkin util.obj                      (cleartool is case-sensitive; checkin fails)
cleartool checkin util.OBJ                      (cleartool is case-sensitive; checkin succeeds)
```

When to Use Case-Sensitive Mode

In general, we recommend that you use case-insensitive mode whenever possible. Use case-sensitive mode only if VOB files have names that differ only in capitalization. In this mode, many Windows applications may fail when they try to access files using incorrectly capitalized names. We recommend that for files you plan to access from Windows computers, you not rely on names that differ only in capitalization. A case-insensitive MVFS on Windows cannot distinguish between the two files. Under these circumstances, the results of any file access are undefined.

NFS Client Products and Case-Sensitivity

NFS client software for Windows computers affects the behavior that ClearCase users see. Most NFS client products can convert to lowercase the file names they create, and some do so by default. To avoid file access problems caused by case-conversion conflicts, we strongly recommend that you *disable automatic case conversion for NFS client products*.

Be aware that if you disable case conversion and create UNIX files without MVFS intervention (that is, you create files outside any VOB namespace), you may end up with UNIX files with names like **UTIL.OBJ**, because some PC tools generate uppercase names. This does not happen for a view-private object that you create in a VOB's namespace if the **Case Preserving** option is disabled (the default setting). In this case, the MVFS converts the name to lowercase when it creates the file.

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6 Cross-Platform File Access

In mixed networks of Windows and UNIX computers, certain ClearCase operations may require a Windows or UNIX computer to access the file system of a different type of computer. Rational ClearCase supports several protocols that allow a Windows computer to access the file system of a UNIX computer and also provides for more limited access by UNIX computers to ClearCase data in Windows file systems. The following protocols—some of which can only be enabled using a software from a third party (neither Rational nor the computer vendor)—may be used.

- **ClearCase File Service (CCFS)** — The ClearCase File Service is a TCP/IP-based file transfer mechanism included with ClearCase. It provides snapshot views with access to VOB data. It does not support dynamic views. For information about CCFS, see *ClearCase File Service* on page 89.

- **NFS** — The NFS (Network File Service) protocol is supported by most UNIX computers for network file system access. NFS client products for Windows allow Windows computers to access UNIX file systems using the NFS protocol. You install an NFS client product on each Windows computer from which you want to access UNIX VOBs and views. For more information about which NFS client products ClearCase supports and how to configure them, see *NFS Client Products* on page 90.

- **SMB** — The SMB (Server Message Block) protocol is the native protocol that Windows computers use for network file system access. SMB servers that run on UNIX computers allow Windows computers to access UNIX VOBs and views using native Windows protocols. You install an SMB server product on each UNIX VOB or view server you will access from a Windows client. For more information about which SMB server products ClearCase supports and how to configure them, see *SMB Server Products* on page 96

Table 4 lists the protocols that ClearCase clients can use to access VOB data. Table 5 lists the protocols that ClearCase clients use to access **view_server** storage. In these tables, protocols

native to their respective computer platforms are labeled “Native.”CCFS is included in ClearCase. All other protocols require third-party software support.

Table 4 Protocols for ClearCase Client Access to VOB Data

Client Platform	Access to VOB data on UNIX	Access to VOB data on Windows
Windows 98, Windows Me	CCFS (requires Windows view server)	Native SMB
Windows (dynamic views)	Third-party NFS or SMB	Native SMB
Windows (snapshot views)	CCFS, third-party NFS or SMB	Native SMB
UNIX (dynamic views)	Native NFS	Unsupported
UNIX (snapshot views)	Native NFS	CCFS

Table 5 Protocols for ClearCase Client Access to View Data

Client Platform	Access to view data on UNIX	Access to view data on Windows
Windows 98, Windows Me	See note.	Native SMB
Windows (dynamic views)	Third-party NFS or SMB	Native SMB
Windows (snapshot views)	Third-party NFS or SMB	Native SMB
UNIX (dynamic views)	Native NFS	Unsupported
UNIX (snapshot views)	Native NFS	See note.

NOTE: When a view has been created with the **-ngpath** option and both the client and server platforms are running ClearCase 4.1 or later, Windows 98 and Windows Me platforms can access view data on UNIX, and UNIX snapshot views can access view data on Windows using the native ClearCase RPC mechanism. This configuration is found most often in ClearCase LT communities.

Table 6 lists the protocols used by a **view_server** process to access VOB data.

Table 6 Protocols for view_server Access to VOB Data

view_server platform	Access to VOB data on UNIX	Access to VOB data on Windows
Windows	CCFS, third-party NFS, or SMB	Native SMB
UNIX	Native NFS	CCFS

6.1 ClearCase File Service

The ClearCase File Service is a TCP/IP-based mechanism that enables cross-platform file transfers between VOB servers and snapshot views. It supports access by snapshot views on Windows computers to VOB data on UNIX computers and access by snapshot views on UNIX computers to VOB data on Windows.

If a ClearCase client uses only snapshot views, no third-party NFS client-based or SMB server-based product is necessary to access VOB data on any platform. Dynamic views support access by snapshot views on Windows computers to VOB data on UNIX computers. Dynamic views on Windows computers still require a supported NFS client or SMB server product to access UNIX VOBs.

ClearCase clients running Windows Me or Windows 98 use CCFS as their sole transfer mechanism when accessing UNIX VOBs. Because Windows Me and Windows 98 computers cannot use dynamic views or run view servers, you must have at least one Windows NT, Windows 2000, or Windows XP computer that will run the **view_server** process and contain the view storage directory for snapshot views created on Windows Me and Windows 98 computers.

When CCFS is enabled, file transfers between snapshot view clients and VOB servers (for example, operations such as checking out, checking in, and creating and updating snapshot views) take place over a standard TCP/IP connection. File transfers between a VOB server and a snapshot view's view server also use this TCP/IP connection.

CCFS is always enabled on a UNIX computer running ClearCase. It may be enabled or disabled on Windows using the **ClearCase** program in Control Panel

Enabling CCFS on Windows

CCFS is disabled by default on Windows computers running ClearCase. When CCFS is disabled on a Windows computer, the computer must use a supported NFS client or SMB server product to access UNIX VOBs.

NOTE: CCFS must be enabled on any Windows computer that is running a **view_server** used by Windows 98 or Windows Me clients to access UNIX VOBs unless the UNIX VOB server host is running a supported SMB server product. A Windows computer configured to use an NFS client product to access UNIX VOBs cannot be the **view_server** host for Windows 98 or Windows Me computers.

To enable CCFS on a Windows computer:

1. Click **Start** > **Settings** > **Control Panel**. Start the **ClearCase** program.
2. On the **Options** tab, select the **Use CCFS to access UNIX VOBs** check box to enable use of CCFS. Clear this check box to disable use of CCFS.

   Click **OK**.
3. Shut down and restart the computer to ensure that the change takes effect for all processes.

6.2 NFS Client Products

ClearCase supports these NFS client products on Windows computers:

- Microsoft Windows Services for UNIX (SFU 1.0) Client for NFS
- Intergraph DiskAccess
- Hummingbird NFS Maestro

Some versions of these products may not be supported for use with ClearCase. The *Release Notes* for Rational ClearCase and ClearCase MultiSite include the most recent information about supported NFS client products and versions.

If you are using an NFS client product, you must install it on each Windows client that will access VOBs or views located on UNIX servers. You must install the product correctly and completely; in particular, you must assign and configure the NFS daemon and authentication process.

NOTE: A Windows computer configured to use an NFS client product to access UNIX VOBs cannot be a **view_server** host for Windows 98 or Windows Me computers.

The *Release Notes* for Rational ClearCase and ClearCase MultiSite contain the most up-to-date information about NFS client products, including which versions of those products Rational supports for use with ClearCase.

The rest of this section describes configuration procedures specific to using an NFS client product with ClearCase. *Read and perform all procedures recommended for your product.*

Disabling Automatic Case Conversion

Some NFS client products change the case of file names by default, typically by converting to lowercase. Because ClearCase is case-sensitive, you need to disable case conversion, as described later in this section.

NOTE: Typically, you can use a command-line option to disable case conversion for a particular NFS mount. However, ClearCase automatically mount remote storage directories. See *Automounting and NFS Client Software* on page 94. For correct behavior on these mounts, configure NFS mount drive options to disable case conversion.

Microsoft SFU and Intergraph DiskAccess

To disable automatic case conversion:

1. Start the Client for NFS (for SFU) or DiskAccess (for DiskAccess) Control Panel program.
2. On the **Filenames** tab, click **Preserve Case (no conversion)**.

Hummingbird NFS Maestro

To disable automatic case conversion:

1. Click **Start** > **Settings** > **Control Panel**. Start the Network program.
2. On the **Services** tab, select **NFS Maestro for Windows NT Client**.
3. Click **Properties** to open the client configuration dialog box.
4. Under **Filename Capitalization**, click **Preserve Case**.

Setting an NFS Client's Default Protection

If you plan to work in a shared UNIX view, configure your NFS client with a default protection that grants group write access. Without this permission, other developers cannot modify view-private files that you have created.

Microsoft SFU or Intergraph DiskAccess

To set the default protection:

1. Start the Client for NFS (for SFU) or DiskAccess (for DiskAccess) Control Panel program.
2. On the **File Access** tab, ensure **User** is `RWX`, **Group** is `RWX`, and **Other** is `RX`.

Hummingbird NFS Maestro

To set the default protection:

1. Click **Start** > **Settings** > **Control Panel**. Start the Network program.
2. On the **Services** tab, select **NFS Maestro for Windows NT –Client**.
3. Click **Properties** to open the client configuration dialog box.
4. Under **Default Protection**, specify the protections as follows:

```
User Group Other
RWX  RWX   RWX
xxx  xxx   x x
```

Setting the Correct Logon Name

To avoid VOB and view access permission problems, do not log on to an NFS server as user **nobody** or with any user or group ID that does not match your Windows user and primary group IDs.

To verify that your Windows user name/UID and group name/GID match their UNIX counterparts, pass the name of a UNIX NFS server to *ccase-home-dir***etc****utils****credmap**. For example:

*ccase-home-dir***etc\utils\credmap saturn**

After you confirm your user name/UID and group name/GID, supply the user name as an NFS logon parameter.

Microsoft SFU or Intergraph DiskAccess

To set your logon user name:

1. Start the Client for NFS (for SFU) or DiskAccess (for DiskAccess) Control Panel program.
2. On the **Authentication** tab, type the correct **User Name**, **Password**, and **PCNFSD Server**.
3. Click **OK**; your logon session is validated.

Hummingbird NFS Maestro

To set your logon user name; at the command prompt, run the **nfs register** command:

nfs register *username*

This command prompts for a password.

Hummingbird NFS Maestro: Disabling DOS Sharing

The Maestro **DOS Sharing** option is incompatible with ClearCase use. When using Hummingbird NFS Maestro with ClearCase, you must disable this mode. If you do not, you may encounter MVFS log errors when attempting to open MVFS files. For example:

```
ZwOpenFile returned status 0xc0000043
```

This error indicates a sharing violation.

To disable DOS Sharing:

1. Start the Network program in Control Panel.
2. On the **Services** tab, select **NFS Maestro for Windows NT –Client**.
3. Click **Properties** to open the client configuration dialog box.
4. Under **Default Links**, clear the **DOS-Style Sharing** check box.

Automounting and NFS Client Software

When you mount a UNIX VOB or start a UNIX dynamic view, ClearCase needs to access the *VOB storage directory* or *view storage directory* on the UNIX file-system partition. In the ClearCase program in Control Panel, the setting of the **Enable automatic mounting of NFS storage directories** check box determines how ClearCase accesses those directories when you use NFS client products.

All supported NFS client products can process UNC names. If you are using one of these products, clear the **Enable automatic mounting of NFS storage directories** check box. ClearCase then uses UNC names to access UNIX VOB and view storage directories. We recommend that you configure ClearCase hosts in this way.

If you have been using ClearCase with the **Enable automatic mounting of NFS storage directories** check box selected, you can continue to do so. ClearCase then maps Windows drive letters to UNIX VOB and view storage directories and accesses the directories through those drive letters.

NOTE: These drive letters are for internal ClearCase use. They are different from the drive letters you can assign and use for your own work within views. In particular, do not confuse them with the drive letters you can assign to dynamic views when you start those views.

We recommend that you disable automounting when using any supported NFS client product. If you install Microsoft SFU or Intergraph DiskAccess before you install ClearCase, the ClearCase installation procedure disables automounting for you.

If you are using Hummingbird NFS Maestro or if you install a supported NFS product after you have installed ClearCase, you can disable automounting using the ClearCase program in Control Panel.

1. Click **Start** > **Settings** > **Control Panel.** Start the ClearCase program.
2. On the **Options** tab, clear the **Enable automatic mounting of NFS storage directories** check box.
3. Click **OK**.

Microsoft SFU 1.0 or Intergraph DiskAccess: Configuring Authentication for the ClearCase Server Process User

SFU and DiskAccess must be configured to allow logins by an individual user (typically the owner of the of the workstation) as well as by the ClearCase server process user. After you install SFU or DiskAccess on a computer, use the following procedure to configure an additional SFU or DiskAccess log-in for the UNIX **clearcase_albd** user.

NOTE: This procedure requires a UNIX account for the ClearCase server process user. See *Creating a ClearCase Server Process User Account on UNIX* on page 79 for more information about how to create this account.

1. Log in as the ClearCase server process user (**clearcase_albd**).
2. Start the Client for NFS (for SFU) or DiskAccess (for DiskAccess) Control Panel program.
3. On the **Authentication** tab, specify the UNIX user name and password for the ClearCase server process user (the name and password that you used in Step #1 of this procedure).
4. Click **OK**.
5. When you exit the program, read the confirmation dialog box. It should show that you have been authenticated on UNIX as the ClearCase server process user. If there is an error, or if the confirmation dialog box shows a UID of -1 and GID of -2, you did not supply a valid name and password in Step #1 of this procedure.
6. Optionally, take the following additional steps to generate a Windows registry key file that other users can run to add support for this **clearcase_albd** login without having to log in as the **clearcase_albd**.

   a. Run the **creds** utility to display the user SID of the **clearcase_albd** user. You will need this SID in a later step.

   *ccase-home-dir***etc\utils\creds clearcase_albd**

   ```
   Windows NT user info (on local system):
   .
   .
   SID S-1-5-21-103034363-981818062-1465874335-1064
   .
   ```

   b. In a Windows Registry Editor, navigate to the key:

   HKEY_LOCAL_MACHINE\SOFTWARE\Intergraph\DiskAccess\CurrentVersion\Users

c. Select the subkey that matches the SID of the **clearcase_albd** user as returned by **creds**.

d. Save the key to a registry file by clicking **Registry** > **Export Registry File** in the Registry Editor. When this saved file is executed on any Windows computer that has SFU or DiskAccess installed, it creates the Windows registry key that enables SFU and DiskAccess logins for the ClearCase server process user on UNIX.

6.3 SMB Server Products

Rational supports two SMB products— Samba, available from **www.samba.org**, and Syntax TotalNET Advanced Server (TAS) from LSI Logic Corporation—to enable access to UNIX file systems from Windows computers. This section describes how to install and configure Samba and TAS.

Only a few versions of Samba and TAS (on a few UNIX platforms) are supported for use with ClearCase. The *Release Notes* for Rational ClearCase and ClearCase MultiSite include the most up-to-date information about SMB server products, including information on supported versions and platforms.

Installing and Configuring Samba

ClearCase supports use of Samba to provide Windows computers that use dynamic views with access to VOBs and views on several UNIX platforms.

Samba can be downloaded from **www.samba.org**. Download it and follow the installation instructions for the operating system on which you are installing it. Samba must be installed and configured on each UNIX VOB and view server that you want to access from Windows.

To configure Samba for use by ClearCase, you must do the following:

1. Create a Samba username map for the **clearcase_albd** user.
2. Configure Samba globals.
3. Create shares for VOB and view storage.
4. Start Samba services.

Creating a Samba Username Map for clearcase_albd

NOTE: In this section, we assume that the user account for the ClearCase server process on Windows is named **clearcase_albd**. If your user account for this server process is configured to use a different name, use that name instead.

Samba requires a username map that associates the user account for ClearCase server process Windows with a UNIX user account.

To create the Samba username map, use any text editor to create a file named **username.map** on the host where Samba is installed. We recommend that you create the file in the same directory where you have installed other Samba configuration files (such as **smb.conf**).

The file must contain a line of the form

```
account = clearcase_albd
```

where `account` is the name of an existing UNIX user account. We strongly recommend that this user's primary group (the group listed in the user's entry in the passwd database) be one to which all ClearCase users accessing VOBs and views on this server belong. For details about group- and user-level access to ClearCase data, see *Understanding ClearCase Access Controls* on page 29.

For more information about the **username.map** file, see the Samba documentation.

Using the Samba Web Administration Tool (SWAT)

Samba can be configured using various methods that range from a simple text editor to graphical tools. The examples in this document describe the configuration of Samba through the use of the Samba Web Administration Tool (SWAT), which is included in the Samba download. Instructions included with the download explain how to enable this tool.

To access the SWAT interface:

1. Type a URL of this format in a Web browser:

   http://*computer:port#*

   where *computer* is the host name of a UNIX VOB server or view server host on which you have installed Samba and *port#* represents the SWAT port number. (The default value is 901.)

2. Log on as **root.** The SWAT interface now appears in your browser.

Configuring Samba Globals for ClearCase

Click the GLOBALS icon at the top of the SWAT interface's home page. Then click **Advanced View**. Set the global options as described in Table 7.

Table 7 Samba Global Settings for ClearCase

Base options	
workgroup	Set to the name of the Windows domain to which ClearCase hosts accessing this server belong
netbios name	Set to the host name of this computer
Security options	
security	DOMAIN (recommended) or USER (see note)
encrypt passwords	Yes
create mask	0775
directory mask	0775
username map	Set to the local pathname of the **username.map** file
Locking options	
oplocks	No
kernel oplocks	No
File-name handling options	
case sensitive	No
preserve case	Yes

NOTE: If you select USER security, you must enter every user that will access Samba file services in a local password encryption database on the server that supports those file services. Click the PASSWORD icon on the SWAT home page. In the Server Password Management section, enter the name and password of each user.

ClearCase has no special requirements for other Samba globals, so you may configure them in any way that's appropriate for your site.

Creating Shares for VOB and View Storage

You must create one or more Samba shares to hold server storage locations or individual VOB or view storage directories. To create a Samba share:

1. Click the SHARES icon at the top of the SWAT interface's home page.
2. Enter a name for the share in the text box to the right of the **Create Share** button. To simplify administration, we recommend that the share name be similar or identical to that of the UNIX directory whose name you will enter in Step #4.
3. Click **Create Share**.
4. Edit the path option under **Base Options**. Set its value to be a directory under which the VOB or view storage areas reside. The VOB or view storage areas do not need to be in the directory specified, but they must be somewhere below the specified directory.
5. Click **Commit Changes**.

Starting Samba Services

The Samba **smbd** and **nmbd** services must be running before Windows computers can access files using Samba. We recommend that you configure your UNIX host to start the **smbd** and **nmbd** services at boot time. Platform-specific instructions for configuring automatic service startup are included in the Samba documentation.

Samba services can also be started manually from the SWAT interface using the following procedure:

1. Click the STATUS icon at the top of the SWAT interface's home page.
2. Click **Start smbd**. The page refreshes and should display the **smbd** status as `running`.
3. Click **Start nmbd**. The page refreshes and should display the **nmbd** status as `running`.

Configuring ClearCase to Support Samba

For all ClearCase clients on Windows that have the MVFS installed and that will access Samba shares, change the **MVFS Performance** settings in the ClearCase program in Control Panel as follows:

1. Click **Start** > **Settings** > **Control Panel**. Start ClearCase.
2. On the **MVFS Performance** tab:

- ➢ Select **Override** for both **Maximum number of mnodes to keep on the free list** and **Maximum number of mnodes to keep for cleartext free list**.
- ➢ Set the value for both to 800.

3. Click **OK** to apply the changes and close the dialog box.
4. Restart Windows.

Testing the Samba Configuration on Non-ClearCase Files

We recommend that you test the Samba installation and configuration using non-ClearCase files and directories before attempting to use Samba to provide file access to VOBs and views, as follows:

1. Create a directory on your Samba server (for example, **/testshare/testdir**) and a test file in that directory (for example, **/testshare/testdir/testfile**).
2. Create a Samba share using **testshare** as the share name and **/testshare** as the path name for the share.
3. From a Windows client, create a file in the Samba share. Then verify that the UNIX user and group settings for that file are correct.
4. Verify that all Windows clients can access the Samba share, including testing permission and access restrictions, until you are confident that Samba is working properly.

Testing the Samba Configuration with ClearCase

To verify that ClearCase and Samba are working together properly:

1. On a UNIX VOB or view server, install and configure Samba as described in this chapter, creating shares for VOB and/or view storage.
2. Verify that your ClearCase user and group assignments are appropriate, as described in *Understanding ClearCase Access Controls* on page 29.
3. Verify that you can access VOBs and views on the server from a UNIX client.
4. Log on to a ClearCase client on Windows. Use the Region Synchronizer to import VOB and view tags for VOBs and views hosted on the UNIX server into the Windows region.
5. Ensure that you can use these views and VOBs by performing some basic ClearCase operations (for example, **mkelem**, **checkin**, and **checkout**) in them.

TotalNET Advanced Server

ClearCase supports the TotalNET Advanced Server (TAS) SMB server product from LSI Logic Corporation to provide Windows computers using dynamic views with access to VOBs and views on several UNIX platforms.

Installing TAS

This section describes how to install TAS, including how to configure TAS and ClearCase to support mixed-environment file access. If you are using TAS, you must install and configure it on each UNIX VOB and view server that you want to access from a Windows client.

Follow the instructions in the appropriate platform-specific installation section of *TotalNET Advanced Server Release Notes* to install TAS on each VOB and view server requiring access from Windows.

Enabling the Multiuser Kernel Driver on AIX

If you are installing TotalNET Advanced Server on an AIX platform, you must enable the multiuser kernel driver after installing TAS. This step provides support for the TAS SMB multiplexor, which is required when using ClearCase with TAS on AIX.

To enable the multiuser kernel driver, use the TAS **smbmxenable** command. This command does not take any command-line options or arguments.

```
cd /var/totalnet/usr/sbin
./smbmxenable
```

To disable the multiuser kernel driver, use the TAS **smbmxdisable** command. This command does not take any command-line options or arguments.

```
cd /var/totalnet/usr/sbin
./smbmxdisable
```

NOTE: You cannot enable or disable the multiuser support from the Framework interface. You must use the command line. For details about multiuser support on AIX platforms, see the *TAS Administration Manual.*

Accessing the Syntax Administration Framework

You can configure and administer TAS using the Syntax Administration Framework (formerly known as the TotalNET Administration Suite, or TNAS) Web interface. For details, see the chapter on syntax administration framework in *TotalNET Advanced Server Administration Manual*.

To access the Syntax Administration Framework Web interface:

1. Type a URL of this format in a Web browser:

   http://*computer***:***port#*

   where

   - *computer* is the host name of a UNIX VOB- or view-server host on which you have installed TAS
   - *port#* represents the Framework port number (the default is 7777)

   The Syntax Enterprise Services page appears.

2. Click **Syntax Administration Framework**; a Framework logon program appears.
3. Log on as **root**, using the **root** password for the TAS server. The Framework interface now appears in your browser.
4. Click **TAS Configuration and Administration** in the *sphere frame* (that is, the frame at the upper right of the interface).

   The TAS configuration and administration menu now appears in the *menu frame* (that is, the frame at the lower left of the interface).

Performing Initial Setup of TAS

NOTE: If you are upgrading an existing installation of TAS, the upgrade procedures preserve the previous configuration, including existing TAS volumes and file services supporting ClearCase, so you can skip the remaining sections of this chapter. After you have upgraded, ensure that opportunistic locks are disabled for each TAS volume that contains ClearCase storage. (The **Support opportunistic locks** check box in the volume definition should be cleared.) For details, see the *TAS Administration Manual*.

The first time you install TAS on a server, you must perform an initial setup on that TAS installation as described in the *TAS Administration Manual*. Click **Initial Setup** in the menu frame

of the Framework Web interface, and follow the instructions in the TAS documentation, subject to the changes noted in these sections that are specific to use of TAS with ClearCase.

For more information on any of the topics related to configuring TAS, see the *TAS Administration Manual*.

General TAS Settings

Accept the defaults for **Admin user**, **Admin group**, and so on in the **General TAS Settings** pane.

Enabling and Configuring the CIFS Realm

In the **Select Realms to Configure** pane, enable the CIFS realm, and click **Next**; the **CIFS Realm Configuration** pane appears.

NOTE: ClearCase does not require that the NetWare and AppleTalk realms be enabled.

Configure the CIFS realm as follows:

- **Server name** — Type the name of the VOB or view server, if it is not already the default.
- **Workgroup** — Type the name of the Windows domain to which your ClearCase clients belong.
- **Transports** — Select the protocols appropriate for your site.
- **Device for NetBEUI** — Accept the default.
- **WINS Server(s)** — If you are using proxy server authentication mode for CIFS file services (see *Configuring the File Service* on page 105), you may have to specify the IP addresses of the WINS servers for the network on which the authentication proxy server resides.

Configuring TAS to Support ClearCase

After initial setup, configure the TAS server to support ClearCase, using the Framework Web interface.

Creating a TAS Username Map for clearcase_albd

Create a TAS username map from the user account for the ClearCase server process user on Windows (see *Defining the Accounts Manually* on page 53) to a UNIX user account whose primary group ID (GID) can access all VOBs and views that will be accessed by TAS file services. In this

section, we assume that this user account is named **clearcase_albd**. If the user account for your server process is configured to use a different name, use that name instead.

To create the TAS username map:

1. Click **TAS System** in the menu frame; the **TAS System Configuration and Administration** pane appears.
2. Click **Username Maps**; the **Username Maps** pane appears. Make these changes to support ClearCase:

   - In the text box, type the name of an existing UNIX user account and click **Create**. We strongly recommend that this user's primary group (the group listed in the user's entry in the **passwd** database) be one to which all ClearCase users who access VOBs and views on this server belong.

     For details about how user and group identities control access to ClearCase data, see Chapter 3, *Understanding ClearCase Access Controls*

   - In **List of client accounts**, type **clearcase_albd**.

   Click **Submit** at the bottom of the form; then click **OK** in the confirmation message.

Creating a Volume

Create a TAS volume that exports the directory in which the VOB and/or view storage are physically located. Clients use the volume name to represent the path to the physical VOB or view storage location.

NOTE: We recommend that you test the TAS installation and configuration using ordinary files before using TAS to access VOBs and views. For details, see *Testing the TAS Configuration on Ordinary Files* on page 108.

The procedure required to support ClearCase is summarized here:

1. Click **TAS System** in the menu frame; then click **Volumes** in the **TAS System Configuration and Administration** pane.
2. Type a name (for example, **ccstore**) in the text box.

   Ensure that the volume name is of a form that is acceptable for all realms that will access it. For example, some realms do not accept names longer than 12 characters.

NOTE: The text box contains a symbolic name for the volume, not the pathname to the volume storage. However, it is a good idea to specify TAS volume names that correlate to the VOB and view storage paths. (For example, a TAS volume named **ccstore** may be associated with **/ccstore** on the UNIX computer.) If these names do not correlate, examine the volume properties to determine which pathnames are associated with which volumes.

3. Click **Create**; a **New Volume Definition** pane appears. Make these changes to support ClearCase:

   - **Pathname** — Type the pathname to the virtual root of the storage area. This pathname is the root of the VOB or view storage areas for the VOB or view server. In other words, all VOB or view storage areas must be located below this pathname (but they need not be direct subdirectories of this pathname).

     For example, if you type **/ccstore**, legal VOB and view storage names for this volume are **/ccstore/vobstore**, **/ccstore/home/vobstore**, and **/ccstore/home/project/viewstore**.

   - **Volume umask** — Type **002**.

   - **Filename Case** — Select **preserve**.

   - **Support opportunistic locks** — Clear the check box.

   Click **Submit** at the bottom of the form; then click **OK** in the confirmation pane.

Configuring the File Service

To configure the TAS file service to support ClearCase:

1. Access the file service:

   a. Click **CIFS (NB) Realm** in the menu frame.

   b. Click **Manage CIFS File Services**; a list of the file services appears.

   c. Click the file service that corresponds to your TAS server; then click **Administer**. A menu of file service operations appears.

2. Click **Configuration**; an update file service form appears. Make these changes to support ClearCase:

   - **Volume references** — Select the TAS volumes this file service references and exports.

   - **Browse master** — Select **off**.

- **Umask** — Type **002**.
- **Freespace report method** — Select **root**.
- **Windows 95 logon server** — Clear this check box.
- **Windows NT logon server** — Clear this check box.

  NOTE: You cannot use the **Windows NT Logon Server** feature if the TAS volumes are to include ClearCase storage.

Click **Submit** at the bottom of the form; then click **OK** in the confirmation pane to return to the menu of file service operations.

3. Click **Authentication Options**; the **Authentication Options** form appears. Under **User-mode authentication options**, click **Local** or **Remote**.

   NOTE: You cannot use **Share mode** authentication if the TAS volumes are to include ClearCase storage.

   For assistance in determining the authentication mode for your site, see your system administrator.

4. If you select **Remote** authentication, configure the authentication as follows:

   - **Proxies**—Click **Proxies** and type the name of the proxy servers in this text box, one per line.

     NOTE: You may need to specify in the CIFS realm the IP addresses of the WINS servers for the network on which the authentication proxy server resides. (See *Enabling and Configuring the CIFS Realm* on page 103.)

   - **Use Username map** — Select this check box to ensure that the file service references the **clearcase_albd** username map specified in *Creating a TAS Username Map for clearcase_albd* on page 103.

   If you select **Local authentication**, configure the authentication as follows:

   - **Use Secure Passwords** — Select this check box.

     NOTE: If you select **Local authentication**, you must enter every user that will access TAS file services in a local password encryption database on the server supporting those file services. If your CIFS realm contains multiple servers supporting TAS file services, you must configure a local password encryption database on each server.

- **Use Username map** — Select this check box to ensure that the file service references the **clearcase_albd** username map specified in *Creating a TAS Username Map for clearcase_albd* on page 103.

Click **Submit** at the bottom of the authentication options form. Then click **OK** in the confirmation pane to return to the menu of file service operations.

Start Services and Accept Service Connections

To start the TAS file services and accept service connections:

1. Click **TAS System** in the menu frame and then click **TAS System Administration**.
2. Click **Start Services** in the **TAS System Administration** pane.

   Click **OK** in the **Confirmation** pane; then click **OK** to return to the **TAS System Administration** pane.
3. In the **TAS System Administration** pane, click **Accept Service Connections**.

   Click **OK** in the **Confirmation** pane; then click **OK** to return to the **TAS System Administration** pane.

At this point, TAS is configured to support ClearCase. You can exit the Framework Web interface.

Configuring ClearCase to Support TAS

For all ClearCase clients on Windows that have the MVFS installed and will access TAS volumes, change the **MVFS Performance** settings in the ClearCase program in Control Panel as follows:

1. Click **Start** > **Settings** > **Control Panel**. Start ClearCase.
2. On the **MVFS Performance** tab:
   - Select **Override** for both **Maximum number of mnodes to keep on the free list** and **Maximum number of mnodes to keep for cleartext free list**.
   - Set the value for both to 800.
3. Click **OK** to apply the changes and close the dialog box.
4. Restart the Windows client.

Testing the TAS Configuration on Ordinary Files

We recommend that you test the TAS installation and configuration using non-ClearCase files and directories before attempting to use TAS to provide file access to VOBs and views, as follows:

1. Create a directory structure on your TAS server (for example, **/tasstore/testdir**) and a test file in that directory (for example, **/tasstore/testdir/testfile**).
2. Install and configure TAS as described in this chapter, using **tasstore** as the volume name and **/tasstore** as the path name for the volume.
3. From a Windows client, create a file in the TAS volume. Then verify that the UNIX user and group settings for that file are correct.
4. Verify that all Windows clients can access the TAS volume, including testing permission and access restrictions, until you are confident that TAS is working properly.

Testing the TAS Configuration with ClearCase

To verify that ClearCase and TAS are working together properly:

1. On a UNIX VOB or view server, install and configure TAS as described in this chapter, creating volumes containing VOB and/or view storage.
2. Verify that your ClearCase user and group assignments are appropriate. To do so, use the tests described in the chapter on configuring ClearCase in a mixed network in *Checking User and Group Assignments* on page 80.
3. Verify that you can access VOBs and views on the server from a UNIX client.
4. Log on to a ClearCase client on Windows. Use the Region Synchronizer to import VOB-tags and view-tags for VOBs and views hosted on the UNIX server into the Windows region.
5. Ensure that you can use these views and VOBs by performing some basic ClearCase operations (for example, **mkelem**, **checkin**, and **checkout**) in them.

7 Configuring VOB and View Access in Mixed Environments

Rational ClearCase supports cross-platform VOB and view access with some restrictions. This chapter describes the tasks required to make VOBs and views on UNIX hosts accessible by Windows hosts, and to make VOBs on WIndows hosts accessible use by UNIX hosts using snapshot views. UNIX computers cannot access Windows VOBs using dynamic views and cannot access dynamic views on Windows computers. Only Windows computers that are set up to support *dynamic views* can access UNIX dynamic views.

These are the most significant tasks associated with enabling cross-platform VOB and view access:

- Creating a new region in the ClearCase registry. UNIX and Windows have different network file naming conventions, so each VOB or view must have two tags: one used by UNIX computers and another used by Windows computers.

  NOTE: If you have not already done so, read about network regions in Chapter 26, *Administering Regions*.

- Creating an additional tag for each VOB or view that must be accessible to a computer that is not running the same operating system (Windows or UNIX) as the computer that hosts the VOB or view.

- Establishing conventions for the treatment of platform-specific text-file line-terminator conventions by views and VOBs.

7.1 Preparing the UNIX VOB or View Host

To prepare the UNIX VOB or view host so that you can use its VOBs or views on Windows:

1. If you have not already done so, install patches as instructed in the ClearCase customer area of the Rational Web site.

2. Determine whether any UNIX VOBs use symbolically linked storage pools (such pools are created with **mkpool –ln**). *Windows Tags for UNIX VOBs with Symbolically Linked Storage* on page 112 describes how to make this determination and how to perform a required extra step before registering such VOBs for a Windows region.

   NOTE: If a UNIX view has symbolically linked private storage (**mkview –ln**), you cannot use the view from a Windows computer if you access that view using an NFS client product. You can use that view if you are accessing the view using the Syntax TAS SMB server product.

7.2 Creating a New Network Region

Because Windows and UNIX have different network file naming conventions, Windows and UNIX computers each need to use platform-specific VOB- and view-tags that conform to those naming conventions. Whenever you must create two tags that refer to the same VOB or view, each tag must be created in a separate ClearCase network region. Creating a new network region is a software procedure; it implies no change in hardware configuration, and the region need not reflect physical locations or geographic regions.

Like VOBs and views, network regions are registered in the ClearCase registry. To create a new region, use the **cleartool mkregion –tag** *region-name* command. From a ClearCase host running Windows, you can also create a region using the ClearCase Registry snap-in to the ClearCase Administration Console. See *Adding a Network Region* on page 422 for more information on this subject.

Assigning Computers to the New Network Region

After the new region has been created, follow the procedures in *To Move a Host into a New Registry Region* on page 425 to add computers to it.

7.3 Creating VOB-Tags and View-Tags in the New Region

Use the Regions subnode of the ClearCase Registry node of the ClearCase Administration Console to create tags in the new region for VOBs and views. You can drag tags from one region into another, or copy them from one region and paste them into another. After you have copied a tag from one region to another, you must edit the tag's name and other properties so that they conform to the network file naming requirements of the platform for which the region was intended to serve.

You can also use the ClearCase Administration Console to create new tags that have the correct global access information. Or you can use the **mktag** command on either UNIX or Windows.

Administering Regions on page 415 has more information on creating VOB- and view-tags in multiple regions.

Using the Region Synchronizer

You can also use the Region Synchronizer on Windows to import the UNIX VOB-tags and view-tags into the ClearCase region to which you have assigned Windows computers.

To use the Region Synchronizer, click **Start** > **Programs** > **Rational ClearCase Administration** > **Region Synchronizer**. For help on using the Region Synchronizer, click **Help** in the **Synchronize ClearCase Regions** dialog box that opens when you start the Region Synchronizer.

NOTE: The Region Synchronizer expects a single ClearCase registry—one registry server. If you are registering UNIX VOBs and views for a network region that is managed by a separate registry server, use **cleartool mktag** to register VOB-tags and view-tags.

7.4 Re-Creating an Incorrect VOB-Tag or View-Tag

If you need to re-create an incorrect VOB-tag or view-tag, you can use the ClearCase Administration Console on a ClearCase host running Windows to change properties of the tag:

1. Navigate to one of the following nodes:
   - The Tags subnode of the VOB or view storage node for the host where the VOB or view storage directory resides

➢ The VOB Tags or View Tags subnode for the tag's region in the ClearCase Registry node

2. Select a VOB-tag or view-tag in the Details pane.

3. Click **Action** > **Properties**. This command opens a dialog box in which you can edit properties of the tag if you are a member of the ClearCase administrators group.

You can also use the command-line interface to re-create a tag:

➤ Use **cleartool mktag**, with the **–replace** option.

For example:

cleartool mktag –vob –tag \libvob –replace \\saturn\vobstore\libvob.vbs

➤ Use **cleartool rmtag** to remove the erroneous tag, and then use the Region Synchronizer to create a new one.

The following command removes the tag for view **anne_main**:

cleartool rmtag –view anne_main

7.5 Windows Tags for UNIX VOBs with Symbolically Linked Storage

NOTE: This section applies only if you are using an NFS Client product to access VOBs with symbolically linked storage pools; if you are using a supported SMB server product, you need not follow the instructions in this section.

If a UNIX VOB includes one or more symbolically linked storage pools, the VOB requires special handling when you register it in a Windows network region. Before you do so, check for linked storage pools. If you discover you have already registered a VOB without accounting for its linked storage pools, see *Mapping Storage Pools for an Existing VOB-Tag* on page 113.

To check a VOB for linked storage pools, move to a UNIX computer and type a command similar to this one:

cleartool lspool –long –invob /vobs/libvob

```
 ...
pool "libvob"
 18-Jun-97.17:00:06 by VobAdmin(VobAdmin.sys@starfield)
  kind: source pool
  pool storage link target pathname "/net/gamma/pools/libvob.1"
  pool storage global pathname "/net/io/vb_store/myvob/s/sdft"
 ...
```

If the output includes one or more `pool storage link ...` lines, follow this procedure when you create the VOB-tag with the Region Synchronizer:

1. Select the VOB-tag, and click **Import**.
2. In the **Create VOB Tag** dialog box, click **Show Mount Options**.
3. Under **NT-Only Options**, in the **Split Pool Map** box, supply a one-line text string that specifies all remote storage pools. For example, the following line (which is broken, illegally, so you can read it) defines three remote pools, separated by vertical bars:

   ```
    s\sdft\=\\gamma\pools\s\libvob.1\
   |c\cdft\=\\gamma\pools\c\libvob.1\
   |d\ddft\=\\gamma\pools\d\libvob.1\
   ```

   In this example, the VOB storage directory is on **io** but includes symbolic links to source, cleartext, and derived object pools on **gamma**.

   NOTE: Pathnames are specified with UNC names, a backslash (\) terminates each path name, and vertical bars (|) separate individual pool mappings.

Mapping Storage Pools for an Existing VOB-Tag

If you discover that you have already registered a VOB without accounting for its linked storage pools, use the ClearCase Administration Console on a ClearCase host running Windows to change properties of the tag:

1. Navigate to one of the following nodes:
   - The Tags subnode of the VOB storage node for the host where the VOB storage directory resides
   - The VOB Tags subnode for the tag's region in the ClearCase Registry node

2. Select a VOB-tag in the details pane.

3. Click **Action** > **Properties**. This command opens a dialog box in which you can edit properties of the tag if you are a member of the ClearCase administrators group.

4. In the dialog box, click the **Mount Options** tab. Enter a pool map string in the **Split Pool Map** box using the syntax described in *Windows Tags for UNIX VOBs with Symbolically Linked Storage* on page 112.

You can also delete the VOB-tag with **cleartool rmtag** and re-create it with the Region Synchronizer.

Alternately, you can re-create the VOB-tag with **mktag –replace**. A sample **mktag** command follows:

```
cleartool mktag –vob –tag \libvob –region dev_nt –replace   ^
More? –options poolmap=s\sdft\=\\gamma\pools\s\libvob.1\   ^
More?                  ^|c\cdft\=\\gamma\pools\c\libvob.1\   ^
More?                  ^|d\ddft\=\\gamma\pools\d\libvob.1\    ^
More? –host io   ^
More? –hpath  /usr1/vb_store/libvob.vbs   ^
More? –gpath  \\io\usr1\vb_store\libvob.vbs   ^
More? \\io\usr1\vb_store\libvob.vbs
```

This command illustrates several important rules to follow when composing the command line:

- A **poolmap** string commonly specifies multiple pools. Use vertical bars (|) to separate individual pool specifications. Escape each vertical bar with a caret (^).
- Use UNC names to specify pool locations.
- Specify all of the **–host**, **–hpath**, and **–gpath** arguments.
- Supply a UNC name to the VOB storage directory as the **–gpath** argument.

Here is formal syntax for each pool specification in a **poolmap** mount option to **cleartool mktag**:

pool-spec := *symlink-source*\=*symlink-target*\

symlink-source
The symbolic link to the remote pool, relative to the VOB storage directory.

symlink-target
The full pathname, in UNC format, of the linked pool. The pool must reside somewhere

in a UNIX directory subtree that has been mounted on the local Windows computer using an NFS product. The path name must be valid on all computers in the Windows network region that access the VOB.

7.6 Configuring Text Modes for Views

UNIX and Windows observe different conventions for terminating lines in text files. UNIX systems normally terminate lines with a single **<LF>** (line feed, or new line) character and Windows systems terminate lines with a two-character **<CR><LF>** (carriage return, line feed) character sequence. Some Windows applications can read and display files in either format, some Windows applications always write files using **<CR><LF>** format, and some Windows applications can be configured to determine which format to use.

As a result of these differing conventions, line-termination problems are a typical result of the use of text editors on files that must be edited on both UNIX and Windows platforms. For example, a file that contains:

```
abc
def
ghi
```

would look like this if it were created by a typical Windows editor and read by a typical UNIX editor (for example, **vi**):

```
abc^M
def^M
ghi^M
```

The UNIX text editor renders the **<CR>** character as **^M**. The same file would look like this if it were created by a typical UNIX editor and read by a typical Windows editor (for example, Notepad):

```
abc■def■ghi
```

To better support parallel development in mixed operating system environments, ClearCase provides a *text mode* setting for views that controls how line terminators are handled when text files are presented to applications.

Text Modes

Each view has a text mode setting that specifies how it handles line terminator sequences. This setting only applies to file elements whose element type is **text_file** or a subtype of type **text_file**. You determine a view's text mode when you create the view. You cannot change the text mode of a view after the view has been created.

A site configuration parameter in the ClearCase registry determines the default text mode for view creation. For details, see the reference page for the **setsite** command.

You can create a view in any of three text modes:

- **transparent text mode**. In a view created in **transparent** text mode, ClearCase does no line-terminator processing. If no other site default is specified, views are created in **transparent** text mode by default. To create a view in **transparent** text mode regardless of the site default, clear the **Use interop (insert_cr) text mode** check box in the **Advanced** options of the **View Creation Wizard**, or use the **-tmode transparent** option to the **mkview** command. (Previous editions of ClearCase documentation and interfaces refer to this mode as **unix** text mode.)

  If all developers at your site use the same development platform (Windows or UNIX) or use tools that are compatible with either line-termination convention, all views should be created in **transparent** text mode.

- **insert_cr text mode.** In a view created in **insert_cr** text mode, ClearCase inserts a **<CR>** character before every **<LF>** character. To create a view in **insert_cr** text mode, select the **Use interop (insert_cr) text mode** check box in the **Advanced** options of the **View Creation Wizard** or use the **-tmode insert_cr** option to the **mkview** command. (Previous editions of ClearCase documentation and interfaces refer to this as **interop** text mode or **msdos** text mode.)

- **strip_cr text mode.** In a view created in **strip_cr** text mode, ClearCase strips the **<CR>** character from every **<CR><LF>** sequence. To create a view in **strip_cr** text mode, use the **-tmode strip_cr** options to the **mkview** command. You cannot create a view in **strip_cr** mode from the **View Creation Wizard**.

In a snapshot view created in either **insert_cr** or **strip_cr** text mode, ClearCase adds or removes the **<CR>** characters whenever it updates the view. In a dynamic view, ClearCase adds or removes the **<CR>** characters as you open and read files. For both snapshot views and dynamic views, ClearCase reverses the **<CR>** manipulation (adding or removing **<CR>** characters as appropriate) during the checkin process.

NOTE: you cannot create a view in **strip_cr** mode from any GUI.

Determining a View's Text Mode

If you do not know a view's text mode, you can find out in one of the following ways:

- In Windows Explorer, right-click a drive that represents a view. Then click **ClearCase** > **Properties of View**. The view's text mode is displayed on the **Access** tab.
- Use the **cleartool lsview** command with the **–properties –full** options.

With these methods, **transparent** text mode is displayed as `unix`, **strip_cr** text mode is displayed as `strip_cr`, and **insert_cr** text mode is displayed as `msdos`.

Choosing a Text Mode for a View

ClearCase does not enforce any policy governing access to VOBs based on a view's text mode, and a user editing a file in a view that has the "wrong" text mode configuration can cause problems for other users who need to edit that file. Most sites with both Windows and UNIX development platforms should adopt a policy that allows users of the primary development platform to create views in **transparent** text mode and that limits the use of **strip_cr** or **insert_cr** text modes to the minority of platforms that require different line-termination conventions.

If most of your users are developing software on UNIX:

- UNIX clients should use views created in **transparent** text mode.
- Windows clients should use views created in **insert_cr** text mode.

If most of your users are developing software on Windows:

- Windows clients should use views created in **transparent** text mode.
- UNIX clients should use views created in **strip_cr** text mode.

No matter what policy you adopt, it is important to maintain a consistent combination of client platform, view text mode, and VOB. If a client uses a view in an interop text mode (**strip_cr** or **insert_cr**) to access a VOB, then later begins using a view in **transparent** text mode to access the same VOB, versions created by the views in different text modes will be difficult to compare or merge.

Enabling Interop Text Mode Support in VOBs

VOBs created with ClearCase version 4.1 or later are compatible with views in any text mode. VOBs created with earlier versions of ClearCase are compatible only with views in transparent text mode until you run the **msdostext_mode** command on the VOB. Previous editions of ClearCase documentation and interfaces refer to VOBs on which **msdostext_mode** has been run as *interop-enabled* VOBs. Beginning with version 4.1, we further generalize this by saying the **msdostext_mode** enables VOBs to support access from views in either transparent or interop text modes.

If you need to enable interop text mode support in a VOB created by an earlier version of ClearCase, use the **msdostext_mode** command. Note that **msdostext_mode** does not convert or modify files in any way. It affects only the information recorded for text file versions in the VOB database.

Only the VOB owner the privileged user can run **msdostext_mode.** The command syntax is

*ccase-home-dir***/etc/utils/msdostext_mode [–d]** *vob-storage-pname*

With no options, **msdostext_mode** does the following:

- For all versions of all file elements whose element type is **text_file** or a subtype of type **text_file**, generates and stores in the VOB database the information required to support access to these versions by views created in **strip_cr** or **insert_cr** text modes.
- Turns on interop text mode support, so that this information can be recorded for newly created versions.

With the **–d** option, **msdostext_mode** disables support for interop text modes.

Determining Whether a VOB Supports Interop Text Modes

To determine whether a entire VOB supports interop text modes, use the following command on either UNIX or Windows:

cleartool dump vob:*vob-tag*

If the `flags` line in the output contains the string `pc_line_count`, the VOB supports interop text modes.

For example, to determine whether the VOB **\pc_src** supports interop text modes:

cleartool dump vob:\pc_src

If the output of this command contains a line similar to the following, the VOB supports interop text modes.

```
flags: predefined, pc_line_count, unrestricted
```

Special Procedure for MultiSite Users

ClearCase MultiSite does not replicate a VOB's text mode support characteristics. If any replica in a VOB family has been enabled for interop text mode support, all replicas in that VOB family must be individually enabled at their local sites using **msdostext_mode** as follows:

1. Synchronize all VOB replicas.
2. Lock all replicas, using this command:

   cleartool lock –nuser root vob:*pname-in-vob*
3. Run **msdostext_mode** on all replica storage directories.
4. Unlock all replicas.

Administering VOBs

8 Understanding VOBs and VOB Storage

This chapter introduces the operational details, storage layout, and data model of versioned object bases, or VOBs. The **mkvob** reference page has additional information about VOBs.

8.1 Introduction to VOBs and VOB Administration

Any ClearCase development environment requires one or more VOBs. A VOB is the principal repository for ClearCase data and metadata. VOBs are a global resource; any VOB on any host in the network can be made accessible to any ClearCase user. Data can be centralized in a few VOBs, organized into multiple components at the VOB level, or distributed across a number of VOBs in other ways. If you have purchased Rational ClearCase MultiSite, VOBs can also be replicated.

A typical VOB is created and populated with an initial collection of data by an administrator or project leader and accessed by many users. Significant administrative responsibilities associated with VOBs include the following:

- VOB creation and access control
- Importing data into a VOB from another source control system
- Backing up and recovering VOBs
- Relocating data from one VOB to another VOB
- Monitoring VOB integrity

- Moving, removing, and managing the storage used by VOBs

CAUTION: Moving a VOB is a complex procedure that requires several steps. You must follow these steps carefully or you risk losing or corrupting VOB data. See Chapter 12, *Moving VOBs*, for more information.

Rational ClearCase provides various VOB storage management tools as well as a job scheduler that can automate many routine VOB maintenance tasks. Chapter 28, *Managing Scheduled Jobs*, provides details on the job scheduler and related tools.

Types of VOBs

There are four types of VOBs. All have the same on-disk directory structure, and all have similar administrative requirements. You may not need all types at your site.

- Ordinary VOBs serve as the permanent repositories for data under ClearCase control. Most of the VOBs in a ClearCase network are ordinary VOBs. These VOBs are likely to consume more disk space and other server resources (memory, CPU cycles, and network bandwidth) than the other types of VOBs.
- Administrative VOBs allow centralized management of certain types of metadata that can be shared by other VOBs. Administrative VOBs are optional. See Chapter 16, *Using Administrative VOBs and Global Types* for more on this topic.
- UCM component VOBs, which function like ordinary VOBs but are treated by UCM as components used by a project.
- UCM project VOBs that store information about UCM artifacts such as projects, baselines, folders, and components. If your site does not use UCM, you will not need any UCM project VOBs. A UCM project VOB is the default administrative VOB for all of the UCM component VOBs that are included in the UCM projects stored in that VOB.

Access to VOB Data and Metadata

Users cannot access VOB data directly. They must access it using a view and refer to the VOB by its VOB-tag.

Views

Users access VOB data through views, which select specific versions of file and directory elements stored in the VOB and present them to a ClearCase user as part of the file system—a standard directory tree, whose top-level directory is called the *VOB root directory*. Users can also access VOB data and metadata using **cleartool** commands and ClearCase GUIs that do not need to use a view. Users cannot access VOB data directly.

Chapter 17, *Understanding Views and View Storage*, introduces views and provides more information about the relationship of views to VOBs.

Tags

ClearCase commands and utilities access a VOB by referring to its *VOB-tag*, which is a name with an associated global path that all ClearCase hosts can use to access the VOB. A VOB-tag is created whenever a VOB is created. All VOB tags are stored in the ClearCase registry, where they are accessible to all ClearCase hosts. Certain network configurations may require you to create additional tags or modify existing ones to ensure access to VOB data by all hosts.

Chapter 25, *Understanding the ClearCase Registry*, provides more information about VOB-tags and the ClearCase registry.

VOB Server Processes

Access to VOB data is managed by several server processes that run on the VOB server host:

- A **db_server** process handles requests from a single client program for access to any VOB on a VOB server host.
- One or more **vobrpc_server** processes are started for each VOB on the VOB server host. Each **vobrpc_server** process handles requests from one or more **view_server** processes.
- A **vob_server** process provides access to VOB storage pools. This process handles data-access requests from clients, forwarded to it by the **vobrpc_server**.
- A single **lockmgr** (lock manager) process manages transactions in the VOB databases of all VOBs on a VOB server host

These server processes run on the host where the VOB database directory physically resides, or on a host that is using a supported Network Attached Storage (NAS) device for VOB storage.

ClearCase Server Processes on page 10 provides additional information on these and other ClearCase server processes.

8.2 The VOB Storage Directory

Every VOB has a *VOB storage directory*. This directory can reside on the VOB server host or on a supported network attached storage device. On UNIX platforms, you can take advantage of UNIX symbolic links to create any or all of a VOB's storage pools on a remote volume.

CAUTION: A VOB storage directory and all of its contents are created and managed by ClearCase commands and services. Never use non-ClearCase commands or utilities to alter either the contents or the protection of the VOB storage directory or any of its files or subdirectories.

A VOB's directory structure is visible when you use native operating system utilities to list the VOB storage directory and its subdirectories and files, which include the following:

.pid	A one-line text file that lists the process ID of the VOB's associated **vob_server** process.
admin	A directory that contains administrative data related to the amount of disk space a VOB and its derived objects are using. Use **cleartool space –vob** to list this data.
vob_oid	A one-line text file that lists the VOB's object identified (OID) expressed as a universal unique identifier (UUID). This UUID is the same for all the replicas in a VOB family (ClearCase MultiSite). This value is also stored in the VOB's database; do not change it.
replica_uuid	A one-line text file that lists the replica UUID of this particular replica of the VOB. Different replicas created with ClearCase MultiSite have different identifiers.
.identity	On UNIX hosts, a subdirectory whose files establish the VOB's owner and group memberships. See *The .identity Directory* on page 131.
identity.sd	On Windows hosts, a binary data file that contains the security descriptor for the VOB storage directory. This security descriptor includes a Windows ACL that assigns all permissions (**full control**) to the VOB owner and also to the ClearCase administrators group (the ClearCase servers run under this user ID).
groups.sd	On Windows, security descriptors of the VOB's supplementary groups.
s	A subdirectory in which the VOB's source storage pools reside.
d	A subdirectory in which the VOB's derived object storage pools reside.
c	A subdirectory in which the VOB's cleartext storage pools reside.

db	A subdirectory containing the files that implement the VOB's embedded database. See *VOB Database* on page 129.
vob_server.conf	A text file read by the **vob_server** at startup. It contains the setting for deferred deletion of source containers; deferred deletion is activated if you have turned on semi-live backup. See the **vob_snapshot_setup** reference page for more information.
.**hostname**	A text file that records the name of the VOB's server host. This will contain either the name of the local host or, if the VOB database is stored on a Network Attached Storage device, the name of the ClearCase host on which the VOB's **vob_server** process runs.
.msadm_acls	Stores MultiSite administration server's ACL

The sections that follow discuss the subdirectories of the VOB storage directory.

VOB Storage Pools

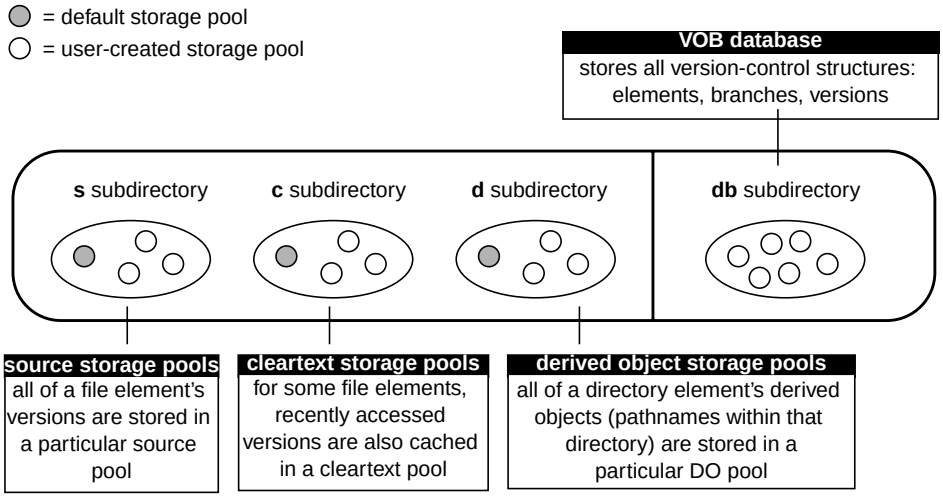
The **c**, **d**, and **s** subdirectories of the VOB storage directory contain the VOB's *storage pools*, each of which can be either an ordinary directory in the host's native file system or, on UNIX, a symbolic link to a directory on another UNIX host. The storage pools in these directories hold *data container* files, which store versions of elements and shared binaries. Depending on the *element type*, the versions of an element may be stored in separate data container files or may be combined into a single structured file that contains interleaved *deltas* (version-to-version differences).

Each VOB storage pool directory is created with a single subdirectory known as the default storage pool. There are three default pools.

s\sdft	Default source storage pool, for permanent storage of the contents of files under ClearCase control.
c\cdft	Default cleartext storage pool, for temporary storage of the **cleartext** versions currently in use (for example, reconstructed versions of **text_file** elements).
d\ddft	Default derived object storage pool, for storage of promoted/shared derived objects.

You may create additional pools as needed using the **cleartool mkpool** or **chpool** commands. Each storage pool holds data containers of one kind (Figure 3). See Chapter 11, *Administering VOB Storage*, for more on managing storage pools.

Figure 3 VOB Database and VOB Storage Pools



Source Storage Pools

Each source pool holds all the source data containers for a set of file elements. A source data container holds the contents of one or more versions of a file element. For example, a single source data container holds all the versions of an element of type **text_file**. The *type manager* program for this element type handles the task of generating individual cleartext versions from *deltas* in the data container. It also updates the source container with a new delta when a new version is checked in.

Source pools are accessed by **cleartool** commands such as **checkout** and **checkin**, as well as by any program that opens a file or directory in a dynamic view (whether or not the file or directory is checked out). If a cleartext version of the element is available, it is used. If it is not available, the request to access the file element causes the cleartext to be constructed and stored in the cleartext pool.

Cleartext Storage Pools

Each *cleartext pool* holds all the cleartext *data containers* for a set of file elements. A cleartext data container holds the contents of one version of an element. These pools are caches that accelerate access to element types (**text_file** and **compressed_text_file**) for which all versions are stored in a single data container.

For example, the first time a version of a **text_file** element is required, the **text_file_delta** type manager reconstructs the version from the element's source data container. The version is cached

as a cleartext data container—an ordinary text file—located in a cleartext storage pool. On subsequent accesses, ClearCase looks first in the cleartext pool. A cache hit eliminates the need to access a source pool, thus reducing the load on that pool; it also eliminates the need for the type manager to reconstruct the requested version.

Cache hits are not guaranteed, because cleartext storage pools are periodically *scrubbed*. (See Chapter 11, *Administering VOB Storage*.) A cache miss forces the type manager to reconstruct the version.

Derived Object Storage Pools

Each derived object storage pool holds a collection of derived object data containers. A derived object data container holds the file system data (usually binary data) of one DO, created by a ClearCase build tool (**clearmake**, for example, or **clearaudit).**

DO storage pools contain data containers only for the derived objects that have been promoted to the VOB by the **winkin** command. Each directory element is assigned to a particular DO storage pool. The first time a DO created within that directory is winked in, its data container is copied to the corresponding DO storage pool. The data containers for unshared and nonshareable derived objects reside in view-private storage.

By default, derived object pools are periodically scrubbed to remove extraneous DOs, as described in Chapter 11.

VOB Database

Each VOB has its own database, which is managed by an embedded database management system (DBMS) and implemented as a set of files in the **db** subdirectory of the VOB storage directory. The database stores several kinds of data:

- Version-control information: elements, their branch structures, and their versions
- *Metadata* associated with the file system objects: version labels, attributes, and so on
- *Event records* and *configuration records*, which document ClearCase development activities
- *Type* objects, which are involved in the implementation of both the version-control structures and the metadata
- (UCM project VOBs only) UCM objects: folders, projects, streams, activities, components, baselines, and so on

The permanent contents of files that are under ClearCase control are stored in the source pools (**.s** and its subdirectories), not in the VOB database.

The **db** directory contains these files:

vob_db.dbd	A compiled database schema, used by embedded DBMS routines for database access. The schema describes the structure of the VOB database.
vob_db_schema_version	A schema version file, used by embedded DBMS routines to verify that the compiled schema file is at the expected revision level.
vob_db.d0*n* **vob_db.k0***n*	Files in which the database's contents are stored.
vista.*	Database control files and transaction logs.
db_dumper (UNIX)	Backup copy of *ccase-home-dir***/etc/db_dumper**. **reformatvob** invokes this copy of **db_dumper** only if it cannot invoke **/usr/atria/etc/dumpers/db_dumper.***num*, where *num* is the revision level of the VOB.
db_dumper (Windows)	A copy of *ccase-home-dir***\bin\db_dumper.exe**. This is an executable program, invoked during the **reformatvob** command's dump phase. Each VOB gets its own copy of **db_dumper** so that it can always dump itself to ASCII files. (Typically, it needs to be dumped after a newer release of ClearCase has already been installed on the host; with this strategy, the *ccase-home-dir***\bin\db_dumper** program in the newer release need not know about the older VOB database format.)
vob_db.str_file	Database string file that stores long strings.

Preserved Database Subdirectories

The root directory of any VOB that has been reformatted using the **reformatvob** command may include a preserved **db** directory that contains the VOB database as it existed before the reformat. **reformatvob** does its work by creating a new VOB database. By default, it preserves the old database by renaming it. Thus, a VOB storage directory may contain old (and usually unneeded) VOB database subdirectories, with names like **db.0318**. If **reformatvob** is interrupted, it may leave a partially reformatted database with the name **db.reformat**.

The .identity Directory

On UNIX platforms, a directory named **.identity** on UNIX records the VOB's ownership and group membership information. Access to this directory is restricted to the VOB owner and **root**.

The **.identity** directory contains these files:

uid	The owner of this file is the VOB owner.
gid	The group to which this file belongs is the VOB's principal group.
group.*nn*	Each additional file (if any) indicates by its group membership an additional group on the VOB's group list. In addition, the file's name identifies the group by numeric ID (**group.30**, **group.2**, and so on).

You can use the **cleartool** subcommands **describe** and **protectvob** to, respectively, display and if necessary change the VOB ownership information recorded in **.identity** or **identity.sd**.

NOTE: On Windows platforms, similar identity information is maintained in two files, **identity.sd** and **groups.sd**, in the VOB root directory. These files contain Windows security descriptors that describe the VOB's owner, principal group, and supplementary groups.

8.3 The lost+found Directory

Each VOB storage directory includes a special directory element named **lost+found**. ClearCase uses **lost+found** to hold elements that are no longer cataloged in any directory version in the VOB. This occurs when you do any of the following:

- Create new elements, and then cancel the checkout of directory in which they were created
- Delete the last reference to an element with the **rmname** command
- Delete the last reference to an element by deleting a directory version with the **rmver**, **rmbranch**, or **rmelem** command

When an element is moved to **lost+found**, it gets a name of the form

*element_leaf_name***.***id-number*

For example:

foo.41a00000bcaa11caacd0080069021c7

The **lost+found** directory has several unique properties:

- It cannot be checked out.
- Its contents can be modified even though it is not checked out.
- No branches can be created within it.

To move an element from the **lost+found** directory to another directory within the VOB, use the **cleartool mv** command. To move an element from the **lost+found** directory to another VOB, use the **cleartool relocate** command.

To conserve disk space, periodically clean up the **lost+found** directory:

- If you need an element in **lost+found**, catalog it in a versioned directory using **cleartool mv**.
- Use **cleartool rmelem** to remove unneeded elements.

NOTE: To access the **lost+found** directory from a snapshot view, you must include the directory in the view's load rules. Once **lost+found** and its elements have been loaded into the view, you can move or remove elements as needed.

8.4 VOB Datatypes

From the user's standpoint, a VOB contains file system objects and metadata. Some metadata is stored in the form of objects; other metadata is stored as records or annotations attached to objects. This section describes VOB datatypes.

Some of these datatypes are created automatically by ClearCase commands. Others must be created explicitly by users or (more often) administrators. Users never access metadata directly. Instead, they use **cleartool describe** and various ClearCase GUIs, most of which can retrieve metadata whether or not they are run in a view context.

The VOB Object and Replica Objects

Each VOB database contains a VOB object that represents the VOB itself. The VOB object provides a handle for certain operations. For example:

- Listing event records of operations that affect the entire VOB (see the **lshistory** command). This includes creation and deletion of type objects, removal of elements, and so on.
- Placing a lock on the entire VOB (see the **lock** command).

If a VOB is replicated using ClearCase MultiSite, it also has a replica object. The replica object is created when the MultiSite **mkreplica** command is run on a VOB.

File System Objects

A VOB database keeps track of users' file system objects using the following database objects:

File element	An object with a version tree, consisting of branches and versions. Each version of a file element has file system data: a sequence of bytes. Certain element types constrain the nature of the versions' file system data; for example, versions of **text_file** elements must contain text lines, not binary data.
Directory element	An object with a version tree, consisting of branches and versions. Each version of a directory element catalogs a set of file elements, directory elements (subdirectories), and VOB symbolic links. An extra name for an element that is already entered in some other directory version is termed a VOB hard link.
VOB symbolic link	An object that contains a text string. On UNIX systems, this string is interpreted by standard commands in the same way as an operating system symbolic link.

Link Counts for UNIX File System Objects

Link counts for UNIX file system objects, which are required when accessing VOB objects in a view on a UNIX computer, are stored in the VOB database and are reported by the UNIX **ls** command as follows:

Symbolic link	1
File element	1
File version	1
Directory element	2
Directory version	2 plus number of directory elements cataloged in that version
Branch	2 plus number of subbranches (each branch appears as a subdirectory in the extended-namespace representation of an element's version tree)

This scheme satisfies two UNIX rules:

- The link count is at least 1 for an object that has a name.
- The link count of a directory is 2 + *number-of-subdirectories*.

The scheme does not satisfy the rule that the link count should be the number of names the object has in the current namespace.

Type Objects

A type object is a prototype for one or more instances of type objects stored in a VOB database. If a type object exists, a user can create an instance of it by entering the appropriate command (for example, **cleartool mklabel** to create an instance of a label type object).

A VOB can store several kinds of type objects:

Type	Mnemonic	Description
Element type	**eltype**	Instances are elements.
Branch type	**brtype**	Instances are branches.
Hyperlink type	**hltype**	Instances are VOB hyperlinks (used to connect pairs of objects).
Trigger type	**trtype**	Instances are triggers.

In addition, VOBs can store type objects that can only be used to modify instances of other type objects:

Type	Mnemonic	Description
Label type	**lbtype**	Instances are labels that can be attached to any version object.
Attribute type	**attype**	Instances are attributes (name/value pairs) that can be attached to any instance of a type object.

The mnemonic associated with each type object can be used in an object-selector prefix to **cleartool** commands like **describe**. For example, to describe a branch type named **v4_patch**, use the **brtype** mnemonic as shown here:

cleartool describe brtype:v4_patch

Instances of Type Objects

After a type object is created, users can create any number of instances of the type. Creating an instance of a type object creates a reference to the type object. For example, attaching version label **BASELEVEL_4.2** to a particular version does not make a copy of the **BASELEVEL_4.2** type object. Instead, it establishes a connection between the version object and the label type object.

This scheme makes it easy to administer type objects and their instances. For example, renaming the label type object from **BASELEVEL_4.2** to **BL4.2** renames all its existing instances.

NOTE: Creating an instance does not make a copy of the type object, but in certain cases it does create a new object. For example, the **mkbranch** command creates a new branch object and creates a reference connecting the new branch object to an existing branch type object.

Element	Each file or directory element in a VOB is created by **mkelem** or **mkdir** as an instance of an existing element type in that VOB.
Branch	Each branch in an element is created by **mkbranch** as an instance of an existing branch type in that element's VOB.
Version label	The **mklabel** command annotates a version with a version label, by creating an instance of an existing label type.
Attribute	The **mkattr** command annotates a version, branch, element, VOB symbolic link, or hyperlink with an attribute, by creating an instance of an existing attribute type. Each instance of an attribute has a particular value—a string, an integer, and so on.
Hyperlink	The **mkhlink** command creates a hyperlink object, which is an instance of an existing hyperlink type. A typical hyperlink connects two objects, in the same VOB or in different VOBs.
Trigger	The **mktrigger** command creates a trigger object, which is an instance of an existing trigger type. The trigger may be attached to one or more elements.

Predefined and User-Defined Type Objects

Each VOB is created with a set of predefined type objects. Users can create additional type objects as needed using the **cleartool mkeltype** command. The online help for **mkeltype** lists the predefined element types for the current release of ClearCase. You can also use the ClearCase Administrator Console or the **cleartool lstype** command to list the type objects defined in a given VOB.

Scope of Type Objects

Each VOB has its own set of type objects, for use in creating instances of the types in that particular VOB. ClearCase also provides a global type facility that you can use to increase the scope of a type object from a single VOB to a group of VOBs. For more information about using global types, see Chapter 16, *Using Administrative VOBs and Global Types*.

Changing an Element's Type

You can use **chtype** to convert an element from one element type to another (for example, from **file** to **text_file**). Typically, you change an element's type to change the way its versions are stored. For example, versions of a *file* element are stored in separate data containers in a VOB source pool. Converting the element to type **text_file** causes all its versions to be stored in a single data container, as a set of deltas (version-to-version differences); this saves disk space.

NOTE: All versions of an element must fit the new element type. For example, converting an element to type **text_file** fails if any of its versions contains binary data, rather than text. You cannot convert files to directories, and vice versa.

Shareable Derived Objects

A VOB's database stores information on all the shareable derived objects (DOs) created at pathnames within the VOB. For each DO, the database catalogs this information:

- The directory element, along with the location of the DO within the directory (for example, **util.o**)
- The DO's unique identifier, its DO-ID
- Shopping information for the DO

DOs are accessible only through a dynamic view.

Configuration Records

A VOB's database stores the configuration records (CRs) associated with shareable derived objects and DO versions (derived objects that have been checked in as versions of elements). Each CR documents a single target-rebuild, which typically involves execution of one build script.

Event Records

Nearly every operation that modifies the VOB creates an event record in the VOB database. See the **events_ccase** reference page for more information.

The **vob_scrubber** utility deletes unneeded event records. By default, the scheduler runs **vob_scrubber** periodically. See the **schedule** reference page for information on describing and changing scheduled jobs.

9 Setting Up VOBs

This chapter presents a procedure for setting up your network's ClearCase data repository, a set of globally accessible VOBs. These are the major steps:

- Select a host for a new VOB.
- Modify operating system resources, if necessary.
- Create one or more VOB storage locations if you want.
- Create the VOB (and, if necessary, adjust its registry and identity information, to ensure global accessibility and implement access controls).
- Coordinate the VOB with other existing VOBs.
- Populate the VOB with new or existing development data.

After VOBs are set up, they can be activated for use with dynamic views with the **cleartool mount** command (or from the VOB Admin Browser on UNIX or, on Windows, with the Rational ClearCase Explorer or Windows Explorer). Two common user mistakes users make that can make a VOB invisible to their dynamic views are forgetting to mount the VOB and forgetting to work in a view. Users of snapshot views must load the view from a VOB before they can access VOB data. Chapter 18, *Setting Up Views*, discusses the procedure for setting up views.

By default, UNIX hosts mount all public VOBs at ClearCase startup time. See the reference page for the **cleartool mount** command for details.

To arrange for a Windows host to mount a VOB each time you log on, do **one** of the following:

- Select the **Reconnect at Logon** check box in the **Mount** dialog box when you first mount the VOB.

- Use the **–persistent** option to **cleartool mount**.
- Add a **cleartool mount** command to a **.BAT** file in the Startup program group.

9.1 VOB Server Configuration Guidelines

A host on which one or more VOB storage directories reside is a *VOB host*. A typical network distributes its VOBs among several VOB hosts. Nearly any host supported by ClearCase can be a VOB host (the exceptions are Windows Me and Windows 98). Selecting and configuring an appropriate VOB host are crucial to obtaining satisfactory ClearCase performance.

NOTE: ClearCase has special requirements for the Windows domain membership of VOB hosts, view hosts, and users. See Chapter 4, *ClearCase and Windows Domains*.

The computer chosen as a VOB host must satisfy these requirements:

- **Main memory (RAM).** The minimum recommended main memory size is 128 MB or half the size of all the VOB databases the server will host, whichever is greater. To this amount, add 7 MB of memory per VOB, regardless of VOB database size, as well as 750 KB of memory for any **view_server** process that will run on the VOB host. Adequate physical memory is the most important factor in VOB performance; increasing the size of a VOB host's main memory is the easiest (and most cost-efficient) way to make VOB access faster and to increase the number of concurrent users without degrading performance. For the best performance, configure the VOB host with enough main memory to hold the entire VOB database.
- **Disk capacity**. A VOB database must fit in a single disk partition, and VOB databases tend to grow significantly as development proceeds and projects mature. We recommend a high-performance disk subsystem, one with high rotational speed, low seek times, and a capacity of at least 10 GB.

  If possible, use a RAID or similar disk subsystem that takes advantage of disk striping and mirroring. Mirrors are useful for backups, although there is a slight performance degradation associated with their use. However, striping helps overall performance and more than makes up for any degradation caused by mirroring. For more information, see *Maximize Disk Performance* on page 496.
- **Processing power.** A VOB host must have adequate CPU capacity. The definition of *adequate* in this context varies from one hardware architecture to another. With ClearCase and similar enterprise applications, server CPU capacity is a critical factor governing

performance of client operations. Make the most of the available server CPU cycles by keeping nonessential processes—including ClearCase client tools and views—off the VOB host.

- **Availability.** A VOB intended for shared access must be located in a disk partition that is accessible to all ClearCase client hosts. Wherever possible, select a host that can be accessed with the same host name by all ClearCase hosts. (A host with multiple network interfaces presents a different name through each interface.) If a VOB host has multiple names, you must create multiple *network regions*, to logically partition the network.

See also Chapter 32, *Improving VOB Host Performance*.

VOB Feature Levels

A feature level is an integer that defines the set of features that a VOB supports. Whenever a ClearCase release introduces features that require support in the VOB database, you must raise the feature level of a VOB before clients can take advantage of the new features when accessing data in that VOB. The primary purpose of feature levels is to manage VOBs that are replicated (using ClearCase MultiSite) across server machines that are not all running the same ClearCase release.

Every ClearCase release is associated with a feature level. See the *Release Notes* for Rational ClearCase and ClearCase MultiSite for information on which feature levels a release supports.

Displaying the Feature Level

To display the feature level of a replica, use the Windows explorer or ClearCase Administration Console to display the properties of the VOB. The feature level is listed on the **Custom** tab. You can also use the **cleartool** command line.

To display the feature level of a replica family, use the command **cleartool describe replica:***replica-name***@***vob-tag*. For example:

```
cleartool describe replica:tokyo@\dev
replica "tokyo"
  created 20-Aug-00.13:35:37 by John Cole (jcole@goldengate)
  replica type: unfiltered
  master replica: sanfran_hub@\dev
...
  feature level: 2
...
```

To display the feature level of a VOB family, use the command **cleartool describe vob:***vob-tag*. For example:

cleartool describe vob:/vobs/dev

```
versioned object base "/vobs/dev"
  created 15-Aug-00.14:19:03 by Susan Goechs (susan.user@minuteman)
  master replica: boston_hub@/vobs/dev
  replica name: boston_hub
  VOB family feature level: 2
...
```

NOTE: Before you set the feature level for a newly created replica, its value is recorded as unknown. For example, if you use the **describe** command to show the properties of a new replica, the output looks like this:

cleartool describe replica:sanfran_hub@/vobs/dev

```
...
  feature level: unknown
```

Changing the Feature Level

The **chflevel** command changes the feature level of a VOB. To raise the feature level of an unreplicated VOB:

1. Log on to the host that contains VOB storage directories for the VOBs you want to upgrade.
2. Issue the **chflevel** command with the **–auto** option. The command lists each VOB served by the host. It then offers to raise the feature level of each unreplicated VOB that is not already at the feature level corresponding to the release of ClearCase that is installed on the host.

When you use MultiSite, each VOB replica has a feature level, and the VOB family has a feature level. Replicas in the same family can have different feature levels. The family feature level is the feature level that is equal to or less than the lowest replica feature level found among members of the VOB family. Before you raise the feature level of a VOB family, you must raise the feature levels of all replicas in that family. For more information about feature levels and VOB replicas, see the *Administrator's Guide* for Rational ClearCase MultiSite.

VOB Schema Versions

Every VOB has a database schema version that denotes the format of the VOB database, and determines the types of data the VOB can accommodate. There are two schema versions:

- Schema version 53, which has been supported by every ClearCase release since 3.0, but is not supported by ClearCase LT
- Schema version 54, which provides better support for Windows security identifiers and is required when using ClearCase in an Active Directory environment. Schema version 54 also provides support for larger VOB database files (greater than 2 GB) on certain platforms.

All VOBs on a VOB server host must be formatted with the same schema version. When you install ClearCase server software on a host, you are prompted to select a schema version to be used by VOBs created on that host.

To change the schema version of an existing VOB to a higher-numbered schema version, use the **reformatvob** command. You cannot reformat a VOB to a lower-numbered schema version.

9.2 Planning for One or More VOBs

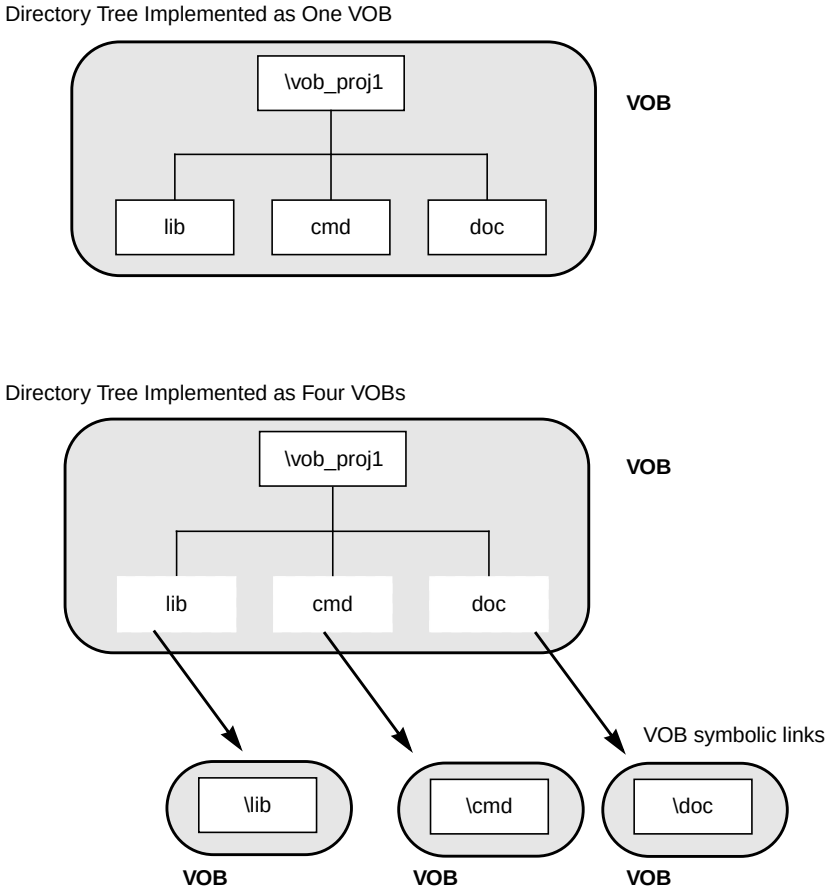
Your organization must decide how to allocate data to one or more VOBs on a VOB host. These are the principal trade-offs to consider:

- Splitting data into several small VOBs increases your flexibility. It is easy to move an entire VOB to another host. It is more difficult to split a large VOB into several new VOBs and move one or more of them to another host.
- Typically, you have fewer performance bottlenecks when you use several smaller VOBs rather than one very large VOB.
- Having fewer VOBs facilitates data backup.
- Having fewer VOBs facilitates synchronizing label, branch, and other definitions across all the VOBs. It reduces reliance on the availability of administrative VOBs and globally defined metadata types.

To users, a VOB appears to be a single directory tree. Thus, it makes sense to consider whether to organize your development artifacts into logically separate trees and create a VOB for each one. If two projects do not share source files, you may want to place the sources in different VOBs. Typically, several or all projects share some header (**.h**) files. You may want to assign these shared sources to their own VOB.

In your VOB planning, keep in mind that you can make several VOBs appear to be a single directory tree, using *VOB symbolic links* (Figure 4).

Figure 4 Linking Multiple VOBs into a Single Directory Tree



NOTE: Be sure that the text of a VOB symbolic link is a relative pathname, not a full or absolute pathname. For example, the following command creates a VOB symbolic link that makes the VOB **\vob_lib** appear as a subdirectory named **lib** in the VOB **\vob_proj1**:

cleartool ln –s ..\vob_lib lib *(..\vob_lib, not \vob_lib)*
Link created: "lib".

cleartool ls lib
```
lib --> ../lib
```

```
dir
...
12/18/94 10:23a        <DIR>        lib
...
```

Relative pathnames ensure that the link is traversed correctly in all view contexts. See the **pathnames_ccase** reference page for more on this topic.

Planning for Release VOBs

VOBs are not for source files only; you can also use them to store product releases (binaries, configuration files, bitmaps, and so on). Such VOBs tend to grow quickly; we recommend that in a multiple-architecture environment, you store releases for different platforms in separate VOBs.

9.3 Modifying a UNIX VOB Host for ClearCase

Each VOB is managed by several server processes, which run on the VOB server host. Because these servers make significant demands on system resources, server configuration is an important contributor to application performance.

UNIX Kernel Resources

You may need to adjust the following kernel resources on a UNIX VOB host:

- **Overall process table.** The operating system's process table must support 96 or more concurrent user processes. If more than three or four VOBs are to reside on the host, increase the size of the process table to at least 128.
- **Overall file descriptor table.** The size of the operating system's file descriptor table must be at least 700. If more than three or four VOBs are to reside on the host, increase the size of the file descriptor table.

You may also find it beneficial to adjust kernel resources for the VOB host after ClearCase has been up and running for some time. For more information, see *Tune Block Buffer Caches on UNIX* on page 497.

Optional Software Packages

To ensure correct ClearCase operation, you may need to install one or more optional software packages available from your hardware vendor. For more information, see the *Installation Guide* for the ClearCase Product Family.

9.4 Creating VOB Storage Locations

You may specify one or more *server storage locations* for each network region defined in your ClearCase registry. You designate whether a server storage location is to be used for VOB or view storage when you create it. VOB storage locations provide administrators with a way to designate specific hosts and disks that will be recommended to users or other administrators creating new VOBs. Although these storage locations are not the default choice for VOB-creation tools, creating and using them can simplify many VOB setup and administration tasks.VOB storage locations should be created on a disk partition that has plenty of room for VOB database growth and is accessible to all ClearCase client hosts in the region. VOB storage locations can also be created on a supported network attached storage device.

On UNIX hosts, the partition where the VOB storage location is created must be exported so that other UNIX clients can mount it. If you plan to make the VOB accessible to Windows clients using CCFS or TAS, the server will need to be configured for that purpose, as described in Chapter 6.

For Windows hosts, the directory (folder) must be shared. You can control whether a directory is shared by using the Windows **net share** command or by setting the directory's sharing properties using Windows Explorer.

NOTE: By default, newly created shares have few access restrictions. If you modify the ACL of a share that corresponds to one or more VOB or view storage directories, you must preserve full access rights for all users who need access to the VOB or view. In addition, you must grant full access to the ClearCase administrators group.

See the **mkstgloc** reference page for more on this topic.

9.5 Creating a VOB

Follow these steps to plan and create each new VOB:

1. **Log on to the VOB host**. Make sure the host meets the criteria laid out in *VOB Server Configuration Guidelines* in this chapter. If possible, log on as a user who is a member of the same primary group as all other users who will need access to the VOB.

   NOTE: The identity of the user who creates a VOB (user ID, primary group, and umask on UNIX; user ID and primary group on Windows) is used to initialize VOB access permissions. If a VOB is created by a user whose primary group is not the same as the primary group of other users who must access the VOB, you will need to edit the VOB's supplementary group list before those users can access VOB data. See also the **protect** and **protectvob** reference pages.

2. **Choose a location for the VOB storage directory**. You can use an existing server storage location, create a new server storage location, or use any other directory that has the proper characteristics for good VOB storage as described in *Creating VOB Storage Locations* on page 146.

   - **Choose a VOB-tag.** A VOB-tag is a globally unique name by which all clients can refer to a VOB. A VOB-tag should indicate what the VOB contains or is used for. VOB tags exhibit syntactic differences on UNIX and Windows hosts because they must conform to the network naming conventions of each platform.

   - On UNIX hosts, each ClearCase client mounts the VOB as a file system of type MVFS, so the VOB-tag must be the full pathname of a mountable file system, for example:

     ```
     /vobs/flex
     ```

     This pathname usually includes a local mount point (**/vobs** in the example above) and the name of a mountable file system (**/flex** in the example above). Unless there is a compelling reason to do otherwise, all clients should mount the VOB at the same local mount point.

   - On Windows hosts, each ClearCase client host uses the VOB-tag as though it were the name of a Windows directory. In a Windows network, a VOB-tag is the VOB's registered name and also its root directory. A Windows VOB-tag must have exactly one backslash (\), which must be the first character of the VOB-tag (for example, **\vob_project2)**. When activated with the **cleartool mount** command, a VOB-tag appears as a subdirectory under each view-tag visible on the dynamic-views drive (drive M by default).

3. **Create the VOB.** This example explains how to create a VOB using the **cleartool** command line. You can also create VOBs using various GUI tools on UNIX or Windows.

   The following command creates a VOB on Windows with the VOB-tag **flex** whose storage is in the directory shared as **vobstore** on a host named **pluto**, and then returns location and ownership information about the newly created VOB.

   cleartool mkvob –tag \flex \\pluto\vobstore\flex.vbs

   ```
   Host-local path: c:\vobstore\flex.vbs
   Global path: \\pluto\vobstore\flex.vbs

   VOB ownership:
     owner vobadm
     group dvt
   ```

   Whenever you create a VOB, you are prompted to enter a comment, which is stored in an event record (as the event "create versioned object base") in the new VOB's database.

   To create a Unified Change Management Project VOB, which can store UCM objects such as baselines, projects, and streams, add the **–ucmproject** option when you run **mkvob**.

   By default, VOBs are created as private VOBs. Specify **-public** on the **mkvob** command line to make a public VOB. Public VOBs can be mounted one at a time using the **cleartool mount** command, or as a group using the command **cleartool mount –all**. If you specify **-public** on the **mkvob** command line, you are prompted to enter the ClearCase registry password. This password is normally established when ClearCase is installed at a site. If you need to create or change this password, see the **rgy_passwd** reference page.

In many cases, the VOB-creation process is now complete. The following sections describe special cases and optional adjustments you may want to make to the new VOB.

NOTE: Before any user can access a new VOB on a client host, the following conditions must be met:

- The user must have a working view.
- To be accessed from a dynamic view, the VOB must be mounted.
- To be accessed from a snapshot view, appropriate elements of the VOB must be loaded into the snapshot view.

Linking a VOB to an Administrative VOB

If you want a VOB to use global types defined in an *administrative VOB*, you must link the client VOB to the administrative VOB. On Windows, if you use the VOB Creation Wizard to create the VOB, you can specify the administrative VOB at the time of VOB creation. To link a VOB to an administrative VOB after you have created the client VOB, see *Linking a Client VOB to an Administrative VOB* on page 305.

Creating a VOB on a Remote Host

UNIX users can use standard UNIX remote host access methods (telnet, for example, and the X Window System) to access a remote host for purposes of creating a VOB.

If you are using Windows and want to create a view or VOB on a remote machine, ClearCase must have access to information stored in the remote machine's registry. Remote access to the Windows Registry can be restricted by setting security on the key:

HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\SecurePipeServers\Winreg

By default, this key is not present on Windows workstations. This allows the underlying security on the individual keys to control access.

On Windows server hosts, the key is preset by default and may prevent workstations from reading the server's registry. When this is the case, if you are on a remote workstation and attempt to create views or VOBs on the server, the creation fails with the error `Invalid argument`.

To work around this problem, either remove the key or modify the security on it.

The ClearCase Doctor program, which runs as part of the installation, warns you if the registry key will prevent you from creating views or VOBs on this machine, and optionally can fix it.

Adjusting the VOB's Ownership Information

This section discusses changes that you may need to make to a new VOB's ownership information.

Access-control issues may arise when all prospective users of the VOB do not belong to the same group. (For detailed information on the topic of user identity and ClearCase access rights, see Chapter 3, *Understanding ClearCase Access Controls*.)

Case 1: One Group for All VOBs, Views, and Users

In organizations where all ClearCase users are members of the same group, all VOBs and views must also belong to the common group. A VOB or view belongs to the principal group of its creator and is fully accessible only to those users who are in the VOB creator's group.

The commands in Step #1–Step #3 on page 147 are sufficient to create a VOB in such a situation.

Case 2: Accommodating Multiple User Groups

If your organization has multiple user groups, there are special considerations when members of different groups share a VOB:

- Users can create an element only if their primary group is in the VOB's group list. If members of more than one group need to create elements, you must add the primary groups of all these users to the VOB's group list. Use the **cleartool protectvob** command.
- If members of more than one group need read access to an element, you must grant read access (and, for a directory, execute access) to **others** for that element. You must also grant read and execute access to **others** for all directories in the element's path, up to and including the VOB root directory. Use the **cleartool protect** command to change permissions for an element.
- Users cannot change an element (by checking out a version and checking in a new version), unless they belong to the element's group. The element's group does not have to be the user's primary group; it can be any group the user belongs to.

  Note that to create an element, you must be able to check out the containing directory. Thus, a user can create an element only if both of the following are true:

  - The user's primary group is in the VOB's group list.
  - Any of the user's groups is the group of the containing directory.

Ensuring Global Access to the VOB—Special Cases for UNIX

The output from the **mkvob** command (Step #3 on on page 148) includes a global (networkwide) pathname for the VOB storage directory. This pathname is derived heuristically; that is, it's an intelligent guess. Depending on the accuracy of the guess, you may have some more work to do before the VOB will be accessible to all ClearCase hosts.

Two of the most common reasons this guess can be wrong are unique to UNIX clients.

Guess Was Wrong, But Global Pathname Does Exist

There may be a global pathname that all ClearCase client hosts can use to access the VOB storage directory, but **mkvob**'s heuristically derived pathname is not the right one. These are the most common reasons:

- Use of a nonstandard automount program
- Use of a home-grown (perhaps manual) scheme for mounting file systems around the network

In this case, use the **mktag** command to correct **mkvob**'s guess. For example:

host and hpath information must be valid on the VOB host. gpath must be a valid pathname to the VOB on all hosts. pathname to the storage directory must be valid on the local host

```
cleartool mktag –replace –vob –public –tag /vobs/flex \
  –host ccsvr01
  –hpath /vobstore/flex.vbs
  –gpath /allvobs/flex.vbs
  /vobstore/flex.vbs
Vob tag registry password: <enter password>
   .
   .
```

Network Requires Multiple Global Pathnames

There may be no single global pathname for the VOB storage directory. The most common reason is that the VOB must be accessible to hosts with different operating systems (for example, UNIX and Windows) which have different conventions for global pathnames. In this case, you must partition your network into multiple *network regions*; each region must have a single global pathname to VOB storage. For background information, see Chapter 26, *Administering Regions*.

Another possible reason is that the VOB host is a UNIX computer that has multiple network interfaces, each with its own host name. Because only one VOB-tag per region can be associated with a given host storage path, a VOB that has storage on a host with multiple network interfaces must have a tag in each region where the host name is listed if clients in each region need access to the VOB.

If a host named **pluto** is in region **ccregion1**, then the **mkvob** command in Step #3 on on page 148 created the VOB-tag in that region. If **pluto** has a second network interface that uses the host name **pluto2**, you must make **pluto2** a member of a different region, and then create a VOB-tag in that region before clients in the region can access the VOB created in that step.

valid pathname –> to VOB on all hosts in network region ccregion2

```
cleartool mktag –vob –public -region ccregion2
–tag /vobs/flex
–host pluto2
–hpath /vobstore/flex.vbs
–gpath /net/pluto2/vobstore/flex.vbs
/vobstore/flex.vbs
Registry password: <enter password>
  .
  .
```

NOTE: Your **–gpath** value may need to take into account the use of a nonstandard automount program or other mounting idiosyncrasies within each network region.

This example used the same VOB-tag even though it was initially created in a different region. This is a practice that we encourage you to follow.

Enabling Setuid and Setgid Mounting of the Viewroot and VOB File Systems on UNIX Hosts

By default, the *viewroot* and VOB file systems are mounted with setUID and setGID disabled; this is the recommended configuration. However, if any hosts at your site must mount these file systems with setUID and setGID enabled (for example, if you run setUID tools from a VOB), you must configure your release area with the **site_prep** script to allow this. When ClearCase is installed on these hosts, the viewroot and VOB file systems are mounted accordingly. (Alternatively, you can run the **change_suid_mounts** script on an individual host to enable honoring of setUID programs in VOBs mounted on that host. However, this setting does not persist across installs, and you must stop and restart ClearCase on the host after running the script.) For more information, see the discussion of **site_prep** in the *Installation Guide* for the ClearCase Product Family.

Creating Remote Storage Pools on UNIX Hosts

As described in the discussion of *Creating Remote Storage Pools on UNIX Hosts* on page 214, you can take advantage of UNIX symbolic links to create remote storage pools on a UNIX VOB server host. Typically, you don't add remote storage pools to a VOB until a disk-space crisis occurs. But as you gain more experience with how your group uses ClearCase and how VOBs grow, you may want to add remote storage pools when you first create a VOB. This approach can help to postpone the disk-space crisis, perhaps even avoid it altogether.

See *Creating Remote Storage Pools on UNIX Hosts* on page 214 for the procedure. See also the **vob** reference page.

9.6 Coordinating the New VOB with Existing VOBs

A typical project involves multiple VOBs. To ensure that they all work together, you must coordinate their *type* objects: branch types, label types, and so on. For example, the following config spec can be used to create a view that selects the source versions for a previous release:

```
element * REL_3
```

For this strategy to succeed, all relevant VOBs must define version label **REL3**; that is, label type **REL3** must exist in each VOB:

- If you are using *global types*, create the label type with the **–global** option to **mklbtype**. The VOB that stores this global type becomes, by definition, an administrative VOB. Users in other VOBs then link to the administrative VOB by creating instances of the predefined hyperlink type **AdminVOB** that point to the administrative VOB. Thereafter, users in any VOB can create instances of label **REL3**.
- If you are not using global types, use **cptype** to copy type objects from one VOB to another.

9.7 Populating a VOB with Data

The new VOB is now ready to be populated with data. At this point, the VOB contains one directory element, the *VOB root directory.* (It also contains a **lost+found** directory. See the **mkvob**

reference page for a discussion of this directory.) ClearCase includes several utilities for exporting data from other configuration management systems.

Importing Data into a UCM Project

You cannot run any of the **clearimport** procedures described in this section in a UCM view. To import data into a UCM project, you must first import the data in a non-UCM view, and then follow the procedures for setting up a project described in *Managing Software Projects*.

Example: Importing RCS Data

A simple conversion scenario illustrates the migration of RCS sources to ClearCase. In this example, we use an entire UNIX RCS source tree to populate a newly created VOB. The root of the RCS tree is **/usr/libpub** on a host where the empty VOB has already been activated, at **/proj/libpub**.

Creating the Data File

1. **Go to the source data.** Change to the root directory of the existing RCS source tree:

   cd /usr/libpub

2. **Run the export utility.** Use **clearexport_rcs** to create the data file and place descriptions of RCS files (**,v** files) in it:

   clearexport_rcs

   ```
   Exporting element "./Makefile,v" ...
   Extracting element history ...
   .
   Completed.
   Exporting element ...
   Creating element ...
   Element "./Makefile" completed.
     .
     .
   Element "./lineseq.c" completed.
   Creating datafile ./cvt_data ...
   ```

   The data file, **cvt_data**, is created in the current directory.

Running clearimport

3. **Use any view. clearimport** ignores the config spec. Importing in a dynamic view improves the performance of the import operation.

4. **Go to the target VOB.** Change to the root directory of the newly created **libpub** VOB—that is, the directory specified by its *VOB-tag*:

   cd /proj/libpub

5. **Run clearimport.** Run **clearimport** on the data file, **cvt_data**, to populate the **libpub** VOB:

   clearimport /usr/libpub/cvt_data

```
Converting files from /usr/libpub to .
Created element "././Makefile" (type "text_file").
Changed protection on "././Makefile".

Making version of ././Makefile

Checked out "././Makefile" from version "/main/0".
Comment for all listed objects:
Checked in "././Makefile" version "/main/1".
  .
  .
```

   There is no need to check out or check in the VOB's root directory element; this is handled automatically. If problems cause **clearimport** to terminate prematurely, you can fix the problems and run **clearimport** again.

Example: Importing PVCS Data

A simple conversion scenario illustrates the migration of PVCS sources to ClearCase. In this example, entire Windows PVCS source tree is used to populate a newly created VOB. The PVCS tree is located at **c:\libpub**, on a host where the empty VOB has been activated, at **\vob_libpub**.

Creating the Data File

1. **Go to the source data.** Change to the directory of the existing PVCS source tree:

   `c:\>` **cd libpub**

2. **Run the export utility.** Use **clearexport_pvcs** to create the data file and place descriptions of PVCS files in it:

```
c:\libpub> clearexport_pvcs
Exporting element ".\makefile" ...
Extracting element history ...
.
Completed.
Exporting element ...
Creating element ...
Element ".\makefile" completed.
  .
  .
Element ".\lineseq.c" completed.
Creating datafile .\cvt_data ...
```

The data file, **cvt_data**, is created in the current directory.

Running the Conversion Scripts

3. **Use any view. clearimport** ignores the config spec. Importing in a dynamic view improves the performance of the import operation.

   NOTE: You cannot run **clearimport** in a UCM view.

4. **Go to the target VOB.** Change to the root directory of the newly created **\vob_libpub** VOB—that is, to the directory specified by its *VOB-tag*:

5. **Run clearimport.** Run **clearimport** on the datafile, **cvt_data**, to populate the **\vob_libpub** VOB:

   ```
   z:\vob_libpub> clearimport c:\libpub\cvt_data
   Converting files from c:\libpub to .
   Created element ".\.\makefile" (type "text_file").
   Changed protection on ".\.\makefile".

   Making version of .\.\makefile

   Checked out ".\.\makefile" from version "\main\0".
   Comment for all listed objects:
   Checked in ".\.\makefile" version "\main\1".
     .
     .
   ```

   There is no need to check out or check in the VOB's root directory element; this is handled automatically. If problems cause **clearimport** to terminate prematurely, you can fix the problems and run **clearimport** again.

For more information on the ClearCase exporters and importer, see the **clearexport_ccase**, **clearexport_pvcs**, **clearexport_rcs**, **clearexport_sccs**, **clearexport_ssafe**, **clearexport_cvs**, **clearimport** and **clearfsimport** reference pages.

9.8 Converting a SourceSafe Configuration

This section uses a sample configuration to show how to use the **clearexport_ssafe** and **clearimport** utilities to migrate a set of source files from the SourceSafe configuration management tool to ClearCase control. This section describes the sample SourceSafe configuration, shows how to convert it to a ClearCase configuration, and examines how the conversion process treats various SourceSafe features.

This example assumes that you have created and mounted a VOB named **\payroll** to hold the imported data.

Overview of Payroll Configuration

The sample payroll configuration contains source files used to build a payroll application.

Figure 5 Sample SourceSafe Payroll Configuration

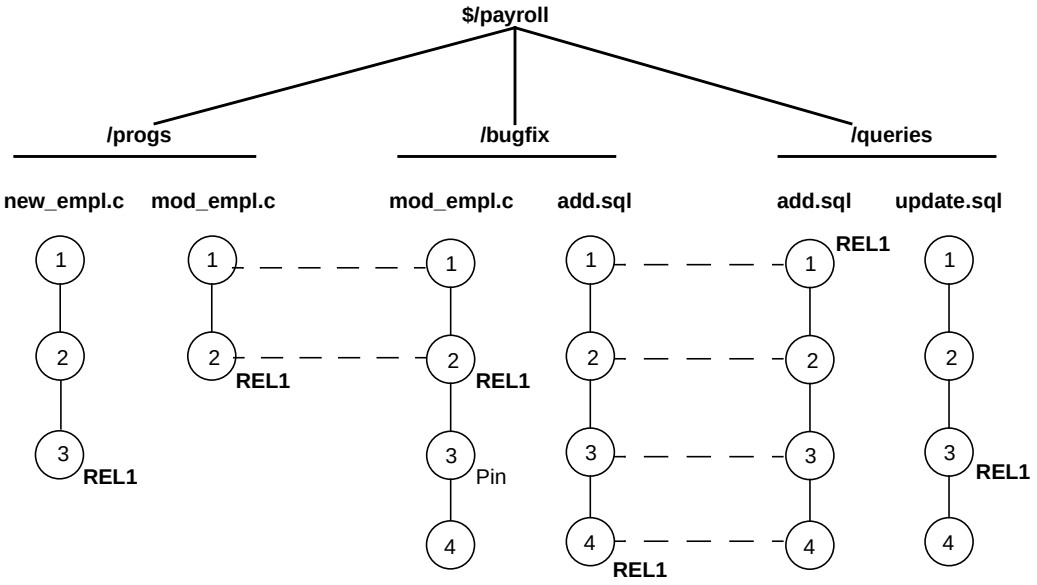


Figure 5 shows the configuration hierarchy in SourceSafe, which consists of these projects:

- **$/payroll** project
- **/progs** subproject for storing C programs
- **/bugfix** subproject where developers store source files while fixing bugs
- **/queries** subproject for storing SQL database access files

The payroll configuration contains the following objects: shares, branches, labels, and pins. **clearexport_ssafe** recognizes and handles some of them during the export phase of the conversion process.

Shares

In SourceSafe, shares are similar to hard links. In the example, the **$/payroll/bugfix/add.sql** and **$/payroll/queries/add.sql** files are SourceSafe shares. In SourceSafe, any changes that you make to one of these shares appears in the other file.

Branches

In SourceSafe, you must create a share before you can create a branch. The **$payroll/progs/mod_empl.c** and **$payroll/bugfix/mod_empl.c** files are shared for versions 1 and 2. At version 3, the **$payroll/bugfix/mod_empl.c** file forms its own branch.

Labels

Labels identify a particular version or a project. The Payroll configuration uses the **REL1** label to identify the versions of source files used to build the first release of the Payroll application.

Pins

By default, SourceSafe uses the latest version of files. Pins allow you to direct SourceSafe to use a version other than the latest. In the Payroll configuration, version three of **$payroll/bugfix/mod_empl.c** is pinned.

Setting Your Environment

Before you start the conversion process, make sure that certain environment variables and your SourceSafe current project are set correctly.

Setting Environment Variables

Verify that the PATH environment variable includes the location of the SourceSafe executable file, **ss.exe** in SourceSafe Version 5.0, and the **ssafeget.bat** batch file. For example, if **ss.exe** is in **C:\ss5.0\win32**, and **ssafeget.bat** is in **C:\atria\bin**, set the PATH environment variable, as follows:

```
set path=c:\ss5.0\win32;c:\atria\bin;%PATH%
```

Set the TMP environment variable to a location where **clearimport** can safely store temporary files. For example:

```
set TMP=c:\temp
```

Setting Your SourceSafe Current Project

The **clearexport_ssafe** utility exports data for files and directories in your SourceSafe current project. Before running **clearexport_ssafe**, verify that your SourceSafe current project is set so that **clearexport_ssafe** exports the desired files and directories. For example:

ss cp
```
Current Project is $/payroll/bugfix
```

ss cp ..
```
Current Project is $/payroll
```

ss dir
```
$/payroll
$bugfix
$progs
$queries
3 item(s)
```

Running clearexport_ssafe

The **clearexport_ssafe** utility reads the files and subprojects in your SourceSafe current project and generates a data file, which **clearimport** uses to create equivalent ClearCase elements. By default, **clearexport_ssafe** names the data file **cvt_data** and stores it in your current working directory. You can specify a different name and storage location for the data file by using the **–o** option.

Using the Recursive Option

By default **clearexport_ssafe** exports the files and subprojects in the SourceSafe current project, but it does not export any files contained in subprojects. For example, with the SourceSafe current project set to **$/payroll**, **clearexport_ssafe** exports subprojects **/progs**, **/bugfix**, and **/queries** but does not export any of the files in those subprojects. To export all files in all subprojects, specify the **–r** option.

Example

In the following example, the SourceSafe current project is **$/payroll**. Because the command line specifies the **–r** option, **clearexport_ssafe** exports all files in the **/progs**, **/bugfix**, and **/queries** subprojects. The **–o** option directs **clearexport_ssafe** to store the output in a data file named **paycvt** in the **c:\datafiles** directory.

ss cd

```
Current project is $/payroll
```

clearexport_ssafe –r –o c:\datafiles\paycvt

```
VOB directory element “.”.
VOB directory element “bugfix”.
Converting element “bugfix\add.sql” ...
Extracting element history ...
....
Completed.
Converting element ...
Creating element ...
Element “bugfix/add.sql” completed.
Converting element “bugfix\mod_empl.c;3” ...
Extracting element history ...
...
Completed.
Converting element ...
Creating element ...
Element “bugfix/mod_empl.c” completed.
VOB directory element “progs”.
Converting element “progs\mod_empl.c” ...
Extracting element history ...
...
Completed.
Converting element ...
Creating element ...
Element “progs/mod_empl.c” completed.
Converting element “progs\new_empl.c” ...
Extracting element history ...
...
Completed.
Converting element ...
Creating element ...
Element “progs/new_empl.c” completed.
```

```
VOB directory element “queries”.
Converting element “queries\add.sql” ...
Extracting element history ...
...
Completed.
Converting element ...
Element “queries/add.sql” completed.
Converting element “queries\update.sql” ...
Extracting element history ...
...
Completed.
Converting element ...
Creating element ...
Element “queries/update.sql” completed.
Creating script file c:\datafiles\paycvt ...
```

Running clearimport

Use any view. **clearimport** ignores the config spec. Importing in a dynamic view improves the performance of the import operation.

NOTE: You cannot run **clearimport** in a UCM view.

Set your working directory to the VOB directory in which you plan to import the configuration. You can run **clearimport** from a location other than the VOB directory by specifying the VOB directory with the **–d** option. You must specify the pathname of the data file created by **clearexport_ssafe**.

clearimport c:\datafiles\paycvt

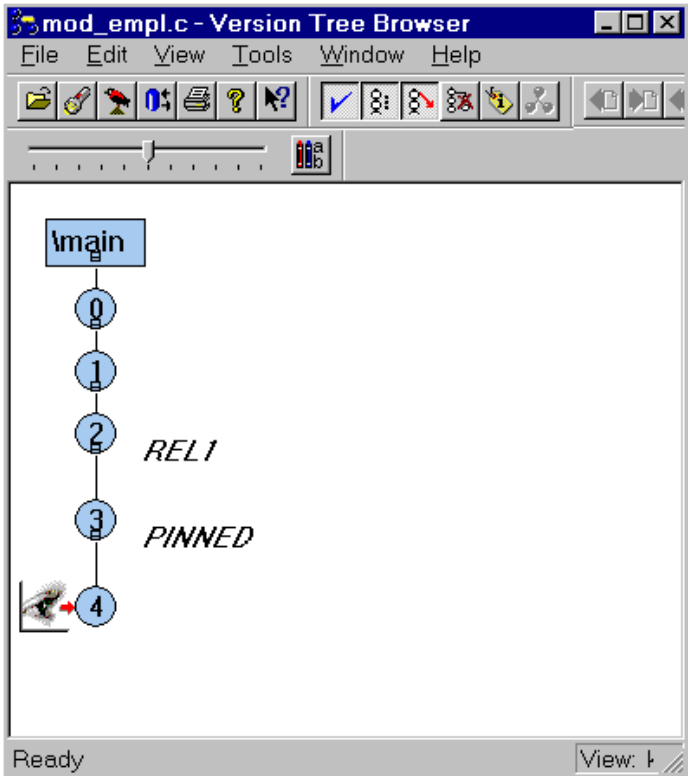
```
Validating label types.
Validating directories and symbolic links.
Validating elements.
Creating element “.\bugfix/add.sql”.
     version “1”
     version “2”
     version “3”
     version “4”
Creating element “.\bugfix/mod_empl.c”.
     version “1”
     version “2”
     version “3”
     version “4”
Creating element “.\progs/mod_empl.c”.
```

```
     version “1”
     version “2”
Creating element “.\progs/new_empl.c”.
     version “1”
     version “2”
     version “3”
Creating element “.\queries/add.sql”.
     version “1”
     version “2”
     version “3”
     version “4”
Creating element “.\queries/update.sql”.
     version “1”
     version “2”
     version “3”
     version “4”
Closing directories.
```

Examining the Results

After **clearimport** finishes populating the VOB, examine the version trees of the new ClearCase elements to verify that **clearexport_ssafe** and **clearimport** converted the SourceSafe configuration as you expected. In Windows Explorer, open the VOB folder and select an element. Then, click **File** > **ClearCase** > **Version Tree**. Figure 6 shows the version tree for the **\bugfix\mod_empl.c** element.

Figure 6 ClearCase Version Tree of \bugfix\mod_empl.c Element



Version Numbers

As it does with all elements, ClearCase adds a version 0 as a placeholder at the start of the version tree.

Labels

The conversion process maps SourceSafe labels directly to ClearCase labels, so version 2 of **mod_empl.c** has the **REL1** label as it does in the SourceSafe configuration.

Branches

In the SourceSafe Payroll configuration, at version 3, the **$payroll/bugfix/mod_empl.c** file forms its own branch. **clearexport_ssafe** does not convert SourceSafe branches to ClearCase branches. Instead, **clearexport_ssafe** creates separate elements. In this case, it creates versions 1 and 2 of the **mod_empl.c** element in the **\progs** directory, and versions 1 through 4 of **mod_empl.c** in the **\bugfix** directory.

Pins

ClearCase does not have a feature equivalent to a SourceSafe pin. Sometimes, pins perform the same function as labels; therefore, the conversion process maps pins to labels. In the SourceSafe Payroll configuration, version 3 of **mod_empl.c** is pinned. The conversion process applies a label with the name **PINNED**.

Shares

ClearCase does not have a feature equivalent to a SourceSafe share. **clearexport_ssafe** does not preserve shares as hard links during conversion. Instead, shares become separate elements.

10 Backing Up and Restoring VOBs

The most important maintenance task for a ClearCase administrator is to ensure frequent, reliable backups of essential ClearCase data. To ensure the integrity of your VOB backups, follow closely the instructions and guidelines in this chapter.

This chapter describes these operations:

- Backing up VOBs
- Restoring VOBs
- Synchronizing VOBs and views after restoring a VOB.

For information on backing up views, see *Backing Up a View* on page 229.

10.1 Choosing Backup Tools

Rational ClearCase does not include any backup tools. All ClearCase data is stored in standard files, within standard directory trees; thus, you can use any backup tools available to you that can handle the special needs of VOB backup and recovery. Because file-system conventions and backup tools for UNIX and Windows differ, keep platform-specific considerations in mind when choosing a VOB backup tool.

UNIX Backup Issues

On some systems (HP-UX and Solaris, for example), **tar** resets file access times, which can disrupt DO and cleartext storage pool scrubbing patterns. For example, the **scrubber** utility, by default,

scrubs cleartext files that have not been accessed in more than 96 hours. A nightly **tar** operation that backs up cleartext pools and resets cleartext file access times will prevent the pools from ever being scrubbed.

On UNIX hosts, VOBs can be created with remote storage pools. If you are backing up a VOB with remote storage pools, it is important to back up these pools as well.

The standard UNIX utility **cpio(1)** is well suited to backing up ClearCase data.

Windows Backup Issues

On Windows, VOB backup programs must be able to handle the file system protection and file locking issues unique to that platform. In particular:

- It must preserve the protections of the VOB storage directory so that they can be restored correctly when the backup is recovered.
- If possible, it should be able to copy files even when they open for writing.

Common Windows backup utilities do not back up files that are open for writing. Unless you have stopped ClearCase on the VOB server host, several VOB database files remain open for writing even when the VOB is locked. If a backup operation skips these files, the backup will be useless. To avoid this problem, do one of the following:

- Purchase and configure backup software that can back up files that are open for writing.
- Stop ClearCase before performing the backup. The VOB will be inaccessible while ClearCase is stopped. You may be able to decrease the length of time the VOB is inaccessible by copying the VOB storage directory to another on-disk location, re-starting ClearCase, and then backing up the copy

NOTE: Utilities such as **ccopy** (a ClearCase utility) and **scopy** (from the Windows NT Resource Kit) do not back up files that are open for writing.

10.2 Backing Up a VOB

Because of operating system differences, VOB backup operations are handled differently on UNIX and Windows. All VOB backup operations begin with locking the VOB. This step is critical to the integrity of any VOB backup.

Backing Up a VOB on UNIX

A VOB backup on UNIX can be summarized as follows:

1. Lock the VOB.
2. Back up the VOB storage directory.
3. Unlock the VOB.

By default, a VOB storage directory is wholly contained in a single directory tree, which resides in a single disk partition. If you use a file-oriented backup tool, you specify only the VOB storage directory to ensure a complete backup. If you use a disk-partition-oriented backup tool, you specify only the partition name. (Remote storage pools complicate the picture. See *Backing Up a UNIX VOB with Remote Storage Pools* on page 176.)

Backing Up a VOB on Windows

VOB storage on Windows is wholly contained in a single directory tree, which simplifies the backup process. A VOB backup on Windows can be summarized as follows:

1. If your backup software can be configured to capture files that are open for write access:
   a. Lock the VOB
   b. Back up the VOB storage directory.
   c. Unlock the VOB.
2. If your backup software cannot process files that are open for write access, you must stop ClearCase on the VOB host, back up the VOB storage directory, restart ClearCase, and unlock the VOB.

WARNING: Many Windows backup utilities do not back up files that are open for writing. Because the VOB database files are typically in this state while ClearCase is running, *even when the VOB is locked*, your backup operation skips these files unless you stop ClearCase before performing the backup. Unless your backup software can capture files open for write access, *you must stop ClearCase on the VOB host before performing a backup.* To stop ClearCase, use the ClearCase program in Control Panel.

Choosing Between Standard and Semi-Live Backup

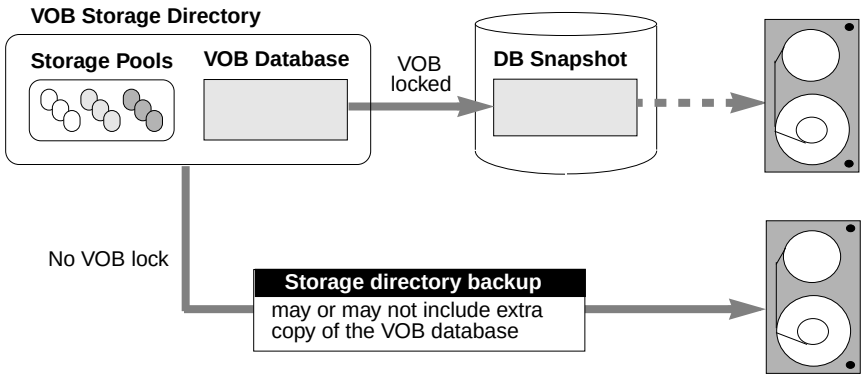
The standard backup procedure is to lock the VOB and back up the entire VOB—VOB database, plus VOB storage pools and various other files in the VOB storage directory. The VOB must remain locked for the duration of the backup. Keeping VOB database and storage pools synchronized on backup media is desirable; the standard backup procedure is recommended for all sites that can accept the duration of required locks. Note that ClearCase build programs are designed to cope with locked VOBs. They will "sleep" when they are unable to open an object in a locked VOB, and then retry as described on the **clearmake** reference page.

As illustrated in Figure 7, semi-live backup involves backing up the two major pieces of a VOB separately, as follows:

- **VOB database.** Configure the VOB to have the **vob_snapshot** utility periodically lock the VOB and copy the VOB database to another location on disk (from which it can be backed up as part of the site's normal backup process).
- **VOB storage pools.** Back up the VOB storage directory routinely, without locking the VOB. The backed up VOB storage directory may include a copy of the VOB database. However, because it is backed up while the VOB is unlocked, this database is useless and is discarded when the VOB is restored.

  If your UNIX VOB servers have remote storage pools, you must back the pools up as well.

Figure 7 Semi-Live Backup



Benefits of Semi-Live Backup

- **VOB lock time reduced.** The VOB storage directory can be backed up unlocked. The **vob_snapshot** utility locks the VOB, copies the VOB database to another disk location, and unlocks the VOB.

Costs of Semi-Live Backup

- **More disk space is required.** A second copy of the VOB database must be captured to disk. In addition, each of the VOB's source pool data containers, when replaced by a container with new version data, is retained for an additional 30 minutes to guarantee that source containers can be reconstructed when **checkvob** resynchronizes the VOB database and the storage pools at VOB restore time.

- **The VOB restore procedure is more complex.** The VOB storage pools and the VOB database have different reference times. VOB database and storage pools must be resynchronized when you restore the VOB. In particular, DO and version data added or removed in the interval between the database snapshot and storage pool backup cause database or pool skew that must be resolved. The **vob_restore** utility runs the **checkvob** utility to do this work.

- **Some data may be lost at VOB restore time.** If the restored pools are older than the restored VOB database, data missing from the pools is lost (as expected). If the restored pool backup is newer than the database, pool version data newer than the snapshot is not added to the restored database. See also *vob_restore: Restoring with a Database Snapshot* on page 193.

Enabling Semi-Live Backup

To enable database snapshots, run **vob_snapshot_setup** on a VOB. This command causes the ClearCase scheduler to run **vob_snapshot** periodically on the VOB (daily, by default). The **vob_snapshot** and **vob_snapshot_setup** reference pages explain these operations. Consult them if you choose to use semi-live backup.

The backup procedures that follow accommodate (but do not require) snapshot-enabled VOBs. However, their focus is the standard backup approach, which requires the VOB to be locked for long enough to back up the database and all the pools. The **vob_restore** procedure applies equally to VOBs with and without database snapshots.

NOTE: The commands used in the following sections do not require a ClearCase view context or mounted VOBs.

Deferred Source Container Deletion

Deferred deletion is enabled by the **vob_snapshot_setup** program. It ensures that the source pool will contain all needed containers when a backup program archives an active VOB. When a container is replaced by new version data (for example, during a checkin), the new container is created and the client requests the **vob_server** to remove the old container. If deferred deletion is deactivated, the container is immediately removed. If deferred deletion is enabled, the old container is added to a list of pending deletions, and it is removed in 30 minutes. Keeping source data containers for 30 minutes increases disk space requirements. The increase can be substantial during any 30-minute interval of heavy VOB checkin activity.

On UNIX platforms, you can execute the **kill –HUP** command on the **vob_server** process to send deferred deletion statistics to the **vob_server** log (see also **getlog** and **getlog –gr**).

When **checkvob** examines source pools, it reports containers on the deferred deletion list.

The deferred deletion list is written every five minutes to the file **delete_list.db** in the VOB storage directory.

Determining a VOB's Location

To determine the location of a VOB storage directory, use the ClearCase Administration Console or the cleartool **lsvob** command. If your backup program runs locally, it probably uses the `VOB server access path`. If your backup program runs over the network, it probably uses the `Global path`.

cleartool lsvob –long \vob_flex

```
Tag: \flex
  Global path: \\ccsvr01\vobstore\vob_flex.vbs
  .
  .
  Region: uno
 .
 .
VOB on host: ccsvr01
VOB server access path: c:\vobstore\vob_flex.vbs
```

Specify the appropriate pathname to your backup program.

NOTE: Some UNIX utilities that back up entire disk partitions require you to specify the disk partition where the VOB storage directory resides.

Ensuring a Consistent Backup

A backup represents a self-consistent snapshot of a VOB storage directory's contents only if the VOB is not modified while the backup program is working. That's why it is essential to lock the VOB before backing it up and unlock it after the backup completes.

WARNING: Regardless of your chosen backup strategy (see *Choosing Between Standard and Semi-Live Backup* on page 170), you must lock the VOB against all users. Use the ClearCase Administration Console, the UNIX **clearvobadmin** GUI, or the Windows Explorer shortcut menu to lock the VOB. If you use the **cleartool lock** command, do not use the **–nusers** option. The lock is mandatory. It is not sufficient to capture a VOB that happens to be idle. The lock does more than ensure that no one modifies the VOB. It also causes the VOB to flush a database checkpoint to disk before backup. A VOB lock applied with the **–nusers** option does not perform the required database checkpoint.

Locking and Unlocking a VOB

You must be a privileged user to lock or unlock a VOB. There are several GUIs that support VOB locking, as well as two **cleartool** commands.

You can lock or unlock a VOB on any UNIX or Windows host from the ClearCase Administration Console:

1. Navigate to the VOB storage node for the VOB. This is a subnode of the host node for the host where the VOB storage directory resides.

2. Click **Action** > **Properties**. In the **Properties of VOB** dialog box, click the **Lock** tab.

From a Windows host, you can lock or unlock a VOB using the Windows Explorer shortcut menu for the VOB. Click **ClearCase** > **Properties of VOB** and click the **Lock** tab.

On UNIX, you can use the VOB Admin Browser (**clearvobadmin**). Click **VOB** > **Lock** or **VOB** > **Unlock**. (The **–nusers** option has no analog in the VOB Admin Browser.)

On the command line, use **cleartool lock** and **unlock**:

cleartool lock vob:/vobs/flex
```
Locked versioned object base "/net/pluto/vobstore/flex.vbs".
```

<perform backup>

cleartool unlock vob:/vobs/flex
```
Unlocked versioned object base "/net/pluto/vobstore/flex.vbs".
```

Partial Backups

If you use a file-oriented backup program, you may want to exclude some subdirectories within the VOB storage directory to save time. Use the guidelines in Table 8 to determine the relative importance of the various directories.

Table 8 Importance of VOB Directories in Partial Backups

VOB Directory	Importance for Backup
Top-level VOB storage directory	Required
VOB database subdirectory	Required
Source storage pools	Required
Derived object storage pools	Important, but not required
Cleartext storage pools	Optional
Administrative directory	Important, but not required

DO Pool Backup

Backing up derived object storage pools is not required because, by definition, DOs can be rebuilt from sources. The importance of backing up these pools may change over time:

- In the early stages of a project, when the source base is changing rapidly, the useful life of most derived objects is very short. Omitting DO storage pools from a backup regimen at this stage should not cause a problem.
- When a project is relatively stable, a VOB's DO storage pools contain many often-reused objects. At this stage, a complete build of a software system may *wink in* virtually all DOs, rather than building them. Loss of a DO storage pool may increase the time required for such a complete system build by an order of magnitude.

Before choosing not to back up DO pools, make sure that you and your development staff can accept the time it may take to rebuild these DOs, which can be very long.

If you do not back up DO pools, include each pool's roots in the backup—the pool's root directory (**d\ddft**, for example) and **pool_id** file, but not its subdirectories. Doing so prevents pool root check failure at restore time (see also *Pool Root Check Failure* on page 279).

WARNING: A shared derived object has two parts: an object in the VOB database and a data container in a DO storage pool. Losing DO data containers (for example, by failing to back them up) throws the VOB's database out of sync with its DO storage pools. To resynchronize, you must delete all the empty DOs from the VOB database, using **cleartool rmdo** and/or **checkvob**. See also *VOB and View Resynchronization* on page 200.

Cleartext Pool Backup

Backing up cleartext storage pools is not important, because they are caches that enhance performance. Type managers re-create cleartext data containers as necessary.

If you do not back up cleartext pools, include each pool's roots in the backup—the pool's root directory (**c\cdft**, for example) and **pool_id** file, but not its subdirectories. Doing so prevents pool root check failure at restore time (see also *Database or Storage Pool Inconsistencies* on page 253) and possible cleartext construction errors in the restored VOB.

Administrative Directory Backup

The **admin** directory contains data on how much disk space has been used by the VOB and its derived objects. The ClearCase scheduler runs periodic jobs that collect data on disk space use and store it in the **admin** directory. By default, the scheduler stores data for the previous 30 days.

This historical data cannot be re-created. If the data is important to you, back up the **admin** directory.

Incremental Backups of a VOB Storage Directory

Using a base-plus-incremental scheme to restore a VOB storage directory typically restores too much data. Depending on your particular VOB and disk, this data may fill up the disk.

ClearCase stores version data in *delta* format (for example, the container of a **text_file** element). Instead of modifying an existing data container when a new version of an element is checked in, ClearCase creates a new container at a different pathname within the source storage pool. (It then deletes the old container.)

An example demonstrates how this storage strategy works with an incremental backup scheme. Suppose that one or more new versions of a particular element are created each day for a week. Each day's incremental backup picks up a different source data container for that element. If a crash occurs on the VOB server host at the end of the week, restoring the VOB places all those source data containers in the source storage pool, even though only one of them (the most recent) corresponds to the current state of the VOB database. Also, **checkvob** reports large numbers of unreferenced data containers when it runs at VOB restore time. (See the **checkvob** reference page for details.)

Given this situation, we recommend that you perform only a few incremental backups on a VOB storage directory before the next full backup. This practice minimizes the extra data involved in a base-plus-incremental restoration of the VOB. Run **checkvob** to detect and clean up the extra *debris* containers.

10.3 Backing Up a UNIX VOB with Remote Storage Pools

If a VOB has remote storage pools, its on-disk storage is probably not wholly contained within a single disk partition. It is quite likely that the storage is distributed among two or more hosts. Here is the procedure for this situation:

1. Lock the VOB.
2. Back up the VOB storage directory.
3. Back up some or all of the VOB's storage pools.

Use the **lspool** command in any view to determine which storage pools are remote, and their actual locations:

cleartool lspool –invob vob:/vobs/flex

```
13-Jan.16:58   vobadm     pool "cdft"
  "Predefined pool used to store cleartext versions."
26-Jan.22:02   vobadm     pool "cltxt01"
  "remote cleartext storage pool for 'flex' VOB"
13-Jan.16:58   vobadm     pool "ddft"
  "Predefined pool used to store derived objects."
13-Jan.16:58   vobadm     pool "sdft"
  "Predefined pool used to store versions."
```

In this example, there is one remote pool, **cltxt01**. If you are not sure which storage pools are remote, enter the **lspool –long** command to list the pool storage global pathname of every pool. Examine these pathnames to determine which ones specify remote locations:

cleartool lspool –long –invob vob:/vobs/flex

```
pool "cltxt01"
     .
     .
  pool storage global pathname
   "/vobstore/flex.vbs/c/cltxt01"
     .
     .
```

4. Unlock the VOB.

10.4 Restoring a VOB from Backup with vob_restore

Given a complete and consistent VOB storage backup, **vob_restore** can accommodate a variety of restore scenarios. You can use **vob_restore** with or without a VOB snapshot. Any valid VOB backup (as defined in section 10.2 and 10.3) will work. **vob_restore** handles all of the following subtasks:

- Stops and restarts ClearCase
- Updates the ClearCase VOB registry
- Merges the VOB database snapshot and VOB storage directory
- Copies the temporary storage directory to the target location
- Runs **checkvob** to resynchronize the VOB database and storage pools

NOTE: You cannot use **vob_restore** to restore a VOB that is located on a Network Attached Storage device.

Before examining alternative restore scenarios, it is useful to summarize the restoration procedure. We recommend that you do not retrieve VOB storage from backup media until **vob_restore** prompts you to do so in Step #3.

1. **Log on to the VOB host.** Log on as a user with permission to stop and start ClearCase—typically the **root** user on UNIX or a local administrator on Windows.

2. **Check available disk space**. If you are not restoring the VOB to the same location, make sure that there is enough free space in the VOB's disk partition to load the backup copy into a temporary storage location. To do so, use the VOB storage node in the ClearCase Administration Console or the **cleartool space** command.

   ```
   # cleartool space /vobstore/flex.vbs
     Use(Mb)  %Use  Directory
        27.0    2%  VOB database /net/pluto/vobstore/flex.vbs
        33.0    3%  cleartext pool /net/pluto/vobstore/flex.vbs/c/cdft
      .
      .
   ------------------------------------------------------------------------
      312.9   28%  Subtotal
      828.4   74%  Filesystem /net/pluto/vobstore (capacity 1115.1 Mb)
   ```

   If the available space is insufficient, delete the VOB storage directory or use other means to make enough space available.

3. **Run vob_restore.** Exit any current working view and run a command like this one:

   vob_restore /vobs/flex *(the VOB-tag is the only argument)*

   When prompted, supply the information required by **vob_restore**—target directory for VOB restoration, location of database snapshot (if any), and so on.

   NOTE: On Windows, you must use UNC names (*host**share**rest-of-path*) for all path information you supply to **vob_restore**.

   For more information on **vob_restore** operations, refer to these sections:

   - *vob_restore: Sample Session* on page 179
   - *vob_restore: Restoration Scenarios* on page 188
   - *vob_restore: Restoring with a Database Snapshot* on page 193

4. (If necessary) **Re-create additional VOB-tags.** When it re-registers the VOB, **vob_restore** creates or re-creates a VOB-tag for the current network region. If the VOB had tags in multiple regions, use the *vob-stg-dir***/../register_save**_*tagleaf* file to re-create the remaining tags. (**vob_restore** runs **cleartool lsvob –region * –long –storage** *registered-stg-location* and saves its output in the **register_save** file.)

   If your site registers the VOB in another registry (not in another region, but in a second registry, served by a second registry host), you must go to a host served by the second registry host and re-register the VOB manually.

5. **If the VOB is replicated, run the MultiSite restorereplica command.** It is critical to perform this processing while the VOB is still locked.

6. **While the VOB is still locked, run some consistency checks.** Activate the VOB on a single host with **cleartool mount** and confirm that it is intact by checking event history on various components, examining recently changed elements, and so on.

7. **Unlock the restored VOB**. **vob_restore** always leaves the VOB locked when it exits.

   ```
   # cleartool unlock vob:/vobs/flex
   Unlocked versioned object base "/vobstore/flex.vbs".
   ```

8. **Mount the restored VOB on all hosts.** The restored VOB is now ready to use. Have users remount the VOB on their workstations, using **cleartool mount**.

9. **If necessary, resynchronize the VOB and views.** See *VOB and View Resynchronization* on page 200.

vob_restore: Sample Session

The sample session presented here restores VOB **\vob_src**. To complete the recovery, **checkvob** is run to find and fix inconsistencies between the restored VOB database and the restored VOB storage pools.

Additional details about this scenario:

- The VOB is being restored to its current location (**\\io\vobstore\vob_src.vbs)**. This is the in-place scenario, which is the most common.
- The data currently in the VOB is invalid, so there is no need to maintain read-only access to the VOB during the restore operation.

- A database snapshot for this VOB, **\\io\e\vob_snaps\src**, is used.
- The administrator is logged on as *Administrator* on the VOB host, **io**.
- As is recommended, the restored data is not retrieved from backup media before running **vob_restore**.

To start the process, run the **vob_restore** command.

*ccase-home-dir***etc\vob_restore \vob_src**

```
This utility helps recover a damaged VOB or replica from backup. It will first
prompt you for the information it needs to perform its job. Then, it will
describe the 'restore scenario' it believes you have in mind, based on the
information you have supplied. You will then be asked various questions as the
script proceeds through the restoration process. Some prompts ask for more
information, others simply request verification for the next step. Each prompt
includes a list of valid responses and the default, where appropriate.

At many prompts, a possible response is the string 'quit'. If you choose to
quit at one of these prompts, a '-restart <pathname>' string will be displayed
as the script exits. Save this output and supply it as a command line option
to vob_restore (before the VOB-tag argument) when you want to resume the
interrupted restore operation on the same VOB or replica. If you choose to
quit at any point, DO NOT in any way alter the state of the VOB or replica
before restarting the restore operation.

Valid responses are (quit,<RETURN> to continue)
There is no default response: <RETURN>
```

Target Prompt

vob_restore prompts for a target destination for the reassembled VOB storage directory.

```
Specify the full path for target storage directory to contain the VOB or
VOB replica. The default is the currently registered local path:
    \\io\vobstore\vob_src.vbs
Type a full pathname, "help", or "quit": <RETURN>
```

Pressing RETURN restores the VOB to its current, registered location. Supplying a different pathname moves the VOB. The pathname supplied here must be on the local host.

Storage Directory Prompt

Next, **vob_restore** prompts for the location of the storage directory backup, which may or may not be retrieved at this point.

```
Please specify the full path for the VOB or replica storage that was
either restored from backup media or will be during this restoration
process.
Valid responses are (Full path, quit or help)
There is no default response: \\io\vobstore\vob_src.vbs
```

This response indicates that the retrieved backup storage directory is already in, or will be loaded into (recommended), the currently registered storage location, overwriting the existing storage directory.

Snapshot Prompt

vob_restore prompts for the location of the VOB database snapshot, if any. If you are not using a semi-live backup strategy for this VOB, press RETURN.

```
If a merge of a snapped database with this retrieved backup data is
desired, please specify the full pathname of the snapped database.
(Full path, help, quit): \\io\e\vob_snaps\src
```

Backup-Loaded Prompt

vob_restore prompts you to specify whether the backup has been loaded.

```
Is the data currently contained in the directory
  \\io\vobstore\vob_src.vbs
the data restored from backup media?
Valid responses are (yes,no,help)
The default is no: no<RETURN>
```

This response confirms that the VOB storage directory is not yet retrieved from backup media.

Sample VOB Restoration Scenario

At this point, **vob_restore** has the information it needs to determine the restore scenario. See also *vob_restore: Restoration Scenarios* on page 188.

```
The information you supplied, and the state of the registry at that time,
resulted in the following initial restoration parameters. If this
invocation is a restart, the current registry state may be different.

 o The vob is currently registered.
 o The restored vob will be placed in its previously registered location
       \\io\vobstore\vob_src.vbs
   on its previously registered host
       io
 o The restoration will be done in place.
 o The database will be copied from the snapshot directory
       \\io\e\vob_snaps\src

If you wish, you may quit for now  and restart the script at a later time.
Do you want to proceed?
Valid responses are (yes,quit)
The default is yes: yes<RETURN>
```

If the VOB is registered in a registry that is served by a different registry host, you must go to a host served by that registry server and unregister the VOB with **cleartool unregister**. You can also use the ClearCase Administration Console.

```
The vob must now be made unavailable. This script will unregister the vob
from this hosts's registry. If it is registered in any other registries
you must unregister it from those registries before continuing. Do not
unregister it from this host's registry. You may quit for now to perform
this operation. Press <RETURN> to continue only when this host's registry
is the only registry the replica remains registered in.
Valid responses are (quit,<RETURN> to continue)
There is no default response: <RETURN>
```

Next, **vob_restore** saves registry parameters before removing the VOB-tag, unregistering the VOB storage directory, and shutting down ClearCase. If you have customized registry entries or cloned the VOB-tag for multiple network regions, you must restore these registry additions manually, using the saved registry file that **vob_restore** creates.

```
The full current registry settings will be saved in the file
    \\io\vobstore\register_save_io
Press return to continue.
Valid responses are (quit,<RETURN> to continue)
There is no default response: <RETURN>
Removing vob tag \vob_src...rmtag complete
Unregistering \\io\vobstore\vob_src.vbs...unregister complete
```

```
Is it all right to shutdown Clearcase on this host?
Valid responses are (yes,quit,help)
The default is yes: yes<RETURN>
Shutting down Clearcase...Clearcase shutdown complete
```

You must now move or remove the old, damaged storage directory before **vob_restore** restarts ClearCase:

```
You must either move or remove the previous storage directory
    \\io\vobstore\vob_src.vbs
now. Press <RETURN> to continue only when it has been completed.
Valid responses are (quit,<RETURN> to continue)
There is no default response: <RETURN>
Starting Clearcase...Clearcase start complete
```

Now, load the backup into the directory supplied at *Storage Directory Prompt*.

```
The restored data must now be retrieved from backup media and placed in
    \\io\vobstore\vob_src.vbs
You may quit to restore the data now or press <RETURN> to continue when
the restoration has been completed.
Valid responses are (quit,<RETURN> to continue)
There is no default response: <RETURN>
```

If the VOB is configured for database snapshots, but not for **db_check** operations at snapshot time (see **vob_snapshot_setup**), run **db_check** now. Note that **db_check** is forced in either of these situations:

- There is no snapshot, and the VOB was unlocked at backup time.
- The snapshot was taken when the VOB was unlocked.

```
A dbcheck was not done during the snapshot. Do you wish to do one now?
Valid responses are (yes,no,quit)
The default is no: yes<RETURN>

Performing data base check. This may take some time...checked clean
```

If you are restoring a UNIX VOB with remote storage pools, restore them now.

```
If there are any remote pools that should be restored now is the time to
restore them. You may quit for now to perform this operation or press
<RETURN> to continue.
Valid responses are (quit,<RETURN> to continue)
There is no default response: <RETURN>
```

Confirm that you have supplied a VOB database snapshot. **vob_restore** merges it with the retrieved VOB storage backup, overwriting any VOB database retrieved with the storage directory:

```
The restored storage area contains a copy of a directory being restored
from the snapshot area.
    \\io\vobstore\vob_src.vbs\db
Is it ok to remove this copy?
Valid responses are (yes,quit,help)
The default is yes: yes<RETURN>
Making tag for storage \\io\vobstore\vob_src.vbs\db...mktag complete
Registering \\io\vobstore\vob_src.vbs\db...register complete
```

If you are testing backup or restore procedures and not restoring a broken VOB, let **vob_restore** temporarily disable VOB database snapshot activity on the VOB:

```
The VOB database snapshot utility is enabled for this VOB/replica. If you
are restoring this VOB/replica because it was broken, this is probably ok.
However, if you are merely testing your backups, and this replica is
actually active in some other region, this may cause a problem. If the
snap path
    \\io\e\vob_snaps\src
is visible on this host, the test backup VOB's database will be snapped,
overwriting the real snap for the VOB/replica . This can be prevented by
removing the snap parameter attribute for this VOB/replica at this
time.You should answer yes to this prompt if this recovery is a test of
backups otherwise answer no.
Do you want this script to remove the snap parameter attribute ?
Valid responses are (yes,no)
There is no default response: no<RETURN>
```

If you supplied a database snapshot when prompted for one, you must run **checkvob** to resynchronize the VOB database and storage pools. We recommend that you run **checkvob** whenever you restore a VOB, because it may expose problems in the restored VOB.

NOTE: **vob_restore** replaces the VOB lock with one that permits access by the **checkvob** process, and relocks the VOB against all users when **checkvob** exits. Make sure that the user ID under which **vob_restore** or **checkvob** runs does not modify the VOB in any way while **checkvob** is running. Failure to do so will irreversibly break a replicated VOB.

```
Do you want to have checkvob examine the vob for possible problems?
Valid responses are (yes,quit,help)
The default is yes: yes<RETURN>
```

```
Would you like to have checkvob run in 'check only' mode?
Valid responses are (yes,no,quit,help)
The default is yes: yes<RETURN>

Source pools?
Valid responses are (yes,no)
The default is yes: yes<RETURN>

Derived object pools?
Valid responses are (yes,no)
The default is yes: yes<RETURN>

Cleartext pools?
Valid responses are (yes,no)
The default is yes: yes<RETURN>

Checkvob expects to be run in a view context. If you are not currently in
a view, checkvob will accept a view tag argument. Supply one now if you
are not in a view.
view_tag: adm_view<RETURN>

Checkvob will now be run in 'check only' mode. This may take a while on
large vobs. Checkvob will generate logs in the directory
    checkvob_sum.03-Oct-96.14.21.06
It will emit rather verbose information to standard output as it runs. All
of this information is also saved in the log directory for later viewing.
You may be prompted for information as well. You may quit for now or press
<RETURN> to continue.
Valid responses are (quit,<RETURN> to continue)
There is no default response: <RETURN>
```

At this point, **checkvob** takes control temporarily from **vob_restore**:

```
The session's log directory is 'checkvob_sum.03-Oct-96.14.21.06'.
================================================================
Starting "source pool" processing at 03-Sep-96.14:21:59

... lots of checkvob output ...

The VOB's derived pools are healthy.

Poolkind transcript log:
checkvob_sum.03-Oct-96.14.21.06\poolkind_derived\transcript
================================================================
```

checkvob's check-only pass is complete. Control has returned to **vob_restore**, which summarizes the results and prompts you run **checkvob** in fix mode to repair any problems:

```
1 source containers are either missing or corrupt
0 derived object containers are either missing or corrupt
0 source containers are misprotected
0 derived object containers are misprotected
Cleartext containers were not checked.
More details may be found in the log files in the above directory

Do you want to have checkvob run in repair mode?
Valid responses are (yes,no,quit)
The default is yes: yes<RETURN>

Source pools?
Valid responses are (yes,no)
The default is yes: yes<RETURN>

Checkvob will now be run in fix mode. This may take a while on
large vobs. Checkvob will generate logs in the directory
    checkvob_fix.03-Oct-96.14.22.02
It will also emit rather verbose information to standard output as it
runs. All of this information is also saved in the log directory for
later viewing. You may be prompted for information as well.
Do you want to proceed?
Valid responses are (yes,quit)
The default is yes: yes<RETURN>

While running checkvob the the vob will be locked for all but user
Administrator (or other account used to invoke vob_restore)
The vob will be open to possible modifications by anyone running as
this user. This MUST NOT be allowed to happen. If you need to make
arrangements to ensure that no one with this identity will attempt to
modify this vob before proceeding you may quit for now. Press <RETURN>
if you are satisfied that no such modifications will occur.
Valid responses are (quit,<RETURN> to continue)
There is no default response: <RETURN>
```

Once again, **checkvob** is back in control, running in fix mode.

```
The session's log directory is 'checkvob_fix.03-Oct-96.14.22.02'.

If any version data is missing from source pool data containers,
fix processing involves irreversibly updating the VOB database
with the equivalent of 'cleartool rmver -data' operations.
By default, checkvob does not allow this class of fix processing.
```

```
Do you want to override the default and fix elements with
missing version data? [no] yes<RETURN>

You must specify a time limit for acceptable missing data.
Refer to the reference manual for more information.

Allow missing version data created since: [date-time, <CR>] <RETURN>

Allowing missing version data created since 02-Oct-96.00:00:00.

WARNING: You are allowing fix processing for missing version data.
If the allowable missing version data limit encompasses
more versions than you expected, you will have to restore
this VOB from backup media to undo the effects of this fix
processing.

Do you want to continue with force mode processing? [no] yes<RETURN>

================================================================
Starting "source pool" processing at 03-Oct-96.14:26:21

... lots of checkvob output ...

The VOB's source pools are healthy.

Poolkind transcript log:
checkvob_fix.03-Oct-96.14.22.02\poolkind_source\transcript
================================================================

0 source containers remain either missing or corrupt
0 source containers remain misprotected
0 source elements experienced loss of version data
0 source versions were lost
0 derived object containers remain either missing or corrupt
0 derived object containers remain misprotected
0 rmdo operations were done
0 derived objects were lost
Cleartext containers were not checked.

Check has either detected no problems or has repaired what it did detect.
This is a non replicated vob so no further action should be required.
```

If you restore a VOB replica, **vob_restore** directs you to run **restorereplica** immediately. If you fail to do so, the replica will remain unsynchronized permanently.

VOB restoration is now complete. Go to Step #6 on page 179.

vob_restore: Restoration Scenarios

vob_restore can accommodate a number of restoration scenarios:

- In place: restore a VOB without changing its location
- VOB is active: restore a VOB that has read-only access
- Move VOB on same host
- Move VOB to new host
- VOB is unregistered

All have two variants: with and without a VOB snapshot.

The previous example restored a VOB in place, loading the backed up VOB storage directly into the currently registered location. The examples also merged in a VOB database snapshot from its on-disk location. This scenario can be called "in place, with snapshot." There are other possibilities.

How vob_restore Determines the Scenario

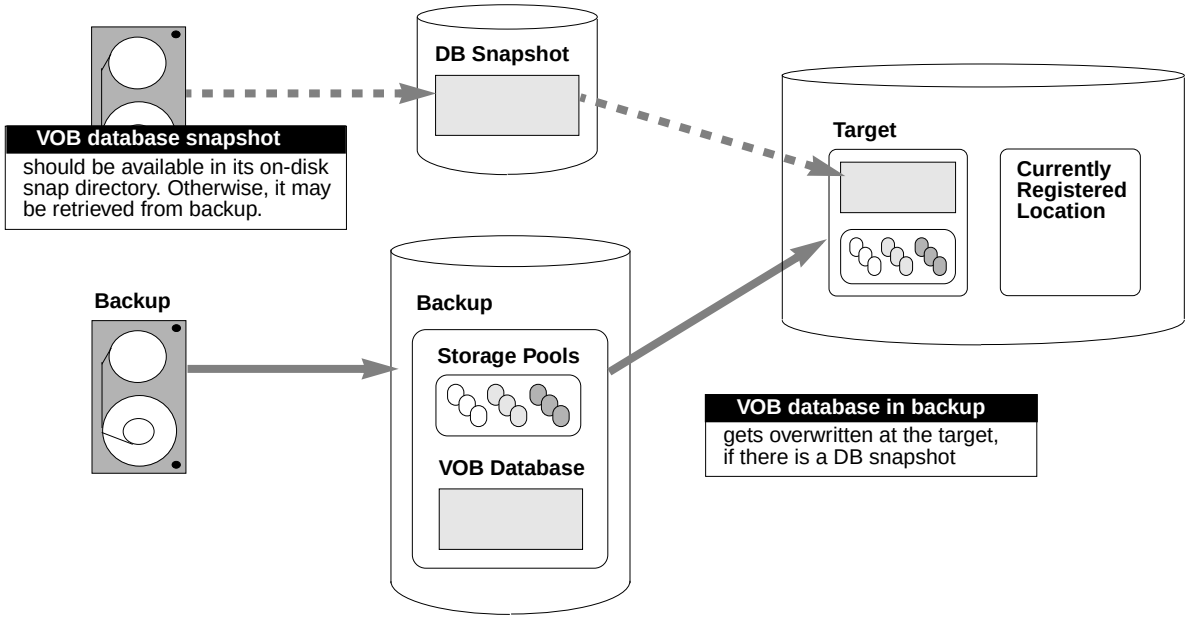
When you run **vob_restore**, it prompts for three critical pieces of information:

- What is the target? That is, where will the restored VOB storage ultimately reside?
- Where are you going to put the VOB storage directory backup (or, where did you put it)?
- If you want to merge in a VOB database snapshot, where is it?

vob_restore also derives the VOB's *currently registered storage location* from the VOB-tag argument supplied on the command line. (It may not be registered.)

As shown in Figure 8, **vob_restore**'s task is to merge the *backup* and the *snapshot* (if there is one) at the *target*, and to correctly re-register the target, which may be at a location other than the VOB's *currently registered location*.

Figure 8 VOB Restoration



vob_restore uses your input to describe the restore scenario. For example, Figure 9 shows the scenario from the sample restore session in the previous section.

Figure 9 Restore Scenario Summarized by Output from vob_restore

```
o The vob is currently registered.
o The restored vob will be placed in its previously registered location
      \\io\vobstore\vob_src.vbs
  on its previously registered host
      io
o The restoration will be done in place.
o The database will be copied from the snapshot directory
      \\io\e\vob_snaps\src
```

This output can vary, depending on the information you supply at **vob_restore** prompts.

Restoration Rules and Guidelines

At restore time, remember these rules and guidelines:

- *Target* must be local.

- All subdirectories should be local if possible.
- *Snapshot* can reside on a remote host.
- Whenever possible, the *backup* and *target* pathnames ought to be the same. That is, always try to load the backup into its final destination. This practice avoids a time-consuming copy operation. (In fact, **vob_restore** copies the backup to the target only if a move operation is impossible.) This avoidance is possible for all scenarios but *vob_restore: VOB Is Active* on page 191.
- If the *backup* and *target* pathnames are different, try to keep them on the same host to avoid possible problems with permissions, network load, and so on.
- If you retrieve the *backup* before running an in-place restoration, you must unregister the VOB, stop ClearCase, load the backup, and restart ClearCase.

Now let's look at the main scenarios, one at a time.

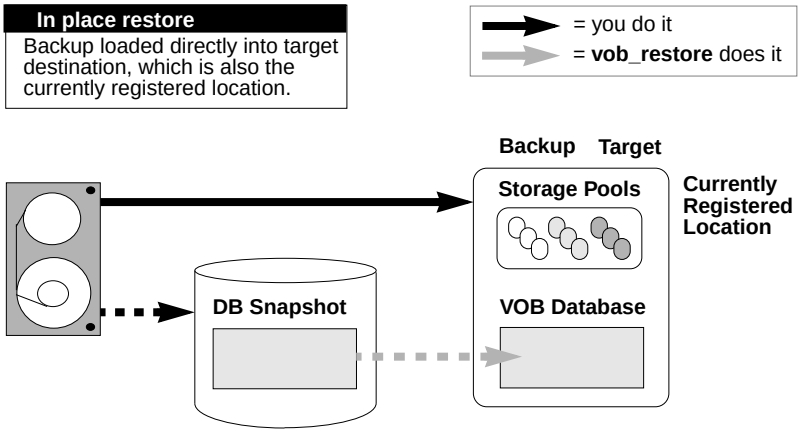
vob_restore: In Place

This scenario is illustrated in Figure 10

Formula. *backup = target = currently-registered-location*

Advice. Use this scenario whenever practical.

Figure 10 vob_restore: In Place



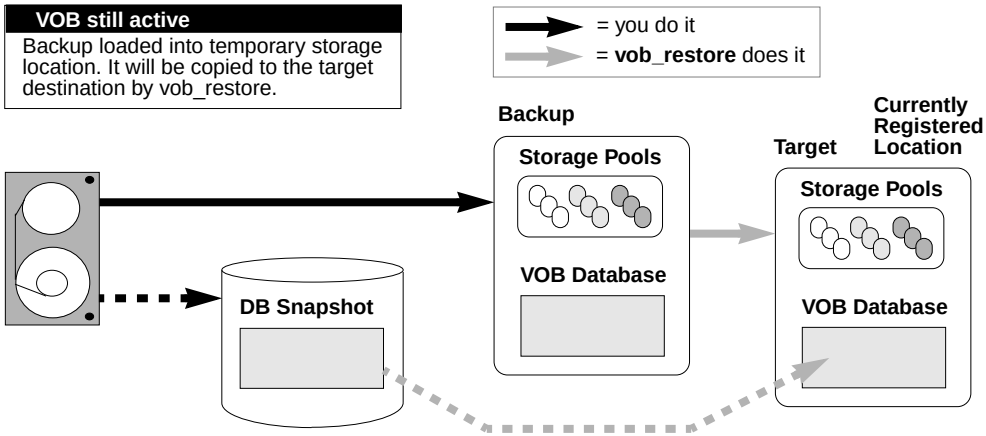
vob_restore: VOB Is Active

In this scenario, the VOB is still active for read-only access, so the backup must be loaded into a temporary storage location. (See Figure 11.)

Formula. (*backup* different from *target*) and (*target = currently-registered-location*)

Advice. Do not combine this scenario with a move VOB scenario. Keep the VOB at its currently registered location.

Figure 11 vob_restore: VOB Is Active



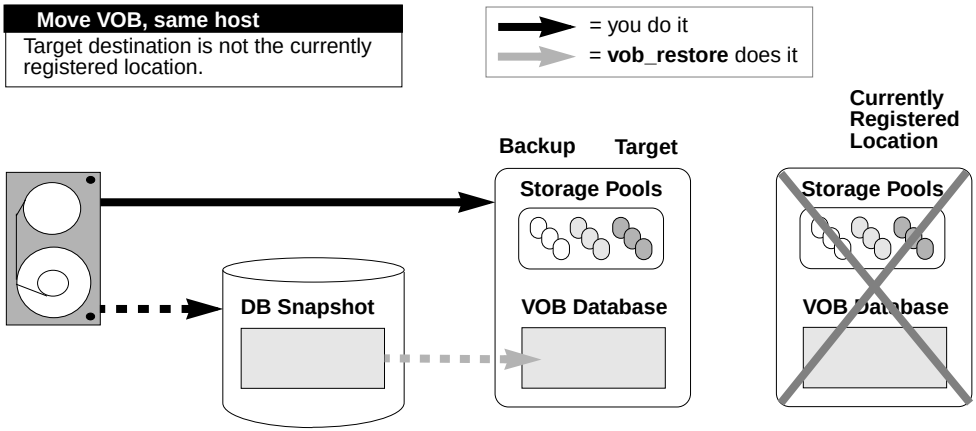
vob_restore: Move VOB on Same Host

In this scenario, the backup is restored to a different location on the same host. (See Figure 12.)

Formula. *target* different from *currently-registered-location*

Advice. Load the backup directly into the target destination.

Figure 12 vob_restore: Move VOB on Same Host



vob_restore: Move VOB to New Host

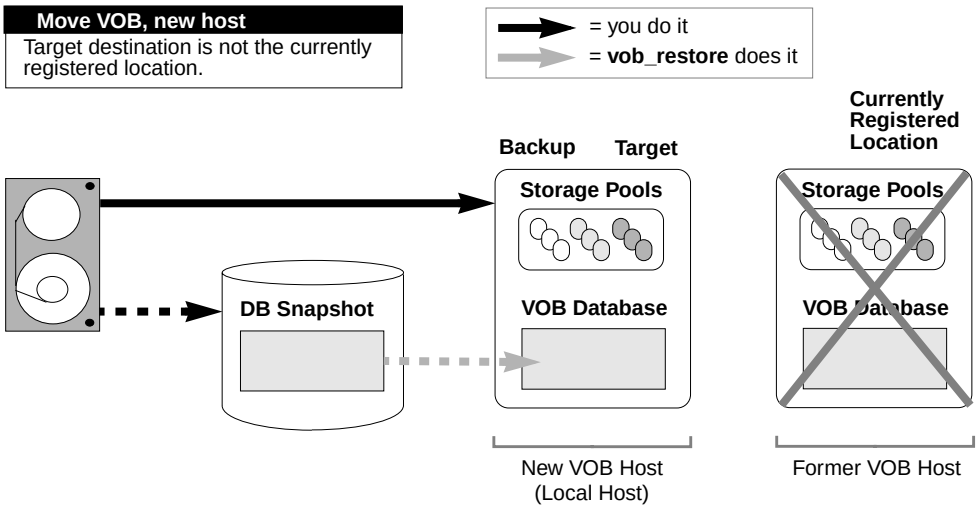
When moving a VOB as part of a **vob_restore** operation, the target host must have the same architecture (hardware and operating system). (See Figure 13.)

Formula. *target* different from *currently-registered-location*

Advice. Load the backup directly into the target destination.

NOTE: You must run **vob_restore** on the target host.

Figure 13 vob_restore: Move VOB to New Host



vob_restore: Unregistered

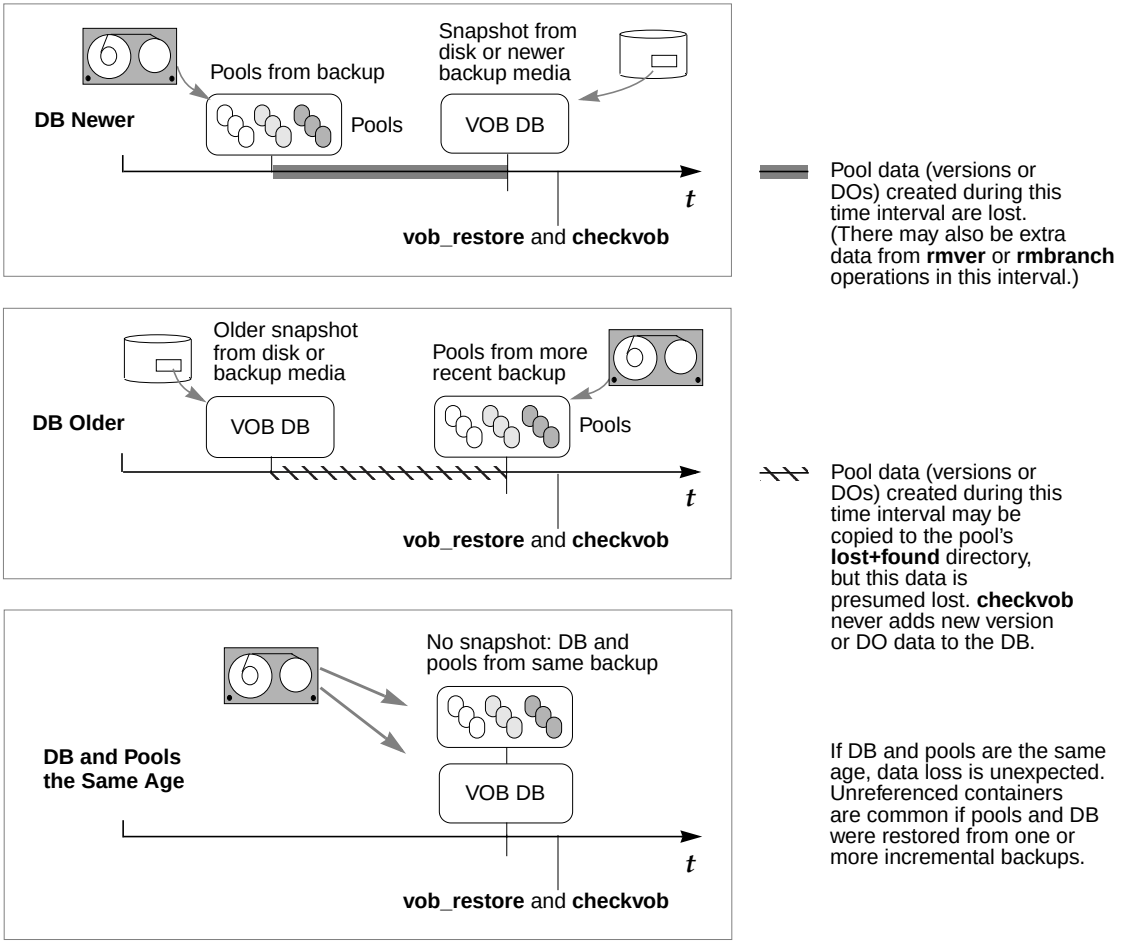
Formula. Same as in place, but no *currently-registered-location*

Advice. Load the backup directly into the target destination.

vob_restore: Restoring with a Database Snapshot

Any restore scenario that includes a VOB database snapshot introduces an additional complication: the VOB database and VOB storage pools have different reference times; that is, one is newer than the other. This skew must be resolved in the restored VOB. Run **checkvob** to resolve it. Figure 14 illustrates the problem and summarizes what **checkvob** does when the a VOB database is newer or older than the VOB's storage pools (the *backup*) at restore time.

Figure 14 VOB Database or Storage Pool Skew Associated with VOB Snapshots



VOB snapshots have minimal impact on the your work at restore time. When prompted by **vob_restore**, you need only supply the correct snapshot directory. However, the **checkvob** portion of a **vob_restore** operation is critical. You must be prepared to respond intelligently to **checkvob** prompts and to understand the implications of any errors reported in its output. Typically, **checkvob** finds and repairs numerous small problems, but it reports version and DO data loss for the interval between storage pool and VOB database reference times.

For more information, see the **checkvob** reference page and Chapter 14, *Using checkvob*.

10.5 Restoring a VOB from Backup Without vob_restore

In most cases, the easiest way to restore your VOB is to run the **vob_restore** utility and follow its instructions. The procedure presented here is an alternative approach for circumstances in which you cannot use **vob_restore** and for administrators who prefer to do it themselves.

The following procedure restores a VOB backup without disrupting ongoing work. The VOB is the same one discussed in *Backing Up a VOB* on page 169.

NOTE: You can restore a VOB to a new location, on the same host or on another host. In this case, you must re-register the VOB at its new location (Step #9).

1. **Unmount the VOB**. The VOB must be unmounted on each client host. For example:

   # **cleartool umount /vobs/flex**

2. **Log on to the VOB host.** Log on as a user with permission to stop and start ClearCase—typically the **root** user on UNIX or a local administrator on Windows.

3. **Check available disk space**. If you are restoring the VOB to a new location, make sure that there is enough free space in the VOB's disk partition to load the backup copy into temporary storage. Use the VOB storage node in the ClearCase Administration Console or the **cleartool space** command to check available disk space.

   ```
   # cleartool space /vobstore/flex.vbs
     Use(Mb)  %Use  Directory
        27.0    2%  VOB database /net/pluto/vobstore/flex.vbs
        33.0    3%  cleartext pool /net/pluto/vobstore/flex.vbs/c/cdft
      .
      .
   ----------------------------------------------------------------------
      312.9   28%  Subtotal
      828.4   74%  Filesystem /net/pluto/vobstore (capacity 1115.1 Mb)
   ```

   If the available space is insufficient, delete the VOB storage directory, or use other means to make enough space available.

WARNING: Step #4 and Step #5 are critical to the integrity of your restored VOB.

4. **Shut down ClearCase on this host.** This ensures that ClearCase processes associated with the VOB are terminated. On Windows, use the ClearCase program in Control Panel. On UNIX, use the following command:

   # *ccase-home-dir***/etc/atria_start stop**

5. **Rename the VOB storage directory**. If it still exists, rename the VOB storage directory. A new one with the same name will be created during restore.

   # **mv /vobstore/vob_flex.vbs /vobstore/vob_flex.OLD**

6. **Restart ClearCase on this host.** Starting ClearCase makes other VOBs on the host available. Do this on Windows by using the **ClearCase** program in Control Panel. On UNIX, use the following command:

   # *ccase-home-dir***/etc/atria_start start**

7. **Load the backup**. Re-create the VOB storage directory if necessary; then restore the VOB storage directory's contents from the backup medium.

   # **mkdir /vobstore/vob_flex.vbs**
   # **cd /vobstore/vob_flex.vbs**
   <enter restore command>

   If your Windows backup tool does not backup and restore ACLs correctly, you may need to fix them now. See Chapter 35, *Repairing VOB and View Storage Directory ACLs on Windows*, for details.

   NOTE: Each UNIX VOB storage area includes a directory named **.identity**, which stores files with special permissions: the *setUID* bit is set on file **uid**; the *setGID* bit is set on file **gid**. You must preserve these special permissions when you restore a VOB backup:

   - If you used **tar**(1) to back up the VOB, use the **–p** option when restoring the VOB. In addition, make sure to enter the **tar** command as the **root** user. If you do not, the **–p** flag is ignored.
   - If you used **cpio**(1) to back up the VOB, no special options are required in the **cpio** command that restores the backup data.

   If the VOB is on UNIX and has remote storage pools, restore the backups of these pools at this point.

8. **Lock the VOB.** As a precaution, lock the VOB as soon as the restore is complete. This will prevent any users from changing VOB data until the restore has been checked for consistency.

9. **If you restored the VOB to a new location, re-register the VOB**. You can use the ClearCase Registry node in the ClearCase Administration Console or **cleartool** commands to re-register the VOB. For example, if you restored the VOB to new location **/vobst_aux/flex.vbs**:

```
# cleartool unregister –vob  /vobstore/flex.vbs    (run unregister first)
# cleartool register –vob  /vobst_aux/flex.vbs
# cleartool mktag –vob –replace –tag /vobs/flex  /vobst_aux/flex.vbs
```

10. **If the VOB is replicated, run the MultiSite restorereplica command.** It is critical that this processing is performed while the VOB is still locked.

11. While the VOB is still locked, run some consistency checks. Activate the VOB on a single host with **cleartool mount** and confirm that it is intact by checking event history on various components, examining recently changed elements, running **checkvob** as described in *Using checkvob* on page 245, and so on.

12. **Unlock the restored VOB**.

    ```
    # cleartool unlock vob:/flex
    Unlocked versioned object base "/vobstore/flex.vbs".
    ```

13. **Mount the restored VOB on all hosts.** The restored copy of the VOB is now ready to use. Have users remount the VOB on their workstations, using **cleartool mount**.

14. **If necessary, resynchronize the VOB and views.** See *VOB and View Resynchronization* on page 200.

10.6 Restoring an Individual Element from Backup

If you mistakenly delete an element with **rmelem**, you can restore it from a backup copy, using the procedure presented in this section.

NOTE: This procedure cannot be used to recover an element in a UCM (component) VOB.

Removing a directory element does not remove the file elements cataloged within it; file elements exist independently of directory elements. In many cases, deleting a directory element causes the files within it to be transferred to the VOB's **lost+found** directory. Look there first if you've accidentally removed a directory element.

This is the procedure for restoring a single element from a backup of a non-UCM VOB:

1. Unmount and unregister the VOB whose element has been deleted.

2. Restore the most recent backup of the VOB storage directory to a temporary location on a VOB server disk.

3. Register and mount the restored backup.

4. Create a temporary VOB to hold the element you need to restore, and then mount it. Because the VOB and the restored backup cannot both be active at the same time, this temporary VOB serves as a staging point to which the element you're recovering can be copied.

5. Use **cleartool relocate** to relocate the element from the backup VOB to the temporary VOB.

6. Unmount the backup VOB.

7. Remount the original VOB.

8. Use **cleartool relocate** to relocate the element from the temporary VOB to the original VOB.

9. Delete the backup VOB and the temporary VOB.

As an example, suppose that file element **util.c** is deleted from directory **\proj\src**. The VOB-tag is **\proj**, and the VOB storage directory is **c:\vobstore\proj.vbs** on the local host. Here's how the VOB owner can restore the element from a backup copy.

NOTE: The procedure described here restores the element to the version of its directory that is selected by the view in which the procedure takes place. It does not restore the element to earlier versions of the directory.

1. **Unmount the VOB whose element has been deleted**. This is required, because two copies of the same VOB must never be active at the same time.

   cleartool umount \proj

2. **Remove the VOB-tag and registry entries**. These entries prevent use of an old version of the same VOB. You can use the ClearCase Registry node in the ClearCase Administration Console or **cleartool** commands to unregister the VOB.

   cleartool rmtag –vob \proj
   cleartool unregister –vob \\sol\vobstore\proj.vbs

3. **(UNIX server only) Terminate the VOB's server processes**. Search the process table for the **vob_server** and **vobrpc_server** processes that manage that VOB. Use **ps –ax** or **ps –ef**, and search for `/vobstore/proj.vbs`; use **kill**(1) to terminate any such processes. (Only the **root** user can kill a **vobrpc_server** process.)

4. **Restore the VOB storage directory from the backup to a temporary location**. Because this is a temporary copy that only one client will need to access for a brief period, you may want

to follow the procedures for a simple manual VOB restore as described in *Restoring a VOB from Backup Without vob_restore* on page 195.

5. **Register and mount the backup VOB**. As in the preceding step, use a temporary mount point, not the original mount point. You can use the ClearCase Registry node in the ClearCase Administration Console or **cleartool** commands to register the VOB or you can use the cleartool command line.

   cleartool register –vob \\sol\users\tmp\proj.vbs
   cleartool mktag –vob –tag \oldproj \\sol\users\tmp\proj.vbs
   cleartool mount \oldproj

6. **Create a new, temporary VOB.** Because the original VOB and the backup VOB cannot be active at the same time, you need this temporary VOB to hold a copy of the element you're recovering. Later, you can unmount the backup, mount the original VOB, and copy the element from the temporary VOB to the original VOB. Because nobody else should access this VOB, do not make it *public*. Unless the element is very large, this temporary VOB does not need much disk space.

   cleartool mkvob –nc –tag \tmpvob \\sol\users\tmp\tmpvob.vbs
   ```
   Created versioned object base.
     .
     .
   ```

7. **Mount the temporary VOB.**

   cleartool mount \tmpvob

8. **Relocate the element from the backup VOB to the temporary VOB.** Use the **cleartool relocate** command to relocate the element into the temporary VOB. Create the data file in the old VOB and run **clearimport** in the temporary VOB. In this example, **Z:** is the root of a view that uses the default config spec.

   ```
   z:\> cd oldproj\src
   z:\oldproj\src> cleartool relocate util.c \tmpvob
   ```

9. **Unmount and unregister the backup VOB**. This corresponds to the work done in Step #1 and Step #2. You can use the ClearCase Registry node in the ClearCase Administration Console or these **cleartool** commands to unregister the VOB.

   **cd **
   cleartool umount \oldproj
   cleartool rmtag –vob \oldproj
   cleartool unregister –vob \\sol\users\tmp\proj.vbs

10. **(UNIX server only) Terminate the backup VOB's server processes**. This is similar to Step #3 of this procedure. This time, search the process table for a **vob_server** and/or **vobrpc_server** invoked with **/usr/tmp/proj.vbs**.

11. **Re-register and remount the original VOB**. This time, make a public VOB-tag. You can use these **cleartool** commands to re-register the VOB.

    cleartool register –vob \\sol\vobstore\proj.vbs
    cleartool mktag –vob –public –tag \proj \\sol\vobstore\proj.vbs
    `Vob tag registry password:` *<enter password>*
    cleartool mount \proj

    NOTE: If you are registering a UCM project VOB, you must use the **–ucmproject** option with the **register** command.

12. **Relocate the element from the backup VOB to the temporary VOB.** Use the **cleartool relocate** command program as in Step #8 to relocate the element from the temporary VOB to the original VOB.

    `z:\>` **cd \tmpvob**
    `z:\tmpvob>` **cleartool relocate util.c \proj\src**

13. **Clean Up.** Unregister and unmount the temporary VOB. Remove the temporary VOB and the backup VOB. Use the VOB storage node for the VOB in the ClearCase Administration Console or the **rmvob** command, which removes the VOB's registry entries and terminates all of its server processes.

    cleartool umount \tmpvob

    cleartool rmvob c:\users\tmp\tmpvob.vbs
    `Remove versioned object base "c:\users\tmp\tmpvob.vbs"[no]` **yes**
    `Removed versioned object base "c:\users\tmp\tmpvob.vbs".`

    cleartool rmvob c:\users\tmp\oldproj.vbs
    `Remove versioned object base "c:\users\tmp\oldproj.vbs"[no]` **yes**
    `Removed versioned object base "c:\users\tmp\oldproj.vbs".`

10.7 VOB and View Resynchronization

A VOB database maintains references to one or more view databases, and vice versa. When a VOB or view is restored from backup, the view and VOB are potentially out of sync; some of the references are no longer valid. This skew can cause a variety of problems.

View-related problems

- View-private files can become stranded because the VOB directory element that they were cataloged in (or under) no longer exist in the VOB.
- Elements can become "checked out but removed" when the VOB has recorded that the view has the element checked out, but the view doesn't have a view-private file for the element.
- Elements can become *eclipsed* by a view-private file when the checkout that was once valid in the view is no longer recognized in the VOB. (The VOB says the element isn't checked out in the view.)
- DO promotions can fail because the VOB records DO information about unshared DOs that don't exist.
- Winked-in DOs become inaccessible when the VOB no longer contains the shared DOs. For example, this can occur if the VOB loses its DO pools and the shared DOs are removed by **checkvob** fix processing.

VOB-related problems

- DOs are prevented from being scrubbed because the VOB has recorded stale reference counts for views (references that the view currently doesn't have).

There are a several things you can do to correct the skew and identify and/or eliminate the problems. You can take action immediately following VOB or view restore, or you can wait until problems surface.

- When a view is restored, perform the resynchronization described in *Resynchronizing Views and VOBs* on the restored view.
- When a VOB is restored, resynchronize it on each view it references. To collect this view list, navigate to the Referenced Views subnode for the VOB storage node in the ClearCase Administration console or run the following command:

  cleartool describe –long vob:*restored-vob*

NOTE: The Referenced Views subnode and the **cleartool describe** command do not list views whose only interaction with the VOB has been to wink in DOs from the VOB. You must find and resynchronize any such views as well.

Resynchronizing Views and VOBs

To resynchronize views and VOBs:

1. (Dynamic views only) Run **cleartool recoverview –synchronize**. This command recovers stranded view-private files. If a view was restored, synchronize it with all of the VOBs. If a VOB was restored, you can restrict the recovery synchronization to the restored VOB. See the **recoverview** reference page for more information.

2. For a dynamic view, inspect the list of checked-out files in the Private Files subnode of the view storage node in the ClearCase Administration Console or run **cleartool lsprivate –co**. For a snapshot view, run **cleartool ls –recurse –view_only**. Look at the output for any checkouts that are marked as "checked out but removed."

   If the VOB was restored, this probably means that the user had once checked out the element but then resolved the checkout (**uncheckout** or **checkin**) at some point more recent than the restored VOB's backup time. If it was a checkin, the data has been lost.

   If the view was restored, any view-private modifications to the checked-out element have been lost.

   In either case, the user must now cancel the checkout (**uncheckout**) or re-create the version data and check it in.

3. For a dynamic view, inspect the list of files in the Private Files subnode of the view storage node in the ClearCase Administration Console or run **cleartool lsprivate –other –long**. For a snapshot view, run **cleartool ls –recurse –view_only**. Look at the output for any elements that are marked as "eclipsed."

   If the VOB was restored, the user had probably checked out the element at a time more recent than the restored VOB's backup time. If the view was restored, this probably means that the user had checked out the element but canceled the checkout later on, or had checked in the version data now present in the restored view.

   If the version had been checked in, the eclipsing view-private file can be removed and the user can check out a new version and continue working. If the version had not been checked in, the eclipsing view-private file may still contain the most recent changes. In this case, it must be moved aside (renamed, not removed) so that the a new version of the element can be checked out to hold these changes.

4. (Dynamic views only) View the list of derived objects in the Private Files subnode of the view storage node in the ClearCase Administration Console or run **cleartool lsprivate –do**.

Attempt to open each file. The view then detects winked-in DOs that are no longer valid and removes them.

NOTE: On UNIX systems, you can use the UNIX **xargs** utility to automatically open the file names returned by **lsprivate.** This command does the job for 50 DOs:

cleartool lsprivate –do | xargs –n50 file

5. (Dynamic views only) Remove all of the view's **.cmake.state** files. The view then queries the VOB regarding the state of DOs created by this view. Rebuilding in the view causes the view to detect view-private files that are no longer recognized as DOs and rebuild them.

After you fix DO promotion problems for a dynamic view, isolated problems may still occur (for example, when a view's DO container does not exist). To prevent this problem from reoccurring, remove the offending DO with **rmdo**. The following section shows a sample cleanup of DOs whose config records have been lost, causing errors at build time.

Reestablishing Consistency of a View's Derived Object State

This section applies to dynamic views in any situation where a VOB's database has been rolled back to a previous state.

After you restore a VOB from backup, its VOB database may be out of date with respect to certain derived objects. The old database does not store config records for any DOs that were created in subsequent builds. As a result, errors occur during hierarchical builds that reuse those late-arriving DOs to construct higher-level targets. The following example is typical of the error messages generated when this problem occurs:

```
======== Rebuilding "libbld.a"========
building libbld.a
        rm -f libbld.a
        rm -f /vobs/atria/sun5/pvtlib/libbld.a
        /opt/SUNWspro/bin/cc -c -o ...
        ar cq libbld.a  bld.o bld_pp.o ...

Will store derived object "/vobs/proj/sun5/libbld_V.o"
Will store derived object "/vobs/proj/sun5/libbld.a"
clearmake: Error: INTERNAL ERROR detected and logged in
"/var/adm/atria/error_log".
```

The **error_log** file shows:

```
Sunday 12/19/93 15:55:02. host "scandium", pid 440, user "chase"
Internal Error detected in "../bldr_vob.c"line 114
clearmake/cm/bldr_vob:
Error: VOB "scandium:/vobs/proj"
missing config record for derived object (OID)
"0b5759d0.fb1811cc.a0af.08:00:69:02:2e:aa"
```

To reestablish the view's consistency with the VOB:

1. **Determine which DOs are causing the inconsistency.** The **cleartool ls** command annotates them with `[no config record]`:

   cleartool ls

   ```
   bldr_comm.ugh@@09-Dec.18:26.287028
   bldr_cr.msg.o [no config record]
   bldr_cr.o [no config record]
   bldr_cr.ugh [no config record]
   bldr_cr_cache.msg.c@@24-May.20:51.42929
     .
     .
     .
   ```

2. **Remove the DOs that have no config record.** Use the standard **rm(1)** command on UNIX:

   rm bldr_cr.msg.o bldr_cr.o bldr_cr.ugh

   Use the **del** command on Windows.

   del bldr_cr.msg.o bldr_cr.o bldr_cr.ugh

11 Administering VOB Storage

VOB storage administration has two primary goals:

- Preserving critical data and metadata
- Managing the disk space required for VOB storage

Implementation of a daily routine for backing up VOB data is the more critical task of the two. See Chapter 10, *Backing Up and Restoring VOBs* for more information on this topic. After you have implemented a backup and recovery strategy for VOB storage, consider the ways in which you can minimize the amount of storage your VOBs require and manage distribution of that storage across an appropriate set of network resources. These topics are covered in this chapter.

11.1 VOB Storage Management

VOB storage grows in proportion to the number of developers using the VOB and the rate at which they create and change the data under ClearCase control. Much of this data needs to be preserved, often for an extended period. But some of it loses value quickly and can be safely removed from the VOB. Rational ClearCase provides tools that perform the following tasks:

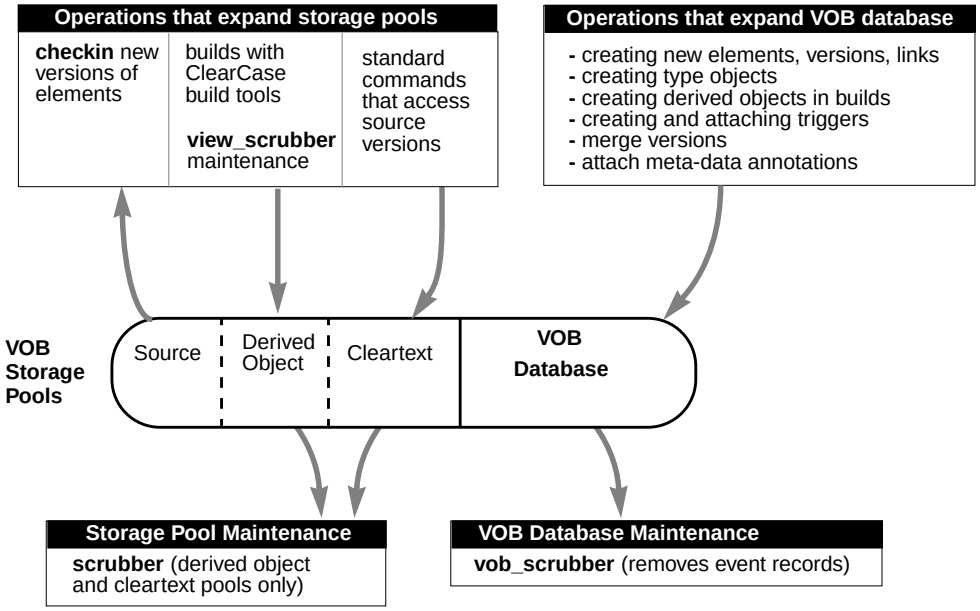
- Monitor the disk space used by VOBs
- Scrub VOBs to remove unneeded data and metadata on a schedule you define, using criteria you specify
- Create additional storage pools for existing VOBs
- Relocate data from one VOB to another

➤ Remove versions and, if necessary, elements when they are no longer needed

You can use any or all of these tools to keep VOB storage requirements to a practical minimum.

Figure 15 shows how VOB storage pools and VOB databases grow in regular use; it also lists the maintenance commands (scrubbers) that control growth of these storage areas.

Figure 15 Controlling VOB Growth



Monitoring VOB Storage

ClearCase provides command line and GUI tools that display information about disk space used by VOBs.

➤ In the ClearCase Administration Console, the VOB storage node for a VOB subnode of the ClearCase Server node shows current and historical disk space use for the VOB. The Derived Objects subnode of a VOB storage node shows disk space used by shared derived objects in the VOB and also shows which views have references to these DOs.

- The **cleartool space –vob** command shows current and historical disk space use for a VOB.
- The **dospace** command shows disk space used by shared derived objects in the VOB. The display also shows which views hold references to these DOs.

Using the Scheduler

The ClearCase scheduler runs several jobs that gather data about disk space used by VOBs and that can reclaim excess disk space used by local VOBs:

- Daily data gathering on VOB disk space used
- Weekly data gathering on disk space used by shared derived objects
- Daily scrubbing of VOB storage pools using the **scrubber** utility
- Weekly scrubbing of VOB databases using the **vob_scrubber** utility
- Daily and weekly execution of jobs that you can customize to run your own programs

In their default configuration, many of these jobs do little or nothing. (For example, the daily VOB space monitoring job does not gather statistics on any VOB until it has been configured to do so.) We recommend reviewing the list of scheduled jobs and enabling all of the ones your VOB storage management routine requires. For more information on the ClearCase scheduler, see Chapter 28, *Managing Scheduled Jobs*.

11.2 Scrubbing to Control VOB Storage Growth

The first step in managing the growth of VOB storage is to understand the **scrubber** and configure each VOB's pools to be scrubbed in a way that is appropriate to the growth and access patterns of the VOB. Several basic rules the govern use of the **scrubber**:

- Cleartext pools are scrubbed to control their size. These pools are essentially caches; scrubbing unneeded data containers in a cleartext pool has little or no effect on ClearCase performance.
- Derived object pools are scrubbed to delete DO data containers that are no longer being used by any view (those whose *reference counts* are zero). Scrubbing also removes the corresponding derived objects from the VOB database.
- Source pools are never scrubbed.

In the default configuration, the **scrubber** runs nightly as part of a scheduled task managed by the ClearCase schedule service. You can also run it manually.

ClearCase also includes a **vob_scrubber** utility that can remove unneeded metadata from the VOB database itself.

Scrubbing VOB Storage Pools

Storage pools are scrubbed by the **scrubber** utility. Each derived object and cleartext storage pool has its own scrubbing parameters, which control how the **scrubber** processes that pool. To change the way VOB storage pools are scrubbed, you can change the scrubbing parameters for an individual pool using the ClearCase Administration Console or a **mkpool –update** command. See *Adjusting Default Scrubbing Parameters* on page 209 for more information on modifying a pool's scrubbing parameters.

Scrubbing VOB Databases

Almost every change to a VOB is recorded in the VOB database as an *event record*. Some event records have permanent value, such as those for the creation of elements and versions. Others may not be useful to your organization or may lose their value as time passes. (For example, you probably don't care about the removal of an unneeded or obsolete version label.)

Each host has a scrubber configuration file, *ccase-home-dir***config\vob\vob_scrubber_params**, which controls **vob_scrubber** operation for all VOBs on that host. If you need more control over scrubbing schedules, you can create a scrubber parameters file for each VOB. This file is also named **vob_scrubber_params**, but it is located in the VOB storage directory. See the **vob_scrubber** reference page for more information.

NOTE: Deleting event records and other metadata from the VOB database, using the **vob_scrubber** or any other mechanism (**rmver**, **rmelem**, **relocate**, and so on) increases the amount of free space within these files so that they can accommodate newly created event records and derived objects, but does not reduce the disk space used by the VOB database. A regularly scrubbed VOB database grows slowly and should not require further intervention to keep growth under control. However, if you must occasionally force a reduction in the size of a VOB database, scrub it, and then run the **reformatvob** command.

Adjusting Default Scrubbing Parameters

Typical motivations for adjusting a VOB host's default procedures for storage pool scrubbing include:

- **Not enough space.** The disk partitions in which VOB storage pools reside may fill up frequently. A more aggressive scrubbing strategy may be necessary.
- **Not enough time.** The **scrubber** utility may be taking too much time to complete, interfering with other overnight activities, such as nightly software builds. A less aggressive scrubbing strategy may be necessary.

You may need to experiment. For example, adjusting scrubbing to take place less frequently may cause disk-space problems that you had not previously experienced. Before making any scrubbing adjustments on a VOB host, be sure to analyze its **scrubber_log** file. The **scrubber** reference page explains how to read this file.

NOTE: If you use a Windows backup tool that changes the time stamps in VOB storage directories, the DO and cleartext pools in those directories may never be scrubbed. The **scrubber** command, by default, scrubs objects that have not been referenced for the last 96 hours. If such a backup tool runs every night, the access time on objects in the pools is reset every night and the objects are never scrubbed.

The following sections present some simple examples of adjusting the way VOB storage pools are scrubbed.

Scrubbing Derived Objects More Often

By default, **scrubber** allows data containers of unreferenced derived objects to remain in their storage pools for 4 days (96 hours). If DOs are filling up a VOB's disk partition, you can shorten this grace period. This command empties a VOB's default DO storage pool (**ddft**) of unneeded data containers every 24 hours:

cleartool mkpool –update –age 24 ddft@*vob-tag*
```
Updated pool "ddft".
```

Fine-Tuning Derived Object Scrubbing

Suppose that the adjustment in the grace period is not enough to keep the disk partition from filling up. You may decide to run the **scrubber** utility more often: during the work day as well as overnight. To minimize the impact on users during the work day, you can pinpoint the

scrubbing—perhaps to the DOs created in a particular directory. This example shows the UNIX command line syntax for moving a DO pool and scrubbing it more often:

1. **Determine the directory's current DO storage pool assignment.** You will need to clean up this storage pool.

   cd /vobs/proj
   cleartool describe –long reorg@@
   ```
   directory element "reorg@@":
     .
     .
     ...  derived pool: ddft
   ```

   This directory uses the default DO pool.

2. **Assign the directory to a separate storage pool.** This assignment enables finer control of scrubbing, which can be invoked on a per-pool basis:

   cd /vobs/proj
   cleartool mkpool –derived new_do_pool
   ```
   Comments for "new_do_pool":
   ```
   pool for DOs created in /vobs/proj/reorg
   .
   ```
   Created pool "new_do_pool".
   ```
   cleartool chpool new_do_pool reorg
   ```
   Changed pool for "reorg" to "new_do_pool".
   ```

3. **Determine the location of the VOB storage directory**. You'll need the pathname of the VOB's storage directory for **scrubber**. Use **lsvob** to determine the pathname:

   cleartool lsvob /vobs/proj
   ```
   * /vobs/proj /net/ccsvr03/vobstore/proj.vbs
   ```

4. **Scrub the new storage pool thoroughly and often**. There are many ways to accomplish this. You can create a new task for the ClearCase scheduler that invokes the **scrubber** utility for your new pool:

   ```
   "$ATRIAHOME/etc/scrubber –e –p new_do_pool \
      /net/ccsvr03/vobstore/proj.vbs"
   ```

   This script invokes the **scrubber** utility on the derived object storage pool **new_do_pool**. The **–e** option to **scrubber** empties the pool of all zero-referenced DOs.

You can then register your task in the scheduler's task database and create a new scheduled job to execute the task several times per day. For more information on tasks and jobs, see Chapter 28, *Managing Scheduled Jobs*.

5. **Clean up the old DO storage pool**. The **chpool** command in Step #2 does not move existing DO data containers; it only affects where a new DO's data container is stored. Accordingly, you should clean up the old storage pool:

   ccase-home-dir/**etc/scrubber –e –p ddft /net/ccsvr03/vobstore/proj.vbs**

Scrubbing Less Aggressively

If the ClearCase scheduler's scrubbing regimen takes too long (perhaps spilling over into the work day), you can make the starting time for the ClearCase default Daily VOB Pool Scrubbing job earlier. Alternatively, you can disable the Daily VOB Pool Scrubbing job and define your own job that changes the way that scrubber is invoked, so that it takes less time to run.

Here's how you can revise scrubbing to process DO pools only, leaving cleartext pools alone:

1. Define a task whose executable program invokes the scrubber as follows:

   ```
   ccase_home_dir/etc/scrubber –f –a –k do
   ```

2. Register the task in the scheduler's task database.

3. Define a new job in the scheduler that runs your task daily. Choose an appropriate starting time.

4. Disable the ClearCase default Daily VOB Pool Scrubbing Job in the scheduler. You can disable a job by setting its end date to a time in the past or by deleting the job.

5. Check all other jobs with sequential schedules. Change the schedule for any job that is defined to follow the ClearCase default Daily VOB Pool Scrubbing job to follow your new job instead. The ClearCase default Daily VOB Snapshots job follows Daily VOB Pool Scrubbing, so you must change this job to follow your new job.

11.3 Removing Unneeded Versions from a VOB

Scrubbing only removes artifacts that can be regenerated. Scrubbing never removes versions of elements. Because elements and versions are historical data, you should approach their removal with extreme caution. Removing entire elements, using **rmelem**, is particularly dangerous:

- Even if an element is no longer needed for ongoing work, you may need it to reproduce and maintain earlier work.
- **rmelem** removes the element's name from all directory versions in which it was ever cataloged. This erasing of history means that the element does not appear in listings or comparisons of old directory versions. Removing an element's name from a VOB directory, using the **rmname** command, preserves its history but makes its name invisible in subsequent versions of the directory.
- Making a mistake can be costly; there is a procedure for recovering from backup an element that was deleted mistakenly, but it's cumbersome. (See *Restoring an Individual Element from Backup* on page 197.)

If you need to reclaim disk space, it is more prudent to remove individual versions of elements, rather than entire elements. The **rmver** command makes it easy to remove versions that you believe you will probably never need again.

By default, **rmver** removes only versions of little use:

- Versions that are unrelated to branching: not located at a branch point and not the first or last version on a branch
- Versions that have no metadata annotations: version labels, attributes, or hyperlinks

You can also use the **cleartool relocate** command to move entire VOB directories and all the element versions they contain from one VOB to another. Chapter 15, *Splitting VOBs with relocate*, has more information on this procedure.

11.4 Creating Additional Storage Pools

You can create as many additional storage pools as you need and adjust their contents as necessary using the ClearCase Administration Console or the **cleartool** command line. On UNIX hosts, you can optionally create remote storage pools.

Tools for Working with Storage Pools

You can use the ClearCase Administration Console on a Windows host to manage storage pools on Windows or UNIX hosts anywhere in your ClearCase network. Navigate to the Pools

subnode of the VOB storage node for a VOB. The VOB storage node is itself a subnode of the host node for the host on which the VOB storage directory resides. Using the Pools node, you can create, delete, and rename a storage pool and change the parameters used for scrubbing a pool.

You can also use the **cleartool** command line. The following **cleartool** subcommands are basic tools for working with VOB storage pools. Each has its own reference page in the *Command Reference*, which provides complete details on its use.

cleartool Subcommands

mkpool
: Creates a new storage pool; with **–update**, it adjusts an existing pool's scrubbing parameters.

lspool
: Lists basic information about one or more storage pools. The **describe pool:***pool-name* command lists the same information.

rename pool:*pool-name*
: Renames a storage pool.

rmpool
: Deletes a storage pool.

chpool
: Reassigns elements to a different pool.

checkvob
: Finds and fixes inconsistencies between the VOB database and VOB storage pools.

space –vob
: Reports disk space used by the VOB database and each storage pool.

dospace
: Reports disk space used by shared derived objects.

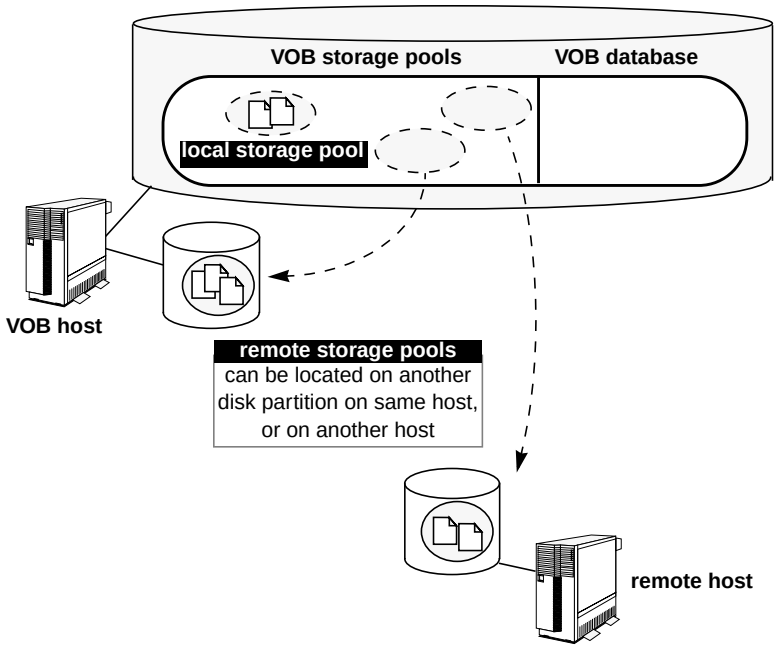
11.5 Creating Remote Storage Pools on UNIX Hosts

On UNIX hosts, which support symbolic links to file systems on other UNIX hosts or on Network Attached Storage devices, you can distribute a VOB's storage pools to provide additional expansion capacity for VOB storage. These remote pools can be on another host or in another disk partition on the local host (Figure 16). Either way, this capability enables a VOB to circumvent the UNIX restriction that a directory tree must be wholly contained within a single disk partition. It also allows you to locate storage pools on dedicated file server hosts on which ClearCase is not installed.

There are several requirements to consider when deciding whether to use remote storage pools:

- VOB backup and recovery can be more complicated for a VOB that uses remote storage pools than for a VOB that is contained within in a single disk partition. See *Backing Up a UNIX VOB with Remote Storage Pools* on page 176.
- The remote location must accessible over the network by all ClearCase hosts that use the VOB. A remote host with multiple network interfaces (and multiple host names) may not work in this role.
- Unless the entire VOB storage directory is located on a Network Attached Storage device, the VOB database (**db** subdirectory) must be physically located on the VOB server host. You may not use a symbolic link for the VOB database directory.

Figure 16 Local and Remote VOB Storage Pools



When deciding which hosts to use for new storage pools, consider that each kind of storage pool has a different pattern of use:

- **Source pools.** These pools store the most precious data: checked-in versions of file elements. Traffic to and from these pools is relatively light, but data integrity is very important. We recommend that you keep source storage pools local, within the VOB storage directory. This strategy optimizes data integrity: a single disk partition contains all of the VOB's essential data. It also simplifies backup/restore procedures. These concerns typically override performance considerations, because losing a source pool means that developers must re-create the lost versions If you decide to use remote source pools, choose a robust file server for which you provide frequent, reliable data backups.

- **Cleartext pools.** These pools probably get the heaviest traffic (assuming that many of your file elements are stored in delta and/or compressed format). But the data in cleartext pools is expendable, because ClearCase can reconstruct it from the source pools. The ideal location for cleartext pools is a machine with a fast file system.

- **Derived object pools.** These pools can become quite large, depending on the number of active configurations (three new development projects, two old releases in maintenance, and so on) you need to maintain. Anticipate the storage requirements in the new pool for

each active configuration; make sure the disk partition can handle the total storage requirement.

Example: Assigning All Files in a Directory to a New Pool

The following example shows how to create a new, remote source storage pool, and then reassign all the current and future elements in a particular directory to the new pool.

1. **Create the new storage pool**. Specify a global pathname for the remote pool that is valid for all hosts that will access the VOB.

   ```
   cd /vobs/bgr
   cleartool mkpool –source –ln /net/ccsvr02/ccase_pools/bgrsrc2 bgrsrc2
   Comments for "bgrsrc2":
   remote source storage pool
   .
   Created pool "bgrsrc2".
   ```

2. **Reassign existing file elements to the new pool.** This example reassigns all the file elements in a particular development subdirectory.

   ```
   cd libbgr
   cleartool find . –type f –exec 'cleartool chpool –force bgrsrc2 $CLEARCASE_PN'
   Changed pool for "./Makefile" to "bgrsrc2".
   Changed pool for "./errmsg.c" to "bgrsrc2".
   Changed pool for "./fork3.c" to "bgrsrc2".
   Changed pool for "./get.c" to "bgrsrc2".
   Changed pool for "./getcwd.c" to "bgrsrc2".
     .
     .
   Changed pool for "./stint.h" to "bgrsrc2".
   Changed pool for "./strut.c" to "bgrsrc2".
   ```

3. **Reassign the directory element to the new pool, too.** All newly created file (and directory) elements in this directory use the new pool, also.

   ```
   cleartool chpool bgrsrc2 .
   Changed pool for "." to "bgrsrc2".
   ```

Example: Moving an Existing Storage Pool to Another Disk

Use the following procedure to move an existing storage pool:

1. **Determine the location of the storage pool**. Use the **lspool** command:

   cleartool lspool –long d_aux@/vobs/bgr
   ```
   pool "d_aux"
    .
    .
   pool storage global pathname
   "/net/ccsvr01/vobstore/bgr.vbs/d/d_aux"
   ```

2. **Lock the VOB**. Any new shared DOs are not being placed in the storage pool while you are working on it:

   cleartool lock vob:/vobs/bgr
   ```
   Locked versioned object base "/net/ccsvr01/vobstore/bgr.vbs".
   ```

3. **Copy the contents of the storage pool**. The storage pool is a standard UNIX directory. You can copy its contents to a new location using **cp**, **rcp**, **tar**, or other commands. For example:

   rlogin ccsvr01
   mkdir –p /vobstore_2/DO_pools
   cp –r /vobstore/bgr.vbs/d/d_aux /vobstore_2/DO_pools

4. **Replace the old storage pool with a symbolic link**. Move the old storage pool aside; then create the link in its place.

   cd /vobstore/bgr.vbs/d
   mv d_aux d_aux.MOVED
   ln –s /net/ccsvr01/vobstore_2/DO_pools/d_aux d_aux

   Be sure the text of the symbolic link is a globally valid pathname to the new storage pool location.

5. **Unlock the VOB.**

   cleartool unlock vob:/vobs/bgr
   ```
   Unlocked versioned object base "/net/ccsvr01/vobstore/bgr.vbs".
   ```

6. **Remove the old storage pool**. When you have verified that the storage pool is working well in its new location, you can remove the old pool:

rm –fr /vobstore/bgr.vbs/d/d_aux.MOVED

NOTE: If a VOB-tag exists for the VOB in a Windows region, you need to re-create that VOB-tag to account for the relocated storage pool. See *Windows Tags for UNIX VOBs with Symbolically Linked Storage* on page 112.

12 Moving VOBs

VOBs cannot be copied from one location to another using an ordinary file copy utility. Special procedures must be followed to maintain the integrity of VOB data and to preserve permissions and ownership on VOB storage directories. This chapter presents procedures for moving VOBs. The following scenarios are covered:

- Moving a VOB from one disk partition to another on Windows or between two Windows hosts in the same domain.
- Moving a VOB from a Windows host in one domain to a Windows host in another domain.
- Moving a VOB from one disk partition to another on UNIX or between one UNIX host and another UNIX host with the same binary format.
- Moving a VOB from one UNIX host to another UNIX host with a different binary data format.
- Moving a VOB from a Windows host to a UNIX host.
- Moving a VOB from a UNIX host to a Windows host.

In addition, this chapter describes special considerations you must take when moving a replicated VOB.

CAUTION: Failure to follow the instructions in this chapter when you move a replicated VOB may result in replica divergence and data loss.

12.1 Important Steps to Take When Moving Any VOB

Although the procedures described in this section differ in various ways, the following steps should be considered when moving any VOB.

- Unless you are moving a VOB between UNIX and Windows, or from one Windows domain to another, make sure that the ownership and access control information for the VOB storage directory is preserved when the directory is copied. Not all file system copy utilities—especially on Windows—preserve this information. If this information is changed during the copy step of the VOB move procedure, the VOB will not be usable in its new location until the protections are corrected. Rational ClearCase provides several programs that can correct damaged file system protections if necessary. See Chapter 35, *Repairing VOB and View Storage Directory ACLs on Windows* for more information on this topic.
- All of the VOB move procedures described in this chapter preserve the original VOB storage directory. After you are sure that the VOB can be accessed at its new location, delete the old VOB storage directory to free the storage it would otherwise consume.
- If VOB database snapshot backups are enabled for the VOB, use the **vob_snapshot_setup** program to disable them before you begin the move, and enable them again after the move is complete.
- Optionally, scrub the VOB's cleartext pools before moving the VOB. This reduces the size of the VOB storage directory.
- Ask users who are working in dynamic views to unmount the VOB before you begin any VOB move procedure and remount it after the procedure is complete.

CAUTION: Never register more than one copy of a VOB in a ClearCase registry. Although the procedures described in this chapter copy the VOB storage directory, none of them registers the copy before the original has been unregistered. If more than one copy of a VOB is registered in the same registry, even if they have tags in separate regions, severe ClearCase errors, including potential data loss, will occur.

12.2 Special Considerations for Replicated VOBs

If you are moving a VOB replica to a new host, take the following steps first:

1. **Make sure the replica masters its own replica object.** For a replica named **portland**:

a. Check which replica has mastership of the **portland** replica object:

cleartool describe replica:portland@\libpub
...
```
master replica: west
```

b. If the replica object is not self-mastered, change its mastership. At the replica that masters the replica object:

multitool chmaster replica:portland@\libpub replica:portland@\libpub

This step is not mandatory, but it is generally recommended that all replicas master their own replica objects. (You can make this change at any time, as long as the replicas are synchronized.) For the purposes of moving a replica, this self-mastership prevents your team from having to diagnose and repair misdirected packet problems that may result after the move. If the replica object names the wrong host, packets are sent to that host. (If this happens, move misdirected packets to the correct host and then import them.)

2. **Change the replica's host name property.** After the last export from the replica's current location, use **multitool chreplica** to update the replica's host name. You must run this command from the site that masters the replica, which is the current site in most cases:

multitool chreplica –host *target-host* **replica:portland@\libpub**
```
Updated replica information for "portland".
```

NOTE: All replicas that export to the replica to be moved must be updated after the move through synchronizations from the moved replica's site (or from the site that executed the **chreplica** command in Step #2, if it was not the current site).

12.3 Moving a VOB on Windows

This section describes procedures for the following types of VOB moves involving Windows platforms:

- moving a VOB to another host in the same domain. This procedure also applies when moving a VOB from one partition to another on a host.
- moving a VOB to a host in another domain

Moving a VOB Within a Domain

The following procedure describes how to move the VOB **\libpub** from storage directory **C:\ClearCaseStorage\VOBs\libpub.vbs** on VOB server host **\\sol** to a storage directory shared as **vobstg** on VOB server host **\\ccsvr01**. The procedure to move the VOB to a new partition on **\\sol** would be similar.

1. **Log on to the VOB's current server as the VOB owner or privileged user.** In this example, the VOB's current server is **\\sol**.

2. **Lock the VOB**.

3. **Stop ClearCase** on the VOB server host.

4. **Copy the VOB storage directory, preserving all ownership information**. You must use a copy utility that preserves ownership information contained in the VOB storage directory ACLs. Typical Windows file system copy utilities like **copy** and **xcopy** do not preserve this information. We recommend using the ClearCase utility *ccase-home-dir***\etc\utils\ccopy** for this purpose.

   C:\ClearCaseStorage\VOBs> net use E: \\ccsvr01\vobstg
   C:\ClearCaseStorage\VOBs> ccopy libpub.vbs E:\libpub.vbs

   NOTE: Although **ccopy** copies all of the ownership information required by ClearCase, it does not copy the full security descriptor of an object, and therefore effectively grants the user who executes this step full access to the copy of the VOB storage directory. If this step is not executed by the VOB owner, you may want to use a different copy program, such as **scopy /s /o** from the Windows NT Resource Kit or **xcopy /o** on Windows 2000 or Windows XP, that copies the VOB storage directory but does not grant the user additional rights to it.

5. **Restart ClearCase** if you have copied the VOB storage directory to a new location on the same VOB server host.

6. **Replace the VOB object and tag** with new ones that reference the new VOB storage directory. Use the ClearCase Administration Console, or the following commands (this example applies to the destination on server **ccsvr01**):

   cleartool register -vob -replace \\ccsvr01\vobstg\libpub.vbs
   cleartool mktag -vob -replace –tag \libpub \\ccsvr01\vobstg\libpub.vbs

   NOTE: If you are registering a Unified Change Management project VOB, you must supply the **–ucmproject** option to the **register** command.

7. **Unlock the VOB.**

8. **Verify that all clients can access the VOB at the new location.**

Moving a VOB to a Different Domain

On Windows, VOBs formatted with schema version 54 store Windows security identifiers (SIDs) to represent users, groups, and resources (hosts). When you move a VOB to a different domain, these SIDs become invalid and must be changed (mapped) to ones that are valid in the new domain. ClearCase includes a utility program, **vob_sidwalk**, that provides a flexible means of mapping SIDs when you move a VOB to a different domain. We strongly recommend that you review the reference page for **vob_sidwalk** before continuing with this procedure.

The following procedure describes how to move the VOB **\libpub** from storage directory **C:\ClearCaseStorage\VOBs\libpub.vbs** on VOB server host **\\sol**, which is in the **OLD** domain, to a storage directory shared as **vobstg** on VOB server host **\\ccsvr-new**, which is in the **NEW** domain. To execute this procedure, you must be able to log in to both the **OLD** and **NEW** domains as the VOB owner of **\libpub** or as the privileged user.

1. **Be sure the VOB has been formatted with schema version 54**. Earlier schema versions do not support moving a VOB across domains. You can use the ClearCase Administration Console or the **cleartool describe** command to determine a VOB's schema version. If the VOB is not formatted with schema version 54, reformat it using **reformatvob**. (All VOBs on a server must be formatted with the same schema version.)

2. **Log on to the VOB server host as the VOB owner or privileged user.** In this example, the VOB server host for this step is **\\sol**.

3. **Lock the VOB.** This ensures that no new VOB objects will be accidentally created while you are performing Step #4 of this procedure.

4. **Generate a SID file** that lists the names of users and groups associated with objects in **\libpub**. Run **vob_siddump** as shown in the following example to generate a SID file in comma-separated-value (csv) format:

   *ccase-home-dir***\etc\utils\vob_siddump \libpub ^**
   C:\ClearCaseStorage\VOBs\libpub.vbs\libpub.csv

   We suggest creating the SID file in the VOB storage directory so that it will be available on the new VOB host after the storage directory has been moved. You will need it Step #10 of this procedure.

5. **Stop ClearCase** on the VOB server host **\\sol**.

6. **Copy the VOB storage directory** to the new location.

   C:\ClearCaseStorage\VOBs> net use E: \\ccsvr-new\vobstg
   C:\ClearCaseStorage\VOBs> ccopy libpub.vbs E:\libpub.vbs

   NOTE: Because the existing VOB storage directory ACLs will be meaningless in the new domain, you can use **xcopy** or a similar utility instead of the ClearCase utility *ccase-home-dir***\etc\utils\ccopy** in this procedure.

7. **Fix the VOB storage directory protections.** Log on to the VOB server host in the new domain (**\\ccsvr-new** in our example) as the VOB owner for **\libpub** or as a privileged user. Run the **fix_prot** utility as shown in the following example, where **vobadm** is the name of the new VOB owner, **ccusers** is the name of the VOB's new principal group, and **V:\vobstg\libpub.vbs** is the host-local pathname of the VOB storage directory on **\\ccsvr-new**.

   *ccase-home-dir***\etc\utils\fix_prot -root -r -chown vobadm -chgrp ccusers ^**
   V:\vobstg\libpub.vbs

8. **Replace the VOB object and tag** with new ones that reference the new VOB storage directory. Use the ClearCase Administration Console, or the following commands:

   cleartool register -vob -replace \\ccsvr-new\vobstg\libpub.vbs
   cleartool mktag -vob -replace –tag \libpub \\ccsvr-new\vobstg\libpub.vbs

   If **\\ccsvr-new** is not in the same registry region as **\\sol**, you do not need to use the **-replace** option to **cleartool register** and **cleartool mktag**, but you should remove the old registration and tag for **\libpub**, which will be invalid after the move.

   NOTE: If you are registering a Unified Change Management *Process VOB*, you must supply the **–ucmproject** option to the **register** command.

9. **Lock the VOB.** Although the VOB is now registered and has a tag, it will not be usable until this procedure is complete. If you are concerned that users may try to access the VOB before it is ready, lock it now.

10. **Create a map file.** Open the SID file you generated in Step #4 of this procedure (**\\ccsvr-new\vobstg\libpub.vbs\libpub.csv**). Editing this file may be simplified if you use a spreadsheet program that can read the comma-separated-value format. This example

shows one line of such a file. We've added a header row for clarity and truncated the SID string to save space.

Old-name	Type	Old-SID	New-name	Type	New-SID	Count
OLD\akp	USER	NT:S-1-2-21-532...	IGNORE	USER		137

For each line in the file, replace the string **IGNORE** in the **New-name** field with a string made up of the new domain name and the user name from the **Old-name** field; then delete the last three fields (**Type**, **New-SID**, and **Count**). In this example, old domain's name is OLD and the new domain's name is NEW, so the line would change as shown here:

Old-name	Type	Old-SID	New-name	Type	New-SID	Count
OLD\akp	USER	NT:S-1-2-21-532...	NEW\akp			

Although this example shows a user name that is the same in the old and new domains, the procedure can also be used to map a user or group name from the old domain to a different user or group name in the new domain.

After you have edited all the rows of the SID file, save it as a comma-separated-value file and use it as the mapping file required when you run **vob_sidwalk -map**. Each line of the mapping file must have exactly four fields, separated by commas. The example row created in this step would look like this in .csv form:

OLD\akp,USER,NT:S-1-2-21-532...,NEW\akp

NOTE: You may reassign ownership of any object in a VOB to the VOB owner by placing the string **DELETE** in the **New-name** field. You may also reassign ownership of all objects in a VOB to the VOB owner without creating a mapping file. See *Reassigning Ownership to the VOB Owner* on page 70.

11. **Test the map file.** Run **vob_sidwalk** without the **-execute** option. The list of mappings prescribed by the map file **libpub-map.csv** is written to the SID file (**libpub-test.csv** in this example), but no changes are made to the VOB.

    *ccase-home-dir***etc\utils\vob_sidwalk -map ^**
    \\ccsvr-new\vobstg\libpub.vbs\libpub-map.csv \libpub libpub-test.csv

12. **Unlock the VOB.** If you are concerned that users may try to access the VOB before this procedure is complete, lock the VOB again for all users except yourself.

13. **Update user and group identities stored in the VOB.** When you are satisfied that the map file is correct, run **vob_sidwalk** as shown in the following example, where **libpub-map.csv** is the map file you created in Step #10 of this procedure:

    *ccase-home-dir***etc\utils\vob_sidwalk -execute -map ^**
    \\ccsvr-new\vobstg\libpub.vbs\libpub-map.csv \libpub libpub-exec.csv

    vob_sidwalk remaps ownership as specified in the map file and records the changes that were made in **libpub-exec.csv**.

14. **Recover file system ACLs.** Finally, while you are still logged in to **\\ccsvr-new** as the VOB owner or privileged user, use **vob_sidwalk** with the **-recover_filesystem** option to apply the correct ACLs to the VOB storage directory.

    *ccase-home-dir***etc\utils\vob_sidwalk -recover_filesystem \vobstore2\libpub**

15. **Verify that all clients in the new domain can access the VOB.** Unlock the VOB if it is still locked.

16. **Verify that all ClearCase users in the new domain can access objects in the VOB.** Users should be able to create new objects as well as change or remove objects they own.

    NOTE: If the user's name in the new domain is not the same as in the old domain, the user ill loses rights associated with the creator of a version or a branch. For example, the user would not be able to remove a version even though the user had created that version. These operations can still be executed by a more privileged user (VOB owner, member of the ClearCase administrators group).

12.4 Moving a VOB on UNIX

This section describes procedures for the following types of VOB moves involving UNIX platforms:

- Moving a VOB to another UNIX VOB server host that has the same architecture (binary data format). This procedure also applies when moving a VOB from one partition to another on a UNIX VOB server host.
- Moving a VOB to another UNIX VOB server host that has a different architecture.

For clarity, the procedures in this section use an example:

- The current location of the VOB storage directory to be moved is **/vobstore/libpub.vbs**, on a host named **sol**.
- The VOB tag is **/vobs/libpub**.
- The new location for the VOB storage directory is **/vobstore2/libpub.vbs**. The example includes these cases:
  - The new location is also on **sol**.
  - The new location is on another host, named **ccsvr04**.

If the VOB Has Remote Pools

Any of the VOB move procedures described in this section can be used to move a VOB that has remote pools. Before you begin the VOB move procedure, take the following steps to determine whether the VOB has any remote pools, and to ensure that the pools will be accessible after the VOB has been moved.

1. **Determine whether the VOB has any remote storage pools.**

   cleartool lspool –long –invob /proj/libpub | egrep '(^pool|link)'
   ```
   pool "cdft"
   pool "ddft"
   pool "sdft"
   pool "s_2"
     pool storage link target pathname "/net/ccsvr04/ccase_pools/s_2"
   ```

   The output of **lspool** shows that this VOB has remote pool, **s_2**.

2. **Verify that the remote pools are accessible on the target host**. Moving a VOB storage directory does not move any of its remote storage pools. You must make sure that the VOB's new host can access each remote storage pool using the same global pathname as the VOB's current host:
   - If you are moving the VOB to another location on the same host, the validity of remote storage pool global pathnames is assured.
   - If you are moving the VOB to a different host, log on to that host and verify that all the remote storage pool global pathnames are valid on that host.

Consolidating Remote Pools

If you are moving a VOB that has remote pools from UNIX to Windows, you must consolidate the remote pools before you move the VOB. You may also want to use this procedure to consolidate a VOB's remote pools after the VOB has been moved to a NAS device (see *Moving a VOB to NAS* on page 378).

1. **Log in to the VOB server host as the VOB owner or root**.

2. **Find the remote pools.** Go to the VOB storage directory and determine the locations of all remote pools and the links that point to them. In this example, the UNIX **find(1)** command shows a single symbolic link to a remote pool.

   ```
   cd /vobstg/libpub.vbs
   find . -type l -exec ls -l {} \;
       lrwxrwxrwx   1 root           12 Dec 30  1999
       d/ddft_2 ->/net/ccsvr5/pools/libpub/d/ddft_2
   ```

3. **Replace each remote pool with a local directory.** For each remote pool, replace the link with a local copy of the pool. You must preserve file and directory protection and ownership information during this operation. These two UNIX commands would remove the symbolic link **d/ddft_2**, and then replace it with the contents of the link's target, **/net/ccsvr5/pools/libpub/d/ddft_2**. (Note that if the target had a different terminal leaf, you would need to ensure that the contents were copied into a local directory named **ddft_2**.)

   ```
   # rm d/ddft_2
   # cd /net/ccsvr5/pools/libpub/d; tar -cf - ddft_2 | (cd /vobstg/libpub.vbs; tar -xBpf-)
   ```

4. **Verify that the VOB has no remote pools.** Stop and restart ClearCase on the VOB server host; then verify that the VOB has no remote pools by using the **lspool** command.

   ```
   cleartool lspool -long -invob /vobs/libpub
   ```

   The output of **lspool** should list no link targets.

5. **Modify the VOB tag.** If the consolidated VOB is not being moved to a new host (for example, if the VOB storage is being moved to a NAS device but the VOB server host remains the same) and has a tag in a Windows region, the tag must be modified to remove the split pool map. Use the ClearCase Administration Console's Registry Regions node. The Properties page for the VOB-tag has a **Mount Options** tab that allows you to edit the split pool map if you are logged in as a member of the ClearCase administrators group (or another group that has permission to change the tag registry). If you cannot use the ClearCase Administration Console, use **cleartool mktag -replace** to remove the VOB-tag and re-create it without a split pool map.

6. **Verify that users can access the consolidated pools.** After you have tested the VOB, you may delete the old remote pool storage.

NOTE: Check and modify your VOB backup procedures after you have consolidated remote pools. Be sure that the newly consolidated pools are backed up with the rest of the VOB and that the old remote pools are no longer being backed up. If you restore backups of the VOB that were made before the pools were consolidated, the remote pools are re-created, and the restored VOB is not usable.

If the VOB Is Exported for Non-ClearCase Access

Any of the VOB move procedures described in this section can be used to move a VOB that has been exported for non-ClearCase access. Before you begin the VOB move procedure, stop any export views that export this VOB. After the move is complete, restart the export views.

See *Setting Up an Export View for Non-ClearCase Access* on page 344 for more information on export views.

Moving a VOB Between UNIX Hosts (Same Architecture)

Use the following procedure to move a VOB from one disk partition to another on a UNIX VOB server host, or between one UNIX VOB server host and another one with the same architecture.

1. **Log on to the VOB server host as root.**
2. **Lock the VOB**.
3. **Stop ClearCase** on the VOB server host:
4. **Copy the VOB storage directory**. The procedure you use depends on whether you're moving the VOB within the same disk partition or to another disk partition.

   a. If you are moving the VOB to another disk partition, use **tar** or a similar command to copy the entire VOB storage directory tree, but not any remote storage pools, to the new location.

   ➢ To the same host on a different disk partition:

   ```
   # cd /vobstore
   # tar –cf – libpub.vbs | ( cd /vobstore2 ; tar –xBpf – )
   ```

➢ To a different host:

```
# cd /vobstore
# tar –cf – libpub.vbs | rsh ccsvr04 'cd /vobstore2 ; tar –xBpf –'
```

NOTE: The **-B** option to the **tar** command may not be supported on all architectures. Also, the **rsh** command may have a different name, such as **remsh**, on some platforms. Refer to the reference pages for your operating system.

b. If you are moving the VOB storage directory within the same disk partition, use a simple **mv** command to relocate the VOB storage directory to the new location.

5. **Restart ClearCase** if you have copied the VOB storage directory to a new location on the same VOB server host.

6. **Replace the VOB object and tag** with new ones that reference the new VOB storage directory. Use the ClearCase Administration Console or the following commands (this example applies to the destination on server **sol**):

   ```
   cleartool register -vob -replace /net/sol/vobstore2/libpub.vbs
   cleartool mktag -vob -replace –tag /vobs/libpub /net/sol/vobstore2/libpub.vbs
   ```

   NOTE: If you are registering a UCM project VOB, you must supply the **–ucmproject** option to the **register** command.

7. **Unlock the VOB.**

8. **Verify that all clients can access the VOB at the new location.**

Moving a VOB Between UNIX Hosts (Different Architectures)

Use the following procedure to move a VOB from one UNIX VOB server host to another UNIX VOB server host that has a different architecture. The procedure is similar to the one described in *Moving a VOB Between UNIX Hosts (Same Architecture)*, but includes the additional steps required to dump the VOB database before it is moved and reformat it on the target host.

1. **Log on to the VOB server host as the VOB owner or root.**

2. **Dump the VOB's database** to ASCII dump files using the **cleartool reformatvob** command. You do not need to lock the VOB beforehand; the **reformatvob** command does this automatically.

   ```
   # cleartool reformatvob –dump /vobstore/libpub.vbs
   ```

reformatvob -dump marks the VOB database as invalid. It will be unusable by clients until it is processed by a **reformatvob –load** command.

3. **Copy the VOB storage directory**. First, make sure that the parent directory of the target location exists and is writable. Then, copy the VOB storage directory to the new host.

   ```
   # cd /vobstore
   # tar –cf – libpub.vbs | rsh ccsvr04 'cd /src/vobstore ; tar –xBpf –'
   ```

   NOTE: The **-B** option to the **tar** commands may not be supported on all architectures. Also, the **rsh** command may have a different name, such as **remsh**, on some platforms. Refer to the *Platform-Specific Guide* in online help for more information or check the reference pages for your operating system.

4. **Terminate the old VOB's server processes**. You may either stop and re-start ClearCase on the VOB server host, or search the process table for the **vob_server** and **vobrpc_server** processes that service the old VOB. Use **ps –ax** or **ps –ef**, and search for the VOB storage directory name (**libpub.vbs** in our example); then use **kill** to terminate any such processes.

5. **Log on to the new VOB server host as the VOB owner or root.**

6. **Re-create the VOB database from the dump files**:

   ```
   # cleartool reformatvob –load /src/vobstore/libpub.vbs
   ```

7. **Replace the VOB object and tag** with new ones that reference the new VOB storage directory. Use the ClearCase Administration Console, or the following commands (this example applies to the destination on server **sol**):

   ```
   cleartool register -vob -replace /net/sol/vobstore2/libpub.vbs
   cleartool mktag -vob -replace –tag /vobs/libpub /net/sol/vobstore2/libpub.vbs
   ```

   NOTE: If you are registering a UCM project VOB, you must supply the **–ucmproject** option to the **register** command.

8. **Unlock the VOB.**

9. **Verify that all clients can access the VOB at the new location.**

12.5 Moving a VOB Between Windows and UNIX

When you move a VOB from a Windows host to a UNIX host or vice versa, all user identity information stored in the VOB storage directory and VOB database must change. The binary data format of the VOB database must change as well. To accommodate these requirements, you must take a number of additional steps beyond those required in most other VOB move scenarios, including the following:

- Run **vob_sidwalk** before the move to capture information about ownership of objects in the VOB.
- Use **reformatvob** to dump the VOB database into a portable ASCII form.
- Copy the VOB storage directory, which includes the dumped database, to the new host.
- Use **reformatvob** to load the VOB database in the proper binary format.
- Reset the file system protections on the VOB storage directory after the move.
- Remap the SIDs (or, on UNIX, UIDs and GIDs) of owners of objects in the VOB.

These steps, along with other ones that are typical of all VOB moves, are detailed in the procedures described in this section.

NOTE: You can move a VOB between Windows and UNIX only if both hosts are configured to support schema version 54.

Schema Version Compatibility

vob_sidwalk and **vob_siddump** are not compatible with VOB schema version 53. **vob_sidwalk** is installed only on hosts that are configured to support local VOBs and views and to support VOB schema version 54. **vob_siddump**, which is not restricted to operating on local VOBs, is installed on all hosts.

Before a VOB formatted with schema version 54 can be moved from Windows to a UNIX host, the UNIX host must be configured to support VOB schema version 54. Not all UNIX hosts have this capability. You cannot reformat a VOB from schema version 54 to schema version 53. You cannot move a VOB formatted with schema version 53 from a UNIX host to a Windows host that supports schema version 54.

Moving a VOB from Windows to UNIX

For clarity, the procedures in this section use an example:

- The current location of the VOB storage directory to be moved is **C:\ClearCaseStorage\libpub.vbs** on Windows host **ccsvr-nt**. The VOB-tag for this VOB is **\libpub**.
- The new location for the VOB storage directory is **/vobstg/libpub.vbs** on UNIX host **ccsvr-ux**. VOB-tag **/vobs/libpub** will be created for this VOB.

To move a VOB from Windows to UNIX:

1. **Log on to the Windows VOB server host as the VOB owner or privileged user.** In this example, the VOB server host for this step is **\\ccsvr-nt**.
2. **Lock the VOB.** This ensures that new VOB objects are not created while you are performing Step #3 of this procedure.
3. **Generate a SID file** that lists the names of users and groups associated with objects in **\libpub**. Run the **vob_siddump** utility as shown in this example:

   *ccase-home-dir***\etc\utils\vob_siddump -raw_sid \libpub ^**
   C:\ClearCaseStorage\libpub.vbs\libpub.csv

   We suggest creating the SID file in the VOB storage directory so that it will be available on the new VOB host after the storage directory has been moved. You will need the SID file in Step #15 of this procedure.
4. **Dump the VOB database** using the **cleartool reformatvob** command:

   cleartool reformatvob –dump C:\ClearCaseStorage\libpub.vbs

   reformatvob -dump marks the VOB database as invalid. It cannot be used by clients until it is processed by a **reformatvob –load** command.
5. **Copy the VOB storage directory**. Use any file system copy utility to copy the entire VOB storage directory to the UNIX host. This example assumes that the target UNIX host **ccsvr-ux** is running an SMB server and has shared its **\vobstg** partition.

   C:\ClearCaseStorage\VOBs> net use E: \\ccsvr-ux\vobstg
   C:\ClearCaseStorage\VOBs> *ccase-home-dir***\etc\utils\ccopy libpub.vbs E:\libpub.vbs**

NOTE: Because the existing VOB storage directory ACLs will be meaningless on the UNIX host, you can use **xcopy** or another copy program instead of the ClearCase **ccopy** utility in this case.

6. **Terminate the VOB's server processes on Windows**. Stop and restart ClearCase on the Windows VOB server host (**\\ccsvr-nt** in our example).

7. **Log on to the UNIX VOB server host as root.**

8. **Update VOB owner identity information.** Use the **fix_prot** utility as shown here to create a new **.identity** directory for the VOB. This example sets the VOB's owner to user **vobadm** and the VOB's primary group to **ccusers**:

   *ccase-home-dir***/etc/utils/fix_prot -root -recurse -chown vobadm -chgrp ccusers ^ /vobstg/libpub.vbs**

9. **Re-create the VOB database from the dump files**. Use the cleartool **reformatvob** command:

   # **cleartool reformatvob –load /vobstg/libpub.vbs**

10. **Create a tag for the VOB.** Use the ClearCase Administration Console, or the following command:

    cleartool mktag -vob -tag /vobs/libpub /net/ccsvr-ux/vobstg/libpub.vbs

    NOTE: You do not need to register the VOB, because **reformatvob -load** registers the VOB after the reformat is complete.

11. **Create a map file.** Open the SID file generated in Step #3 of this procedure (**/vobstg/libpub.vbs/libpub.csv**). Editing this file may be easier if you use a spreadsheet program that can read the comma-separated-value format. This example shows one line of such a file. We've added a header row for clarity and truncated the SID string to save space.

Old-name	Type	Old-SID	New-name	Type	New-SID	Count
OLD\akp	USER	SID:3.0105037...	IGNORE	USER		137

For each line in the file, replace the string **IGNORE** in the **New-name** field with a user or group name that is valid on the UNIX VOB server host; then delete the last three fields (**Type**, **New-SID**, and **Count**).

Old-name	Type	Old-SID	New-name	Type	New-SID	Count
OLD\akp	USER	SID:3.0105037...	akp			

Although this example shows a user name that is the same on UNIX as it was on Windows, the procedure can also be used to map a Windows user or group name to a different user or group name on UNIX.

After you have edited all the rows of the SID file, save it as a comma-separated-value file and use it as the mapping file required when you run **vob_sidwalk -map**. Each line of the mapping file must have exactly four fields, separated by commas. The example row created in this step looks like this in .csv format:

OLD\akp,USER,SID:3.0105037...,akp

NOTE: You may reassign ownership of any object in a VOB to the VOB owner by placing the string **DELETE** in the **New-name** field. You may also reassign ownership of all objects in a VOB to the VOB owner without creating a mapping file. See *Reassigning Ownership to the VOB Owner* on page 70

12. **Test the map file.** Run **vob_sidwalk** without the **-execute** option. The list of mappings prescribed by the file **libpub-map.csv** is written to the SID file (**libpub-test.csv** in this example), but no changes are made to the VOB.

    *ccase-home-dir***/etc/utils/vob_sidwalk -map /vobstg/libpub.vbs/libpub-map.csv \ /vobs/libpub /libpub-test.csv**

13. **Unlock the VOB.** If you are concerned that users may try to access the VOB before this procedure is complete, lock the VOB again for all users except yourself.

14. **Update user and group identities stored in the VOB.** When you are satisfied that the map file is correct, run **vob_sidwalk** as shown in the following example, where **libpub-map.csv** is the map file created in Step #11 of this procedure:

    *ccase-home-dir***/etc/utils/vob_sidwalk -execute -map /vobstg/libpub.vbs/libpub-map.csv \ /vobs/libpub /libpub-exec.csv**

    vob_sidwalk makes the changes specified in the map file and records the changes that were made in a new SID file, **libpub-exec.csv**.

15. **Update the VOB's group list and container protections**. Use the **vob_sidwalk** program as shown in the following example:

    *ccase-home-dir***/etc/utils/vob_sidwalk -recover_filesystem /vobs/libpub libpub.csv**

16. **Verify that all clients can access the VOB at the new location.** Unlock the VOB if it is still locked.

17. **Verify that all ClearCase users in the new domain can access objects in the VOB.** Users should be able to create new objects as well as change or remove objects they own.

Moving a VOB from UNIX to Windows

For clarity, the procedures in this section use an example:

- The current location of the VOB storage directory to be moved is **/vobstg/libpub.vbs** on UNIX host **ccsvr-ux**. The VOB-tag for this VOB is **/vobs/libpub**.
- The new location of the VOB storage directory is **C:\ClearCaseStorage\VOBs\libpub.vbs** on Windows host **ccsvr-nt**. VOB-tag **\libpub** will be created for this VOB.

To move a VOB from UNIX to Windows:

NOTE: If the VOB has remote storage pools, you must first consolidate those pools under the VOB root directory. UNIX symbolic links are not supported on Windows, so the entire VOB storage directory must reside on a single partition on the Windows host. See *Consolidating Remote Pools* on page 228 for the procedure.

1. **Log on to the VOB server host as the VOB owner or root.** In this example, the VOB server host for this step is **ccsvr-ux**.
2. **Lock the VOB.** This ensures that new VOB objects are not created while you are performing Step #3 of this procedure.
3. **Generate a SID file** that lists the names and UIDs/GIDs of users and groups associated with objects in **/vobs/libpub**. Run the **vob_siddump** utility as shown in this example:

   *ccase-home-dir***/etc/utils/vob_siddump /vobs/libpub /vobstg/libpub.vbs/libpub.csv**

   We suggest creating the SID file in the VOB storage directory so that it will be available on the new VOB host after the storage directory has been moved. You will need it in Step #15 of this procedure.
4. **Dump the VOB database** using the **cleartool reformatvob** command:

   cleartool reformatvob –dump /vobstg/libpub.vbs

   reformatvob -dump marks the VOB database as invalid. It will be unusable by clients until it is processed by a **reformatvob –load** command.

5. **Copy the VOB storage directory**. Use any file system copy utility to copy the entire VOB storage directory to the Windows host. This example assumes that the UNIX host **ccsvr-ux** is running an SMB server and has shared its **\vobstg** partition. From the Windows host, run these commands:

   C:\ClearCaseStorage\VOBs> net use E: \\ccsvr-ux\vobstg
   C:\ClearCaseStorage\VOBs> *ccase-home-dir***\etc\utils\ccopy E:\libpub.vbs libpub.vbs**

   NOTE: Because the existing VOB storage directory ACLs are not supported on the UNIX host, you can use **xcopy** or a similar utility instead of the ClearCase utility *ccase-home-dir***\etc\utils\ccopy** in this case.

6. **Terminate the VOB's server processes on UNIX**. You may either stop and restart ClearCase on the VOB server host or search the process table for the **vob_server** and **vobrpc_server** processes that service the old VOB. Use **ps –ax** or **ps –ef**, and search for the VOB storage directory name (**libpub.vbs** in our example), then use **kill**(1) to terminate any such processes.

7. **Fix the VOB storage directory protections.** Log in to the Windows VOB server host (**\\ccsvr-nt** in our example) as the VOB owner of **\libpub** or as a privileged user. Run the **fix_prot** utility as shown in the following example, where **vobadm** is the name of the new VOB owner, **ccusers** is the name of the VOB's new principal group, and **C:\ClearCaseStorage\VOBs\libpub.vbs** is the host-local pathname of the VOB storage directory.

   *ccase-home-dir***\etc\utils\fix_prot -root -r -chown vobadm -chgrp ccusers ^**
   C:\ClearCaseStorage\VOBs\libpub.vbs

8. **Re-create the VOB database from the dump files**. Use the cleartool **reformatvob** command:

   cleartool reformatvob -load C:\ClearCaseStorage\VOBs\libpub.vbs

9. **Create a tag for the VOB.** Use the ClearCase Administration Console, or the following command (assuming that **C:\ClearCaseStorage** is shared as **\\ccsvr-nt\ClearCaseStorage**):

   cleartool mktag -vob -tag \libpub \\ccsvr-nt\ClearCaseStorage\VOBs\libpub.vbs

   NOTE: You do not need to register the VOB, because **reformatvob -load** registers the VOB after the reformat is complete.

10. **Lock the VOB.** Although the VOB is now registered and has a tag, it will not be usable until this procedure is complete. If you are concerned that users may try to access the VOB before it is ready, lock it now.

11. **Create a map file.** Open the SID file generated in Step #4 of this procedure (**\\ccsvr-nt\ClearCaseStorage\VOBs\libpub.vbs\libpub.csv**). Editing this file may be easier if you use a spreadsheet program that can read the comma-separated-value format. This example shows one line of such a file. We've added a header row for clarity.

Old-name	Type	Old-SID	New-name	Type	New-SID	Count
akp	USER	UNIX:UID-1247	IGNORE	USER		137

For each line in the file, replace the string **IGNORE** in the **New-name** field with a domain-qualified name of the user or group to which the old name should be mapped; then delete the last three fields (**Type**, **New-SID**, and **Count**).

Old-name	Type	Old-SID	New-name	Type	New-SID	Count
akp	USER	UNIX:UID-1247	NEW\akp			

Although this example shows a user name that is the same on Windows as it was on UNIX, this procedure can also be used to map a UNIX user or group name to a different user or group name on Windows.

After you have edited all the rows of the SID file, save it as a comma-separated-value file and use it as the mapping file required when you run **vob_sidwalk -map**. Each line of the mapping file must have exactly four fields, separated by commas. The example row created in this step looks like this in .csv format:

akp,USER,UNIX:UID-1247,NEW\akp

NOTE: You may reassign ownership of any object in a VOB to the VOB owner by placing the string **DELETE** in the **New-name** field. You may also reassign ownership of all objects in a VOB to the VOB owner without creating a mapping file. See *Reassigning Ownership to the VOB Owner* on page 70.

12. **Test the map file.** Run **vob_sidwalk** without the **-execute** option. The list of mappings prescribed by the file **libpub-map.csv** is written to the SID file (**libpub-test.csv** in this example), but no changes are made to the VOB.

*ccase-home-dir***etc\utils\vob_sidwalk -map^**
\\ccsvr-nt\ClearCaseStorage\VOBs\libpub.vbs\libpub-map.csv ^
\libpub libpub-test.csv

13. **Unlock the VOB.** If you are concerned that users may try to access the VOB before this procedure is complete, lock the VOB again for all users except yourself.

14. **Update user and group identities stored in the VOB.** When you are satisfied that the map file is correct, run **vob_sidwalk** as shown in the following example, where **libpub-map.csv** is the map file you created in Step #10 of this procedure:

    *ccase-home-dir***etc\utils\vob_sidwalk -execute -map**
    \\ccsvr-nt\ClearCaseStorage\VOBs\libpub.vbs\libpub-map.csv \libpub
    libpub-exec.csv

    vob_sidwalk remaps ownership as specified in the map file and records the changes that were made in a new SID file, **libpub-exec.csv**.

15. **Recover file system ACLs.** Finally, while you are still logged in to **\\ccsvr-nt** as the VOB owner or privileges user, use **vob_sidwalk** with the **-recover_filesystem** option to apply the correct ACLs to the VOB storage directory.

    *ccase-home-dir***etc\utils\vob_sidwalk -recover_filesystem \libpub libpub.csv**

16. **Verify that all clients in the region can access the VOB.** Unlock the VOB if it is still locked.

17. **Verify that all ClearCase users on Windows can access objects in the VOB.** Users should be able to create new objects as well as change or remove objects they own.

    NOTE: If the user's name on Windows is not the same as on UNIX, the user loses rights associated with the creator of a version or a branch. For example, the user would not be able to remove a version even though the user had created that version. These operations can still be executed by a more privileged user (VOB owner, member of the ClearCase administrators group).

13 Removing VOBs

This chapter presents procedures for making a VOB inaccessible to clients temporarily and for removing a VOB altogether.

13.1 Locking as an Alternative to VOB Deactivation

In some situations, you may not need to make the VOB inaccessible. For example, to prevent a VOB from being modified, you can lock it using the ClearCase Administration Console, the UNIX **clearvobadmin** tool, or the following command:

cleartool lock vob:*vob-specifier*

To lock a VOB, you must be the VOB owner or the privileged user. The pathname you specify as the *vob-specifier* can be either the VOB storage directory or the VOB-tag.

13.2 Taking a VOB Out of Service

Suppose that the VOB to be taken out of service has storage directory **/net/sol/vobstore/libpub.vbs** and has VOB-tag **/proj/libpub**. To make the VOB inaccessible:

1. **Have all clients unmount the VOB.** On each client, this command unmounts the VOB:

   cleartool umount /proj/libpub

NOTE: You can also unmount and unregister a VOB from the ClearCase shortcut menu in Windows Explorer or, on UNIX, using the **clearvobadmin** utility

2. **Remove the VOB from the object registry.** Removal prevents anyone from reactivating the VOB. Use the ClearCase Administration Console's VOB Objects node (a subnode of the ClearCase Registry node) to remove the VOB object. You can also use this command:

   cleartool unregister –vob /net/sol/vobstore/libpub.vbs

3. **(Optional) Remove the VOB from the tag registry.** Use the VOB Tags node of the ClearCase Administration Console to remove the VOB's VOB-tag from each region where you want to temporarily take the VOB out of service. If you do not remove the VOB-tag from the tags registry, attempts to mount the VOB produce the following error message at the client:

   cleartool mount /proj/libpub
   ```
   cleartool: Error: An error occurred mounting.
   Refer to the log file "/var/adm/atria/log/mntrpc_server_log"
   for more information on the warning or failure.
   ```

   If you remove the VOB-tag, the error message from **cleartool mount is** more informative:

   cleartool rmtag –all –vob /proj/libpub
   cleartool mount /proj/libpub
   ```
   cleartool: Error: /proj/libpub is not a registered vob tag.
   ```

   (The **–all** option ensures correctness in a network with multiple regions; the VOB-tag is removed from all the logically distinct tags registries.)

4. **Terminate the VOB's server processes.** If the VOB host is a UNIX computer, search the server's process table for the **vob_server** and **vobrpc_server** processes that manage that VOB. Use **ps –ax** or **ps –ef**, and search for **/vobstore/libpub.vbs**; use **kill**(1) to terminate any such processes. (On UNIX, only the **root** user can kill a **vobrpc_server** process.)

Restoring the VOB to Service

To restore a VOB to service:

1. **Restore the VOB to the object registry.** Use the VOB Objects subnode of the Registry node in ClearCase Administration Console to create a VOB object entry. Or use this command:

   cleartool register –vob /net/sol/vobstore/libpub.vbs

NOTE: If you are registering a UCM project VOB, you must use the **–ucmproject** option with the **register** command.

2. **(If necessary) Restore the VOB to the tag registry**. This is necessary only if you removed the VOB-tag in Step #3 of *Taking a VOB Out of Service*. Use the VOB-Tags node of the ClearCase Administration Console. Or use this command:

   cleartool mktag –vob –tag /proj/libpub /net/sol/vobstore/libpub.vbs

   (Repeat, as necessary, for other network regions.)

3. **Have clients reactivate the VOB**. On each client host, this command mounts the VOB:

   cleartool mount /proj/libpub

13.3 Removing a VOB

VOBs are usually repositories for critical data. Removing a VOB destroys all of its data. Do not remove a VOB unless the data it contains is no longer valuable.

To remove a VOB:

1. Unmount the VOB on all hosts where it is active.
2. Use the ClearCase Administration Console to remove the VOB.
   - Navigate to the VOB storage node for the VOB. This is a subnode of the host node for the host where the VOB storage directory resides.
   - Click **Action** > **All Tasks** > **Remove VOB**.

   You can also use the **cleartool rmvob** command
3. Stop and restart ClearCase on the host where the VOB storage directory resides.

NOTE: If the VOB is replicated, you must follow the procedures for removing replicas that are described in the *Administrator's Guide* for Rational ClearCase MultiSite.

14 Using checkvob

This chapter explains how to use the **checkvob** utility to find and fix inconsistencies between a VOB database and its storage pools, to clean up broken cross-VOB hyperlinks, and to find and fix global type problems.

See also the **checkvob** reference page.

14.1 When to Use checkvob

Use **checkvob** for these purposes:

- Checking VOB database or storage pool consistency after a VOB restore operation
- (Optional) Cleaning up broken cross-VOB hyperlinks
- (Optional) Finding and fixing problems in an administrative VOB hierarchy
- (Optional) Monitoring VOBs
- (Optional) Diagnosing and repairing damaged VOBs

Running **checkvob** to verify a VOB restore operation is always recommended, but it is required (and happens automatically) when you restore a VOB that uses the semi-live backup strategy. (See also **vob_snapshot**, **vob_restore**, and *Choosing Between Standard and Semi-Live Backup* on page 170.) We recommend that you run **checkvob** as part of your normal maintenance routine.

14.2 Checking Hyperlinks

In hyperlink mode (**–hlinks**), **checkvob** cleans up hyperlinks that **rmhlink** does not delete because they appear to be broken. It examines the hyperlinks on each object you specify and tries to determine whether they are intact. Hyperlinks typically break because an object in a cross-VOB hyperlink is unavailable. This usually happens when a VOB at one end of a cross-VOB hyperlink is offline. By default, **checkvob** prompts you before deleting each partially unavailable hyperlink that it detects. Use **–force** to suppress prompts.

NOTE: When you specify a VOB, **checkvob –hlinks** does not look at all hyperlinks in that VOB; it looks only at hyperlinks attached to the VOB object itself.

14.3 Checking Global Types

In global types mode (**–global**), **checkvob** verifies that no VOB has more than one administrative VOB. If any VOB has more than one administrative VOB, **checkvob** lists it and stops. If the administrative VOB hierarchy is valid, **checkvob** lists this information:

- Global types with local copies whose names do not match
- Eclipsing types
- Eclipsing locks on local copies of global types
- Mismatched protections between global types and their local copies

If you specify a VOB selector, **checkvob** starts its search for global types in that VOB and checks all global types it finds in the administrative VOB hierarchy associated with that VOB. If you specify a type selector, **checkvob** checks only the specified type.

You can restrict the checks by specifying one or more of **–acquire**, **–protections**, **–lock**, or **–unlock**. See the **checkvob** reference page for descriptions of these options.

Fix Processing

With the **–fix** option, **checkvob** does the following:

- Changes the name of each local copy to match the name of its global type. **checkvob** queries for confirmation unless you specify **–force**.

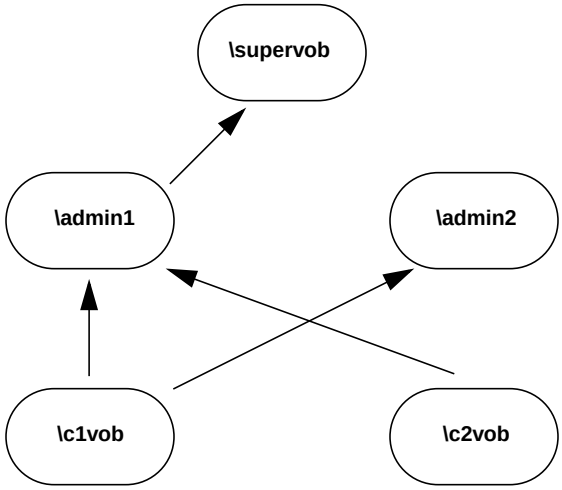
- Attempts to acquire eclipsing local copies and eclipsing ordinary types. **checkvob** queries for confirmation unless you specify **–force**. If a type being acquired is locked, the locks are discarded if there is a lock on the global type. If there is no lock on the global type, the lock information from the first acquired type is applied to the global type.
- Corrects eclipsing locks on local copies. **checkvob** queries for confirmation and whether to unlock or lock the copy unless you specify **–force** and either **–lock** or **–unlock**.
- Changes ownership of each local copy to match the ownership of its global type. **checkvob** queries for confirmation unless you specify **–force**.

Output Log for Global Type Checking

The output from **checkvob** is captured in a log file. By default, the file is named **checkvob.***date***.***time* and written to the current directory.

Example Check or Fix Scenario

In this scenario, the VOB hierarchy looks like this:



To check and fix the global types problems in the hierarchy:

1. Run **checkvob –global** in any VOB in the hierarchy.

   cleartool checkvob –global vob:\supervob

   ```
   The session's log file is "checkvob.03-Aug-99.17:15:15".
   Starting analysis of Admin VOB hierarchy.

   cleartool: Error: There are too many Admin VOBs for vob "\c1vob".

   Analysis of Admin VOB hierarchy complete.
   cleartool: Error: 4 VOBs analyzed, 1 VOBs had problems.
   cleartool: Error: Please fix the listed problems, then rerun this command.
   ```

2. List the **AdminVOB** hyperlinks for **\c1vob**.

   cleartool describe –long vob:\c1vob

   ```
   versioned object base "\c1vob"
   ...
     Hyperlinks:
       AdminVOB@2@\c1vob -> vob:\admin2
       AdminVOB@3@\c1vob -> vob:\admin1
   ```

3. Delete one of the **AdminVOB** hyperlinks. In this example, the hyperlink to **\admin2** is deleted.

   cleartool rmhlink AdminVOB@2@\c1vob

   ```
   Removed hyperlink "AdminVOB@2@\c1vob".
   ```

4. Run **checkvob –global** again to check for problems with the global types in the hierarchy.

cleartool checkvob –global vob:\supervob

```
The session's log file is "checkvob.03-Aug-99.17:23:25".
Starting analysis of Admin VOB hierarchy.

Analysis of Admin VOB hierarchy complete.
4 VOBs analyzed, no hierarchy errors found.

Starting "global type" processing.

Detection of eclipsing local copies is: ENABLED
Detection of protection mis-matches is: ENABLED
Detection of eclipsing local locks is: ENABLED
Correction of detected errors is: DISABLED
cleartool: Error: Definition of element type "global_el" in \supervob is
eclipsed by definition(s):
        element type "global_el" in \admin1
        element type "global_el" in \c2vob
cleartool: Error: Definition of branch type "global_br" in \supervob is
eclipsed by definition(s):
        branch type "global_br" in \admin1
        branch type "global_br" in \c2vob
cleartool: Error: Global branch type "global_br" in "\supervob" has local
copies with non-matching names:
        "global_br_mismatch" in "\c1vob"
cleartool: Error: Definition of attribute type "global_at" in \supervob is
eclipsed by definition(s):
        attribute type "global_at" in \admin1
        attribute type "global_at" in \c2vob
cleartool: Error: Definition of hyperlink type "global_hl" in \supervob is
eclipsed by definition(s):
        hyperlink type "global_hl" in \c2vob
cleartool: Error: Global hyperlink type "global_hl" in "\supervob" has
local copies with non-matching names:
        "global_hl_wrong" in "\admin1"
```

```
cleartool: Error: Definition of label type "global_lb" in \supervob is
eclipsed by definition(s):
        label type "global_lb" in \admin1
cleartool: Error: Definition of element type "global_el" in \admin1 is
eclipsed by definition(s):
        element type "global_el" in \c2vob
cleartool: Error: Definition of branch type "global_br" in \admin1 is
eclipsed by definition(s):
        branch type "global_br" in \c2vob
cleartool: Error: Definition of attribute type "global_at" in \admin1 is
eclipsed by definition(s):
        attribute type "global_at" in \c2vob
cleartool: Error: Global label type "global_lb" in "\admin1" has local
copies with non-matching names:
        "nt_global_lb" in "\c2vob"


Completed "global type" processing.
Processed 9 global types in 4 VOBs.
The following 9 global types may still have problems:
        element type "global_el" in "\supervob"
        branch type "global_br" in "\supervob"
        attribute type "global_at" in "\supervob"
        hyperlink type "global_hl" in "\supervob"
        label type "global_lb" in "\supervob"
        element type "global_el" in "\admin1"
        branch type "global_br" in "\admin1"
        attribute type "global_at" in "\admin1"
        label type "global_lb" in "\admin1"
```

5. Review the log file, and then run **checkvob –global –fix** to correct the problems.

cleartool checkvob –global –fix vob:\supervob

```
The session's log file is "checkvob.03-Aug-99.17:31:06".
Starting analysis of Admin VOB hierarchy.

Analysis of Admin VOB hierarchy complete.
4 VOBs analyzed, no hierarchy errors found.

Starting "global type" processing.

Detection of eclipsing local copies is: ENABLED
Detection of protection mis-matches is: ENABLED
Detection of eclipsing local locks is: ENABLED
Correction of detected errors is: ENABLED
Global element type "global_el" in "\admin1" is eclipsed by acquirable
types.
Correct this problem?  [no] yes
Attempting to acquire ... acquire completed successfully.
cleartool: Error: Global element type "global_el" in "\admin1" has local
copies with inconsistent protections in VOBs:
        \c2vob
Correct this problem?  [no] yes
Attempting to correct this problem ... corrected.
Global branch type "global_br" in "\admin1" is eclipsed by acquirable
types.
Correct this problem?  [no] yes
Attempting to acquire ... acquire completed successfully.
cleartool: Error: Global branch type "global_br" in "\admin1" has local
copies with inconsistent protections in VOBs:
        \c2vob
Correct this problem?  [no] yes
Attempting to correct this problem ... corrected.
Global attribute type "global_at" in "\admin1" is eclipsed by acquirable
types.
Correct this problem?  [no] yes
Attempting to acquire ... acquire completed successfully.
cleartool: Error: Global attribute type "global_at" in "\admin1" has local
copies with inconsistent protections in VOBs:
        \c2vob
Correct this problem?  [no] yes
Attempting to correct this problem ... corrected.
cleartool: Error: Global label type "global_lb" in "\admin1" has local
copies with non-matching names:
        "nt_global_lb" in "\c2vob"
```

```
Correct this problem?  [no] yes
Attempting to correct this problem ... corrected.
Global element type "global_el" in "\supervob" is eclipsed by acquirable
types.
Correct this problem?  [no] yes
Attempting to acquire ... acquire completed successfully.
Global branch type "global_br" in "\supervob" is eclipsed by acquirable
types.
Correct this problem?  [no] yes
Attempting to acquire ... acquire completed successfully.
cleartool: Error: Global branch type "global_br" in "\supervob" has local
copies with non-matching names:
        "global_br_mismatch" in "\c1vob"
Correct this problem?  [no] yes
Attempting to correct this problem ... corrected.
Global attribute type "global_at" in "\supervob" is eclipsed by acquirable
types.
Correct this problem?  [no] yes
Attempting to acquire ... acquire completed successfully.
Global hyperlink type "global_hl" in "\supervob" is eclipsed by acquirable
types.
Correct this problem?  [no] yes
Attempting to acquire ... acquire completed successfully.
cleartool: Error: Global hyperlink type "global_hl" in "\supervob" has
local copies with non-matching names:
        "global_hl_wrong" in "\admin1"
Correct this problem?  [no] yes
Attempting to correct this problem ... corrected.
cleartool: Error: Global hyperlink type "global_hl" in "\supervob" has
local copies with inconsistent protections in VOBs:
        \c2vob
Correct this problem?  [no] yes
Attempting to correct this problem ... corrected.
Global label type "global_lb" in "\supervob" is eclipsed by acquirable
types.
Correct this problem?  [no] yes
Attempting to acquire ... acquire completed successfully.

Completed "global type" processing.
Processed 9 global types in 4 VOBs.
```

6. Run **checkvob –global** again to confirm that there are no problems.

   cleartool checkvob -global vob:\supervob

```
The session's log file is "checkvob.03-Aug-99.17:36:49".
Starting analysis of Admin VOB hierarchy.


Analysis of Admin VOB hierarchy complete.
4 VOBs analyzed, no hierarchy errors found.

Starting "global type" processing.

Detection of eclipsing local copies is: ENABLED
Detection of protection mis-matches is: ENABLED
Detection of eclipsing local locks is: ENABLED
Correction of detected errors is: DISABLED

Completed "global type" processing.
Processed 5 global types in 4 VOBs.
```

14.4 Database or Storage Pool Inconsistencies

Under normal circumstances, the VOB database maintains a complete and uninterrupted record of all activity in the VOB's *source* and *derived object pools*. (Cleartext pools are caches and are expendable.) The VOB database reflects all additions (checkins, branch creation, element creation, DO promotion, and so on) and deletions (removal of DOs, versions, branches, and elements) in the pools. Each data container is referenced from the database.

In general, inconsistencies between the database and storage pools occur because of damage to the VOB database, to the storage pools, or to both. If the damage requires VOB restoration from backup, database or pool inconsistency occurs at restore time if the VOB has been backed up using the semi-live backup approach (database and pools were backed up at different times). That is why a **vob_restore** operation includes **checkvob**. In general, **checkvob** tries to make the pools match the database. If the pools are missing data, **checkvob** cannot re-create the data, and must adjust the database to compensate for the missing information.

Here are three scenarios:

- **VOB database damage.** The database must be retrieved from snapshot or backup and is older than existing storage pools. It does not record recent pool changes (**checkin**, **rmver**, and so on).

- **VOB storage pool damage.** The database is newer than the storage pools, which must be retrieved from backup. The database records development activity that is not reflected in the older pools.

- **Database and pool damage, with semi-live VOB backup procedures in use.** The database snapshot and storage pool backups occur at different times (see **vob_snapshot**). The database retrieved from backup may be older or newer than storage pools retrieved from backup.

In addition, system crashes or network failures can prevent **cleartool** operations from completing cleanup tasks. This often results in unreferenced data containers. Any aborted operation that fails to clean up properly can have the same effect, as can OS bugs and disk problems.

Given a time lapse between current instances of VOB database and storage pools:

- Any operation that modifies storage pools can create database or source pool inconsistencies: **protectvob**, **mkpool**, **rename**, **mkelem**, **rmelem**, **checkin**, **checkout** with auto-make-branch, **mkbranch, rmbranch**, **rmver**, **chtype**, **chpool**, **protect**.

- Any operation that creates or deletes shared DOs can create database or DO pool inconsistencies: **clearmake**, **winkin**, **clearaudit**, **rmdo**, **scrubber**, **protectvob**, **mkpool, rename**, **chpool**, **protect**.

checkvob can identify—and in most cases, fix—these kinds of data container problems:

- **Misprotected data containers—**containers with incorrect access control information

- **Missing data containers—**VOB database references to nonexistent data containers

- **Unreferenced data containers—**data containers for which there is no corresponding VOB database entry

Of these problems, missing containers is the most serious, as it may represent loss of data.

Problem	Found by checkvob
All pool kinds (source, DO, cleartext)	
Bad pool roots (pool names, identity info)	Yes (**–pool**)
Source and DO pools only	
Misprotected containers	Yes (**–protections**)
Missing containers	Yes (**–data**)
Unreferenced containers (debris)	Yes (**–debris**)
Corrupted containers	No

By default, **checkvob** prints detailed reports on one or more storage pools (**–pool**) or on specific file elements or DOs passed in the command line. With the **–fix** option, **checkvob** fixes as many problems as it can, adjusting *data containers* to match what is expected by the VOB database.

WARNING: Fixing problems detected with **–data** can update the VOB irreversibly. If version or DO data is recorded in the database but missing from the storage pools, **checkvob** updates the VOB database, dereferencing this data with the equivalents of **rmver -data** (missing source containers) and **rmdo** (missing DO containers).

Updating the VOB Database

checkvob never updates the VOB database to reference newer pool data. If versions or DOs are stored in the pools but not recorded in the database, **checkvob** moves the unreferenced data containers to the pool's **lost+found** directory. That is, if pool storage is newer than the database, **checkvob** does not salvage the latest versions from the unreferenced pool containers and update the database. It uses the unreferenced containers to return the pool to the state expected by the database, and it moves the unreferenced containers (with the latest version data) to *pool-dir***lost+found**. These versions should be presumed lost. Contact Rational Technical Support for more information. (By contrast, barring unexpected events, any missing data that **checkvob** reports in this scenario can generally be attributed to **rmver** operations that were not recorded in the older database; and the fix processing that accepts this data loss is inconsequential.)

Although it does not add new version or DO information to the VOB database, **checkvob** updates the VOB database in the following ways:

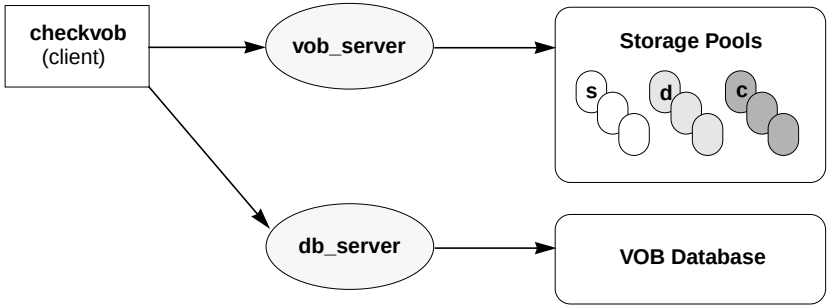
- It removes references to versions and DOs that are confirmed missing by **checkvob** and accepted as missing by the user (interactive **yes** or **–force –fix** option).
- After successfully reconstructing a missing container, in whole or part, **checkvob** adjusts the database to reference the newly reconstructed container, not the old, missing container.

Requirements for Using checkvob

If you use a customized *type manager*, it must include the **get_cont_info** method; if it does not, **checkvob** cannot repair data containers managed by this type manager. See the **type_manager** reference page for more information.

checkvob requires operational **vob_server** and **db_server** processes on the VOB host where it executes. As shown in Figure 17, the **vob_server**, which runs as the VOB owner on UNIX and as the **clearcase_albd** user identity on Windows, is the only process that can create or delete data containers. Similarly, the **db_server** mediates all VOB database access.

Figure 17 Pool Access Through vob_server and VOB Database Access Through db_server



To understand the **checkvob** results, you must understand how ClearCase type managers operate on data containers. For example, changes to a data container (checkin, in particular) always result in a new, renamed container, regardless of the applicable type manager. See the **type_manager** reference page for more details.

Replicated VOB Considerations

checkvob is a per-replica operation. You run it to achieve local pool or database consistency. **checkvob** does not create oplog entries for its updates. (In fact, this is a requirement, because in a VOB replica restoration scenario, **checkvob** must be able to run before **restorereplica**.) To synchronize replicas after running **checkvob**, run the **restorereplica** command.

When fixing a data loss (missing container) problem, **checkvob** does not search other replicas for missing containers or version data. Similarly, after the current replica's database is updated with **rmver –data** to reflect missing version data, you cannot repopulate this database with version data from another replica, other than by hand. If you choose this approach (create new branches and versions, move labels, and so on), version selection based on config records is not affected; the old versions (now with no version data) are still selected.

Data loss (missing containers) at the current replica does not affect synchronization exports or imports. Data loss at the current replica can be propagated only with **mkreplica**. In this case, the new replica inherits the "lost data" state. For example, if data loss occurs on the replica that created the lost version, there are two synchronizing export scenarios:

- Subsequent export packet contains a dataless "create version" operation (as if **rmver –data** followed **checkin**).

  The system appends a comment at the end of the event record for a dataless sync-import "create version" event. The additional text says the a dataless checkin occurred, and it identifies the replica (OID) from which this dataless "create version" originated.

- A full data "create version" operation was already propagated to a sibling replica. The sibling replica retains the data.

Running checkvob

To accept as lost any pool data (versions or DOs) added in the interval between the pool and database reference times, run **checkvob –force –fix** and supply an appropriate time interval (see *Force-Fix Mode on page 264*).

To accept the default data loss interval of one day, run **checkvob –force –fix**. Then, run **checkvob** without **–force**, and fix any remaining elements with missing containers manually (as prompted for).

Output Log for Pool Checking

The output from **checkvob** is captured in a log file directory created each time **checkvob** runs. The default location of the log directory is *current-dir***checkvob.***date-time***,** but you can move it with the **–log** option. A **checkvob** log directory's contents:

.\checkvob.11-Oct-99.18.30.45
poolkind_source\transcript
poolkind_derived\transcript
poolkind_cleartext\transcript
summary

NOTE: The output log is a single **summary** file if you run **checkvob** on a single object.

Each **transcript** file contains a detailed report on check and fix processing for each existing pool kind. The **summary** file contains the header and tail sections from each **transcript** file.

Figure 18 shows a **summary** log file. This output was generated with a command like the following, on a VOB with one missing data container:

cleartool checkvob –pool –fix \\saturn\vobstore\src.vbs

Figure 18 checkvob Output Log: Summary File

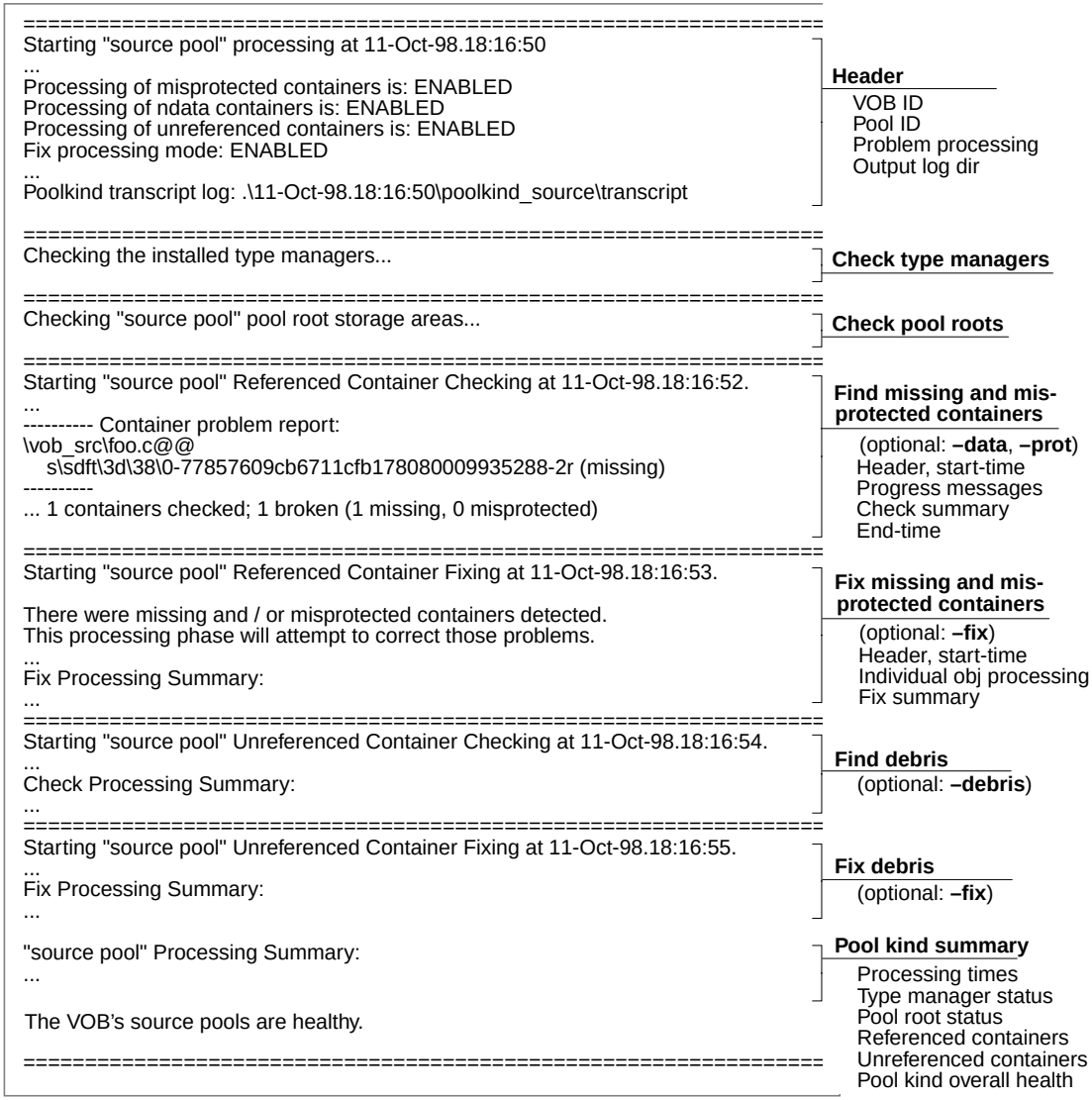
```
================================================================
Starting "source pool" processing at 11-Oct-98.18:16:50

Running from host: saturn
VOB hostname: saturn
VOB host storage pathname: \vobstore\src.vbs
VOB global storage pathname: \net\saturn\vobstore\src.vbs
VOB replica oid: 110a7bca.cb6711cf.b514.08:00:09:93:52:88
VOB host reference time: 11-Oct-98.18:16:50
Processing pools: sdft
Processing of misprotected containers is: ENABLED
Processing of ndata containers is: ENABLED
Processing of unreferenced containers is: ENABLED
Fix processing mode: ENABLED
Not allowing fixes involving missing data.

Poolkind transcript log: .\11-Oct-98.18:16:50\poolkind_source\transcript
================================================================

Completed "source pool" processing at 11-Oct-98.18:16:51

"source pool" Processing Summary:
Referenced Container Check Processing Time: 00:00:01
Referenced Container Fix Processing Time: 00:00:03
Unreferenced Container Check Processing Time: 00:00:00
*** Unreferenced Container Fix Processing was not performed.

Installed type managers are OK.

Pool root storage areas are OK.

Pool: s\sdft
Referenced container check processing:
   1 containers checked
         1 ndata         0 misprotected
   1 objects checked
         1 ndata         0 misprotected
Referenced container fix processing:
   1 Initial objects with problem containers.
         1 ndata         0 misprotected
   0 Final objects with problem containers.
         0 ndata         0 misprotected
   0 Fixed objects suffered data loss (0 lost data items).
Unreferenced container check processing:
   1 containers checked     (0 kbytes)
         0 unreferenced but under age      (0 kbytes)
         0 unreferenced but maybe needed   (0 kbytes)
   0 unreferenced containers (0 kbytes, 0 empty)

The VOB's source pools are healthy.

Poolkind transcript log: \11-Oct-98.18:16:50\poolkind_source\transcript
================================================================
```

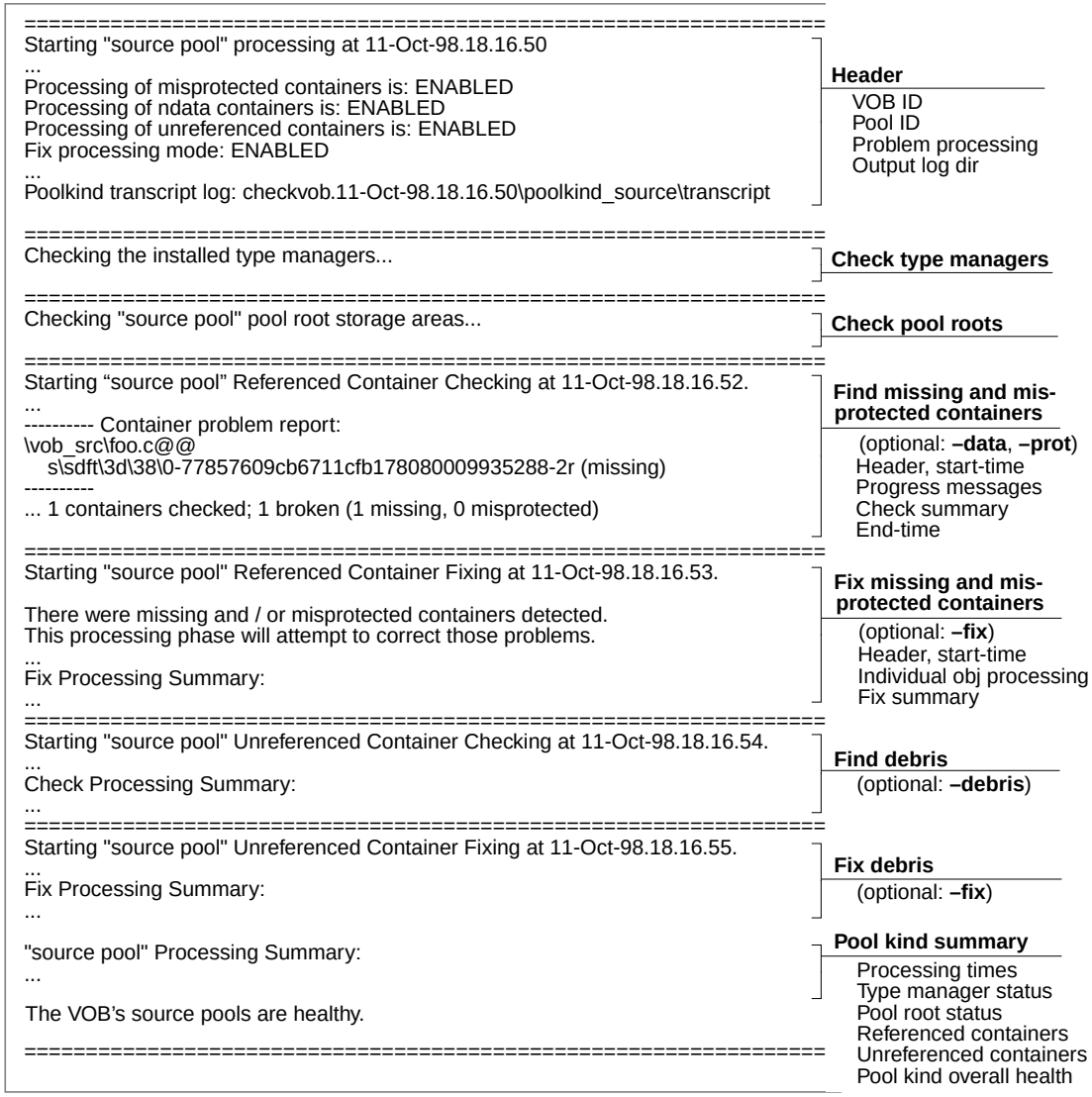
```
==========================================================================
Starting "source pool" processing at 11-Oct-98.18.16.50

Running from host: saturn
VOB hostname: saturn
VOB host storage pathname: C:\vobstore\src.vbs
VOB global storage pathname: \\saturn\vobstore\src.vbs
VOB replica oid: 110a7bca.cb6711cf.b514.08:00:09:93:52:88
VOB host reference time: 11-Oct-98.18:16:50
Processing pools: sdft
Processing of misprotected containers is: ENABLED
Processing of ndata containers is: ENABLED
Processing of unreferenced containers is: ENABLED
Fix processing mode: ENABLED
Not allowing fixes involving missing data.

Poolkind transcript log: checkvob.11-Oct-98.18.16.50\poolkind_source\transcript
==========================================================================

Completed "source pool" processing at 11-Oct-98.18.16.51

"source pool" Processing Summary:
Referenced Container Check Processing Time: 00:00:01
Referenced Container Fix Processing Time: 00:00:03
Unreferenced Container Check Processing Time: 00:00:00
*** Unreferenced Container Fix Processing was not performed.

Installed type managers are OK.

Pool root storage areas are OK.

Pool: s\sdft
Referenced container check processing:
   1 containers checked
         1 ndata         0 misprotected
   1 objects checked
         1 ndata         0 misprotected
Referenced container fix processing:
   1 Initial objects with problem containers.
         1 ndata         0 misprotected
   0 Final objects with problem containers.
         0 ndata         0 misprotected
   0 Fixed objects suffered data loss (0 lost data items).
Unreferenced container check processing:
   1 containers checked     (0 kbytes)
         0 unreferenced but under age      (0 kbytes)
         0 unreferenced but maybe needed   (0 kbytes)
   0 unreferenced containers (0 kbytes, 0 empty)

The VOB's source pools are healthy.

Poolkind transcript log: checkvob.11-Oct-98.18.16.50\poolkind_source\transcript
==========================================================================
```

Figure 19 shows a condensed **transcript** file for source pool check and fix processing. This output was generated with a command like the following, on a VOB with one missing data container:

cleartool checkvob –fix –force –pool –source \\saturn\vobstore\src.vbs

Figure 19 checkvob Output Log: Condensed Transcript File





Overview of checkvob Processing

The following sections describe **checkvob** actions.

Individual File Element or DO Processing

When run in fix mode (**–fix**) against individual file-system objects (no **–pool** option), **checkvob** writes output like the following to standard output and also to *log-dir***transcript**. For example:

```
======================================================================
Processing element "\vob_src\open.c@@".
The element is now locked.
Checking status of 1 referenced containers in pool "s\sdft"...
...
    fix processing output
Initial container status: 0 missing, 0 misprotected.
Final container status: 0 missing, 0 misprotected.
The element is now unlocked.
======================================================================
```

File element processing:

1. Check the element for **–data** (missing container) and **–protection** problems.
2. If fix mode (**–fix**), fix protection and missing container problems:

   NOTE: Fix processing is blocked if the VOB, source pool, or element is locked.

   a. Lock the element.
   b. Fix missing protection problems.
   c. Fix missing data container problems by scanning the pool for missing or misplaced containers and reconstructing containers as necessary.
   d. Update the VOB database to reference the reconstructed containers.
   e. For missing version data, update the VOB database to dereference lost versions with the equivalent of **rmver -data**.
   f. Apply minor events to element's event history.
   g. Move alternate (unreferenced) containers for this element to pool's **lost+found** directory.
   h. Unlock the element.

DO processing:

1. Check for **–data** and **–protection** problems.

2. If fix mode (**–fix**), fix protection and missing container problems:

   a. Fix missing protection problems.

   b. For each missing container, remove the DO with the equivalent of **rmdo**.

Pool Mode (–pool Option) Processing: Overview

When run with the **–pool** option, **checkvob** examines some or all of the VOB's source, DO, and cleartext pools.

For each kind of pool (source, DO, cleartext):

1. Check pool roots. Check pool names, locations, and pool identity information (each pool must have a **pool_id** file, which stores the pool's OID). These problems cannot be fixed with **checkvob** and must be directed to Rational Technical Support.
2. For source pools, check the installed type managers for **checkvob** support (**get_cont_info** method).

For source and DO pools only:

3. Scan VOB database for missing (referenced, but not found) or misprotected containers.
4. Generate a list of problem VOB objects.
5. If **–fix** is specified, process each problem VOB object as described in *Individual File Element or DO Processing* on page 263.
6. Scan for unreferenced data containers.
7. If **–fix** is specified, move each unreferenced container to the pool's **lost+found** directory.

Force-Fix Mode

If you use the **–force –fix** options, **checkvob** prevents you from unintentionally accepting data loss:

- **Do not allow removal of all non-*branch*\0 versions.** In force-fix mode, **checkvob** does not update the VOB database to reflect an element's missing data containers unless at least one version having a version number greater than 0 and its data remain. That is, you must run **checkvob** in **-fix** mode, without **–force**, and agree when prompted to accept a reconstructed element whose only remaining versions have version IDs like **\main\br1\0** and **\main\br1\br2\0**.

- **Prompts to allow data loss.** In force-fix mode, **checkvob** prints the following prompt:

  ```
  Do you want to override the default and allow fixing of
  elements involving missing version data? [no] n
  ```

  If you answer **yes**, **checkvob** prompts you to specify a time interval for which data loss is allowable (or expected). For example, if you restored source pools from a backup with date-time **6-Oct-99.00:02:02:00**, and your VOB database is current, you can reasonably expect to lose version data created since that time. In this case, you can direct **checkvob** to allow the loss of data created and recorded in the VOB database after that time:

  cleartool checkvob –force –fix –data –pool –source c:\vobstore\proj1.vbs
  ```
  ...
  Allow missing data created since: [date-time, <CR>] 6-Oct-99.00:02:02:00
  ```

  If **checkvob** cannot find an expected container with data that was created before **6-Oct-99.00:02:02:00**, it records this fact in the output log but does not update the VOB to dismiss the missing container; it does not accept the data loss. Run **checkvob** again without the **–force** option to process such elements individually, or adjust the allowed data loss time.

To silently accept (fix) all missing data containers without regard for creation time, use a very old date-time. The default time interval for allowed data loss is "since yesterday at 00:00:00." If you supply a date older than one week, **checkvob** forces you to confirm it.

checkvob log files do not capture the time-interval dialogue from **–force –fix** operations.

See the description of the *date-time* argument in the **lshistory** reference page for a list of acceptable values.

Pool Setup Mode

checkvob –setup –fix –pool is run by **reformatvob** (and by **mkreplica –import**, for replicated VOBs) when you upgrade a VOB server host to a new ClearCase release. If this part of the **reformatvob** or **mkreplica** operation fails, you must run **checkvob –setup –fix** manually. This command must complete successfully to enable **checkvob** processing in the VOB's storage pools (which is a prerequisite to using the **vob_snapshot** utility successfully.)

checkvob –setup –fix –pool does the following:

- Checks pool roots—pool names, locations, and pool identity information. (Each pool must have a **pool_id** file, which stores the pool's OID). For any pool, if a missing **pool_id** file is the only detected error, **checkvob** adds the file.

- (Source pools only) Verifies that the installed type managers support use of **checkvob**. If a type manager does not support the **get_cont_info** method, **checkvob** cannot fix missing data containers managed by that type manager.
- (Source pools only) Converts source pool data container pathnames to the correct format. See the **type_manager** reference page for a description of the source container name format.

VOB, pool, or element locks prevent setup processing. In this case, do the following:

1. (Pool or VOB locks only) Log on as the VOB owner or a privileged user.
2. Replace the VOB lock:

   cleartool unlock vob:*vob-pname*
   cleartool lock –nusers *userid-that-will-run-checkvob* **vob:***vob-pname*
3. Replace pool locks:

   cleartool lock –replace –nusers *userid-that-will-run-checkvob locked-pools*
4. Replace element locks:

   cleartool lock –replace –nusers *userid-that-will-run-checkvob locked-elements*
5. Rerun **checkvob –setup –fix** manually.

Descriptions of Storage Pool Problems

The following sections describe how storage pool problems arise and how **checkvob** fixes them.

Notes on problem descriptions:

- **Unexpected events.** Many problems described here are often side effects of various infrequent or uncommon events. Such events include network failure, system crash, failed or aborted cleanup operations, operating system bugs, disk failure, network reconfiguration events, and so on. In addition, there is a class of events that includes accidental or malicious delete, move, rename, or change-protection operations on the actual containers. These are all varieties of unexpected events.
- **Major and minor problems.** The summary output from **checkvob** records the number of major and minor problems detected. Bad pool roots and missing data containers (source or DO pools) are considered major problems. All others are considered minor.

- **Reference times.** A pool or VOB database's *reference time* is the point at which VOB activity was last recorded there. This can be the current date-time, the date-time when a still-operational VOB was locked, or the date-time when a snapshot or backup operation captured the pool or database. Expected output and fix processing from **checkvob** varies markedly depending on the relative reference times on the VOB database and storage pools being compared. There are three general cases:
  - The database is newer.
  - The pools are newer.
  - The database and storage pools are synchronized: they're both current, or they were retrieved as a unit from a complete backup of the VOB storage directory.
- **Fix processing.** The following sections describe, under *Fix Processing* headings, how **checkvob** fixes the problems it finds. However, some descriptions include additional repair steps for the user.

Source, DO, or Cleartext Pool: Bad Pool Roots

Description

Misnamed or misidentified pools**.**

Cause

mkpool, **rmpool**, or **rename** *pool* in the interval between database and storage pool reference times.

Fix Processing

Unless pool names and IDs match VOB database expectations exactly, abort processing for this pool kind (source, DO, or cleartext) and skip to the next pool kind.

Exception: If, for any pool, the only inconsistency is a missing **pool_id** file, create the **pool_id** file.

Source or DO Pool: Misprotected Container on Windows

Description

FAT file system: incorrect RO attribute.
NTFS file system: incorrect RO attribute or ACL.

Cause

User copied or restored pools or containers without preserving protection information.

Fix Processing

Reset container's RO attribute and ACL as necessary. If the VOB owner's rights to pool contents are insufficient, **checkvob** reports, but cannot fix, container ACLs. If **checkvob** cannot repair protection problems, you must take the following steps:

1. Log on as a member of the ClearCase administrators group.
2. In Windows Explorer, click **File** > **Properties**. On the **Security** tab, take ownership of all files and directories in the VOB's storage directory tree.

   NOTE: If you have identified only a small number of affected files, take ownership of these files only, to avoid a time-consuming **checkvob** operation in Step #6.
3. For all files and directories in the VOB storage directory, use the **Security** tab to grant **full rights** to the **clearcase** and *vob-owner* accounts.
4. Log out. Log on as VOB owner.
5. Take ownership of all files and directories in the VOB storage directory tree.
6. Run **checkvob** to fix protections on storage pools:

   cleartool checkvob –force –fix –protection –pool c:\vobstore\myvob.vbs

Missing and Unreferenced Data Containers

checkvob works to reconcile the contents of VOB storage with the information in the VOB database. This reconciliation requires **checkvob** to categorize data containers based on their relationship to this information. There are two categories:

- **Missing data container.** A container is considered missing if it does not appear under the exact name and location recorded in the VOB database. This definition implies missing version data (for a source pool) or a missing derived object (for a DO pool). During fix-mode processing, **checkvob** attempts to fix missing containers by scanning all storage pools, looking for alternate containers from which to reconstruct containers for the missing data.

- **Debris.** A container is considered debris if its pathname is not recorded in the VOB database. During **–fix –debris** processing, **checkvob** finds all debris in the source and DO pools. It checks various aspects of an unreferenced container before moving it to the applicable pool's **lost+found** directory.

Whenever the VOB database and storage pools have different reference times (one is older than the other), **checkvob** is likely to find both missing and unreferenced containers. For example, consider a container whose location has changed as a result of a rename operation on a pool: it stores the data that the database is trying to reference, but at the wrong location in the storage pool. **checkvob** reports a missing container and an unreferenced container. Note that in fix mode, **checkvob** resolves these simple location problems.

Source Pool: Missing Container

Description

The VOB database references a source pool data container that does not exist at the expected location. A container is considered missing if it does not appear under the exact name and location recorded in the VOB database.

Causes

- (Database newer) Database records checkin not found in (older) pool.

- (Pool newer) Pool stores updated, renamed container with new checkin data, but (older) database references pre-checkin container name, which no longer exists.

- (Pool newer) Pool stores updated container to reflect versions removed with **rmver** or **rmbranch**, but the database references old container.

- (Pool or database reference times differ) A **chpool** operation on a file element in the interval between pool and database reference times leaves the database pointing at wrong pool.
- Unexpected events.

Fix Processing

During fix mode processing, **checkvob** uses the following algorithm to fix missing containers by scanning all storage pools for alternate containers from which to reconstruct missing data containers.

1. Scan pools for alternate containers.

   In a previous pass over the pools, **checkvob** found all referenced containers. It now scans for unreferenced containers for that element, looking for alternate containers that can be used to reconstruct a replacement for the missing container by rebinding the alternate container to take the place of the missing one. There are two types of rebind operations:

   Optimized rebind: find alternates maintained by the right type manager.

   a. Find best match: identical, superset, or subset.

      identical—container with correct contents (user ran **chpool** during interval between pool and database reference times).

      superset—container with superset of versions expected by database. This is common when the pool is newer than the database.

      subset—container with subset of versions expected by database. This is common when the database is newer than the pool.

   b. Clone and prune best match. Create a new container and copy the best alternate's contents. Delete extra version data from the new container.

   Nonoptimized rebind: alternate containers with the right type manager not available (no "best match" found).

   a. Construct container one version at a time from whatever sources are available: containers maintained by other type managers and cleartext pools.

2. If container reconstruction is incomplete, collect and report a list of missing versions.
3. If **–force** is not specified, prompt user to accept fix.

If **–force** is specified, safety features prevent some kinds of inadvertent data loss. See *Force-Fix Mode on page 264* for details.

4. If **–force** is in effect, or if user accepted fix prompt, update VOB database:

   a. Adjust database to reference reconstructed containers.

   b. With the equivalent of **rmver –data**, adjust the database to dereference lost version data.

5. Move all of the element's alternate containers to pool's **lost+found** directory.

   NOTE: Because (unreferenced) alternate containers are moved to **lost+found** now, rather than during **checkvob**'s subsequent debris processing pass, you have an opportunity to reclaim disk space from **lost+found** if the disk fills up during reconstruction. Reconstruction can consume substantial disk space. For example:

   - A **chtype binary_delta *.gif** operation (from element type **file**) been lost to the (older) database. **checkvob** uses the newer pool's (unreferenced) delta containers to reconstruct the missing whole copy containers expected by the (older) database.

   - A **chpool** operation is not reflected by older, rolled-back storage pools. **checkvob** may have to find and clone hundreds, or thousands, of unreferenced data containers.

Source Pool: Unreferenced Container (Debris)

Description

Source pool includes a data container that is not referenced by the VOB database. Such containers are tentatively classified as debris, but must pass several tests before being moved to the applicable pool's **lost+found** directory.

Causes

- (Database newer) Database references newer, post-checkin container name (which is *missing*), but pool stores older, unreferenced container.

- (Database newer) Database records **rmver** or **rmbranch** events, but older pool stores container with branches or versions still in place.

- (Pool newer) Pool has container with versions from one or more checkin operations not recorded in the older database.

- (Pool or database reference times differ) A **chpool** operation on a file element in the interval between pool and database reference times leaves the database pointing at the wrong pool. The containers, being at an unexpected location, are unreferenced.
- Restoring a pool from incremental backups.
- Unexpected events.

Fix Processing

checkvob usually moves an unreferenced container to the applicable pool's **lost+found** subdirectory (*vob-storage-dir***s****sdft****lost+found**, by default). It leaves in place unreferenced containers that fit into these categories:

- **May be needed. checkvob** found, but did not fix, a *missing* container problem, and the pathname of the current *unreferenced* container suggests that it may be able to contribute to reconstruction of the missing container on a subsequent **checkvob** run. If you specify [**–force**] **–fix –debris**, without **–data**, **checkvob** performs **–data** check (not fix) processing to identify debris that may be needed.
- **Underage.** The container is less than one hour old. **checkvob** skips underage containers to avoid removing a newly created container before the VOB database has been updated to reference it. Typically, the time between new container creation and database reference update is less than one second, but **checkvob** takes a conservative approach because of the critical nature of source containers.
- **Scheduled for deletion.** The VOB is configured for deferred source container deletion (see **vob_snapshot_setup** and **vob_server**), and the container is already marked for deletion.

NOTE: When the pool is newer than the database and includes more recent versions not recorded in the (older) database, **checkvob** does not salvage versions from the unreferenced containers and update the database. It uses the unreferenced containers to return the pool to the state expected by the database, and it moves the unreferenced containers (with the latest version data) to *pool-dir***lost+found**. These versions should be presumed lost. Contact Rational Technical Support for more information.

Source Pool: Corrupted Container

Description

File truncated and similar conditions

Cause

Unexpected events

Fix Processing

None. **checkvob** does not find or fix corrupted data containers. A container with the right pathname is considered healthy.

DO Pool: Missing Container

Description

VOB database references a DO pool data container that does not exist at the expected location.

Causes

- (Database newer) Database references recently promoted DO, but the older pool does not include its container.
- (Pool newer) Older database references a DO that has been scrubbed from the newer pool. See also the **scrubber** reference page.
- Unexpected events.

Fix Processing

With the equivalent of **rmdo**, adjust the database to dereference the DO container.

DO Pool: Unreferenced Container (Debris)

Description

DO pool includes a data container that is not referenced by the VOB database. Such containers are classified as debris and moved to the pool's **lost+found** directory. (The **scrubber** does not remove unreferenced DO data containers, only those with zero reference counts.)

Causes

- (Database newer) Older pool includes DO that was subsequently scrubbed.
- (Pool newer) DO was promoted to the DO pool, but the older database is not aware of it.
- Unexpected events.

Fix Processing

Container moved to pool's **lost+found** directory.

DO Pool: Corrupted Container

Description

Blocks of NUL characters and similar conditions

Causes

- Unexpected events

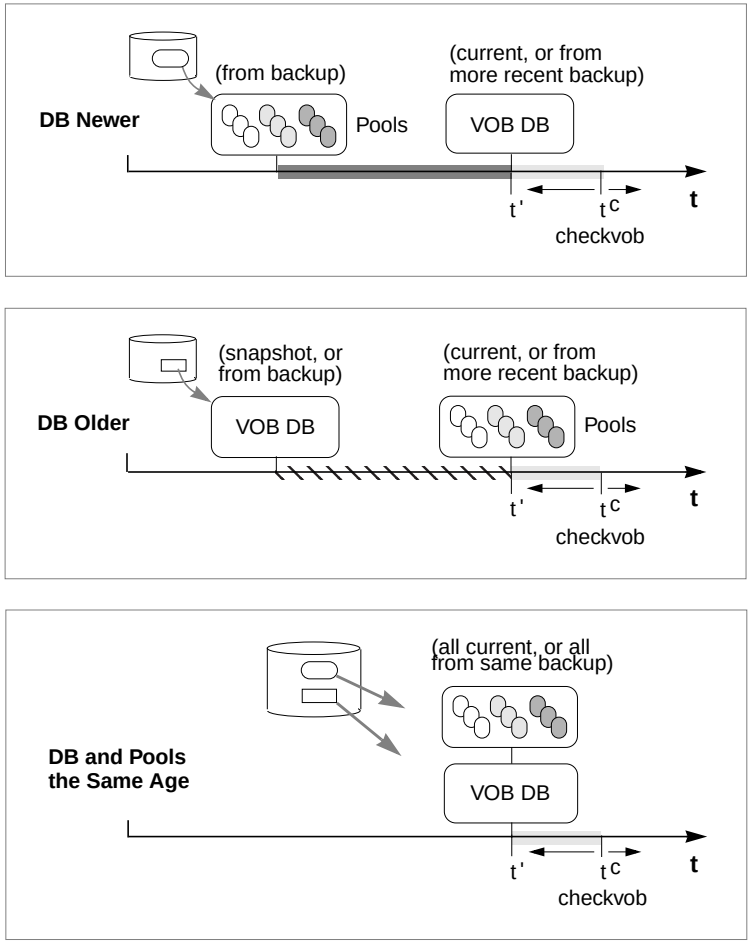
Fix Processing

None. **checkvob** does not find or fix corrupted data containers. A container with the right identify information at the right location is considered healthy for the purposes of **checkvob**.

14.5 Sample Check and Fix Scenarios

The following sample scenarios (see Figure 20) illustrate some general guidelines for using **checkvob**.

Figure 20 Common Scenarios in VOB Database or Storage Pool Synchronization



Somewhere in this time interval is t^c — the point at which you run **checkvob**. If $t^c \neq t'$, VOB activity in the Interval is lost

Pool data created during this time interval is lost. (There may also be "extra" data from rmver or rmbranch operations in this interval.)

Pool data created during this time interval may get copied to the pool's **lost+found** directory, but this data should be presumed lost. checkvob never adds new version or DO data to the DB.

If DB and pools are the same age, data loss is unexpected. Unreferenced containers are common if pools and DB were restored from one or more incremental backups.

Scenario 1: VOB Database Newer Than Storage Pools

A disk crash destroyed remote storage pools, which have been retrieved from backup. The VOB database is current, and the VOB is locked against any further write operations.

The VOB database records development activity that is not substantiated in the storage pools. Under these circumstances, **checkvob** ought to find these anomalies:

- File element or source pool problems: missing and unreferenced data containers. Checkins have been recorded in the VOB database, but they do not appear in the storage pools. This represents real data loss. **checkvob** synchronizes the VOB database with the storage pool by executing **rmver -data** on missing versions.

- DO or DO pool problems: missing data containers. The database references DOs that were promoted to VOB storage containers, but these containers are not found in the (older) pool. **checkvob** deletes these DOs from the database with the equivalent of **rmdo**.

- DO or DO pool problems: unreferenced data containers. DOs were scrubbed from VOB storage, but the (older) pool still includes their containers.

Running checkvob

To accept as lost any pool data (versions or DOs) added in the interval between the pool and database reference times, run **checkvob –force –fix** and supply an appropriate time interval (see *Force-Fix Mode*).

To accept the default, one-day data loss interval, run **checkvob –force –fix**; then, run **checkvob** without **–force** and fix any remaining elements with missing containers manually (as you are prompted by **checkvob**).

Scenario 2: Storage Pools Newer Than VOB Database

The VOB database is corrupted. The storage pools are current, and you have a recent VOB database snapshot on disk. You have run **vob_restore** to recover the VOB database and storage pools. **checkvob** runs to complete the restoration process.

The VOB storage pools reflect development activity that has not been recorded in the VOB database. This scenario, like the previous one, is consistent with using a semi-live VOB backup scheme, as described in *Backing Up a VOB* on page 169. Under these circumstances, **checkvob** ought to find these anomalies:

- File element or source pool problems: missing and unreferenced data containers. New checked-in versions have been written to VOB storage after the reference time on the available VOB database. Note that if any **rmver**, **rmbranch,** or **rmelem** events occurred during the time gap, recovering all versions is not possible (and, presumably, not desirable).

- DO or DO pool problems: missing data containers. The **scrubber** has deleted DOs from the (newer) pool, but the (older) database still references them.

- DO or DO pool problems: unreferenced data containers. DOs have been promoted from view-private to VOB storage, but the (older) database does not know about them.

Running checkvob

Run **checkvob –force –fix** and supply an appropriate time interval (see *Force-Fix Mode*). Most new work (versions found in the newer pools, but unknown to the older database) will be captured in containers identified as debris and moved to the pool's **lost+found** subdirectory (from where you can, under some circumstances, retrieve it successfully). Note that under no circumstances does **checkvob** update a VOB database with "new" version data found in more recent pools. You may be able to construct versions from containers in **lost+found** and check them in as new versions, but **checkvob** cannot do so. The safety net features (see *Force-Fix Mode*) prevent large scale data loss. The only expected data loss reports should be the result of **rmver** or **rmbranch** operations no longer reflected by the (older) database.

14.6 Sample checkvob Runs

The remaining sections in this chapter describe some common problem scenarios for storage pools, and they refer to **checkvob** log files that can be found online in *ccase-home-dir***\doc\examples\checkvob_sample_logs**.

Notes on the sample logs:

- The **–force** option is not used in the sample runs. (Runs without **–force** do not illustrate the acceptable data-loss-interval dialogue.)
- The log transcripts do not capture user input.

14.7 Database Newer Than Pools

Log: *ccase-home-dir***\doc\examples\checkvob_sample_logs\checkvob.DB_newer**

Highlights from this run:

- The database records a missing data container for a checkin (**foo.c**) that is newer than the source pool. A corresponding older unreferenced container appears in the source pool.

- A promoted DO is reported missing.

The only alternate container for element **foo.c** is missing version **\main\2** (a newer checkin). Note that nothing happened during the check and fix processing of unreferenced containers because the only unreferenced containers in the pool were for this broken element. These unreferenced containers were moved to the pool's **lost+found** directory.

14.8 Database Older Than Pools

Log: *ccase-home-dir***\doc\examples\checkvob_sample_logs\checkvob.DB_older**

Highlights from this run:

- An unreferenced container for **foo.c** stores the newest checkin data. There is a corresponding missing container, because the database is looking for a different, older one.
- An **rmver** operation took place in the source pool for **bar.c** but is not reflected in the database, which continues to look for a missing container.
- A scrubbed DO is reported missing.

The only alternate container for element **foo.c** has an extra, unreferenced version, **\main\3**. This version appears to have been checked in sometime in the future, from the database's point of view. The only alternate container for element **bar.c** is the missing version **\main\2**. It was removed in the future from the database point of view. Note that the unreferenced container check or fix phase found nothing to do, because the only unreferenced containers in the pool were for these broken elements, and these unreferenced containers were moved to the pool's **lost+found** directory.

NOTE: From **checkvob**'s perspective (and its output), there is no difference between the **foo.c** and **bar.c** cases; both containers are missing version data.

14.9 Unreferenced Containers from Incremental Backup or Restore

Log: *ccase-home-dir***\doc\examples\checkvob_sample_logs\checkvob.incremental**

In this case, a synchronized, healthy VOB underwent incremental backup and restore operations, resulting in unreferenced containers.

Highlights of this run:

- The backup captured two replaced containers each for **foo.c** and **bar.c**.

14.10 Pool Root Check Failure

Log: *ccase-home-dir***doc\examples\checkvob_sample_logs\checkvob.pool_roots**

In this case, we created a new source pool, **sdft2**, and restored an older pool set that was missing **sdft2**. As a result, **checkvob** reports `pool roots are not healthy`.

Pool check failure can happen in response to various kinds of pool-related events—especially events that occur in any interval between VOB database and storage pool reference times.

Use the following procedures to diagnose and fix pool root problems.

Fixing Pool Roots: Getting Started

Try to determine the failure scenario. Use **lshistory** to see what has happened recently in the VOB:

- Run **lshistory** on any problem pools (newly created pools or renamed pools, for example).

  cleartool lshistory –l pool:sdft@vob:*vob-tag*

- Run **lshistory** on the VOB itself (to find pools that have been removed, for example).

  cleartool lshistory vob:*vob-tag*

Fixing Pool Roots: The Most Common Problems

The following sections explain how to fix common pool root inconsistencies.

For the following sections, the term *skew* refers to inconsistency in what the VOB database expects and what actually appears in the storage directory.

Pool Skew Caused by Addition of New Pool

Problem: An older storage directory doesn't include the newest pool (which is known to the newer VOB database). To fix the skew:

1. In the VOB storage directory, create the pool root with **mkdir** (or**,** for a remote pool on a UNIX host, using **ln -s**.):
2. Add a **pool_id** file as described in *How to Re-Create a Pool's pool_id* on page 281.

   If the pool is a remote pool on a UNIX host, it is probably intact and needs only a new symbolic link, not a **pool_id** file.

Pool Skew Caused by Pool Deletion

Problem: An older database looks for a pool that has been removed from the more recent storage directory.

To fix the skew, see *Pool Skew Caused by Addition of New Pool* on page 280.

Pool Skew Caused by Renamed Pool

To fix the skew, rename the pool root in the storage directory so that it matches the database. The **pool_id** info is already correct. Only the pool's name has changed, not its identity or OID.

A More Complex Pool Skew Scenario

Problem: You removed pools **sdft1** and **sdft2** and redistributed their containers to new pools **sdft3** and **sdft4**, and then renamed **sdft3** to **sdft2**. As a result:

- Some new pools were created.
- Some pools were deleted.
- A new pool was renamed to reuse the name of a deleted pool.

The database is older than the storage directory. Therefore, from the database's perspective:

- **sdft2** is has the wrong **pool_id** info. (The pool is a different object.)
- **sdft4** is extra.

To fix the storage directory to match what is expected by the database:

- Create a **sdft2** pool that has the correct identity.
- Eliminate **sdft3** without losing its containers.

To fix the skew:

1. Edit the storage directory's **sdft2\pool_id** information to set the pool's OID to that which the database associates with **sdft2**.

2. Merge the extra pools into the existing pools and remove the extra pools. It is critical that the merged-in containers retain the same tree structure. For example, **sdft4\0\1***leaf* becomes **sdft2\0\1***leaf*

   To merge **sdft4** into **sdft2**:

   a. Log on as the privileged user.

   b. Go to the **s/sdft** pool directory.

   c. Make sure that the **pool_id** file for **sdft2** is not overwritten.

   d. Copy the pool directory trees, making sure to preserve container ownership and access control information.

      NOTE: If you fail to preserve protection data, **checkvob** detects and fixes the errors in the moved containers.

   e. Delete the extra pool.

How to Re-Create a Pool's pool_id

The **pool_id** file must have a single line with the following format:

`poolkind=`*poolkind* `pool_oid=`*pool-oid* `replica_uuid=`*replica-uuid* `vob_oid=`*vob-oid*

- *poolkind*. **s**, **d**, or **c** for source, derived, cleartext respectively.
- *pool-oid*. The pool's OID, as determined from a command like this one:

  cleartool describe –fmt '%On\n' pool:sdft2

- *replica-uuid*. The VOB's replica UUID (from the VOB storage directory's **replica_uuid** file or from **lsvob –long** (`VOB replica UUID` field))
- *vob_oid*. The VOB's family OID (from the VOB storage directory's **vob_oid** file or from **lsvob –long** (`VOB family UUID` field))

15 Splitting VOBs with relocate

The export/import utilities included with Rational ClearCase provide a way to copy elements between VOBs. To move directory elements, file elements, and VOB symbolic links from one VOB to another, use the **relocate** command. A relocate operation is appropriate if you need to reorganize VOB data to reflect changes in component architecture or organizational structure or if you need to groups of elements out of a VOB to reduce its size, or provide better load balancing across more VOB servers.

Relocating elements is a complex operation. All of the data and metadata associated with each relocated element must be preserved, and all clients must be able to access the relocated elements along with their metadata.

This chapter first describes how **relocate** works. Then, it examines what happens before, during, and after a relocate operation from an administrator's point of view.

NOTE: You cannot use **relocate** in a UCM VOB. Do not perform any **relocate** operation without also consulting the **relocate** reference page.

15.1 What Does relocate Do?

The **relocate** command moves a designated set of elements from one VOB (the source VOB) to another VOB (the target VOB)—typically, a new VOB created for this purpose. The **relocate** command does all of the following:

- Moves elements from one VOB to another, including these:
  - Data containers

- Event histories (some minor events are lost)
- Bidirectional hyperlinks (see also **mkhlink**)
- Related VOB database records
- The config records associated with checked-in derived objects (DOs)

- Creates *VOB symbolic links* from the source VOB to the target directory, generally preserving the source VOB's namespace for views bound to specific, preexisting versions of relocated elements.
- Copies metadata types associated with moved elements to the target VOB, as necessary (label, attribute, element, trigger, and hyperlink types).
- Leaves behind an event history for each relocated element—a remove element event in the source VOB, and a relocate event in the target VOB.
- Deletes nonversioned DOs and config records for DOs contained in relocated directories. (See the **rmdo** reference page.)
- Strands view-private files and DOs contained in relocated directories (**recoverview –sync** *view-tag* recovers these files to *view-stg-dir***\.s\lost+found**).
- Creates a log of its activities—by default, in the file **relocate.log.***date-time* in the current directory.

relocate does not do the following:

- Relocate elements when either the source or the destination VOB is a UCM VOB.
- Copy elements; it moves them. (**relocate** is not a backup tool.)
- Move view-private files and nonversioned DOs stored in relocated directories.
- Move elements to a new location in the same VOB. (Use **cleartool mv** for this purpose.)

NOTE: Because nonversioned DOs do not move with relocated directories (they are instead removed, as if by **rmdo**), any views that exist to help re-create past releases must rebuild any nonversioned DOs that were stored in relocated directories.

15.2 Element Relocation Illustrated

The following series of figures illustrates several variants of a comparatively simple relocate operation and emphasizes how the various versions of affected directories catalog elements after the move. The figures assume these conditions:

- The view used for the **relocate** operation selects **\main\LATEST** for all elements being relocated. This approach is recommended because it is least likely to generate confusing results for VOB users and administrators. (You can use a different branch, as long as the config spec selects the latest version on that branch.)
- The target VOB was created to accommodate the relocated elements. This approach is not mandatory, but we recommend it. It minimizes the chances of name collision between an existing element and a relocated one and of encountering locked type objects in the target VOB.

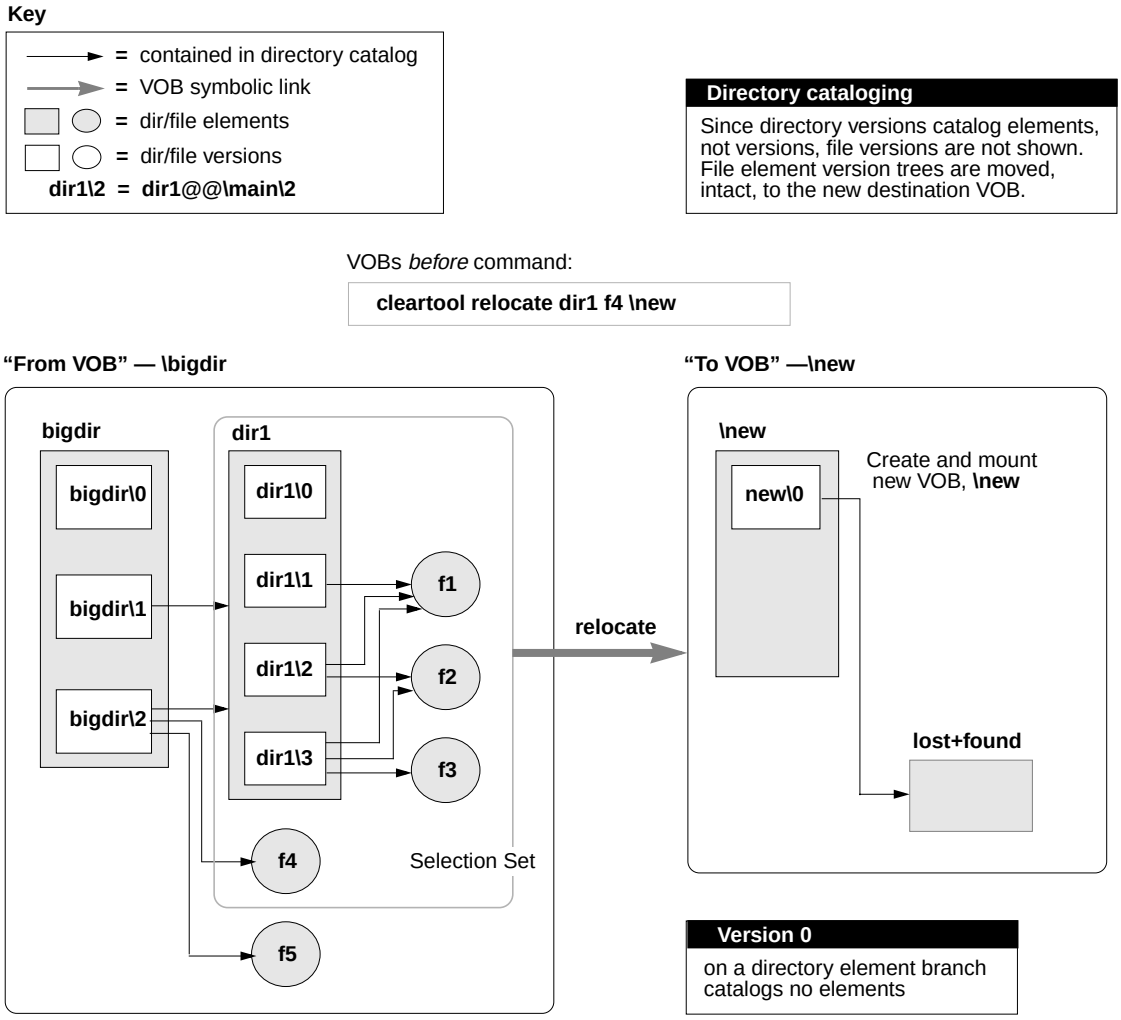
NOTE: All figures use the following shorthand notation for directory versions:

dir1\1 = dir1@@\main\1

Figure 21 shows the source and target VOBs, **\bigdir** and **\new**, before relocating one directory element (**dir1**) and four file elements (three contained by **dir1**, plus the single element **f4**). This is the applicable **relocate** command sequence:

```
c:\> net use v: \\view\main        (view selects \main\LATEST in source and target VOBs)
c:\> v:
v:\> cd \bigdir
v:\bigdir> cleartool relocate dir1 f4 \new
```

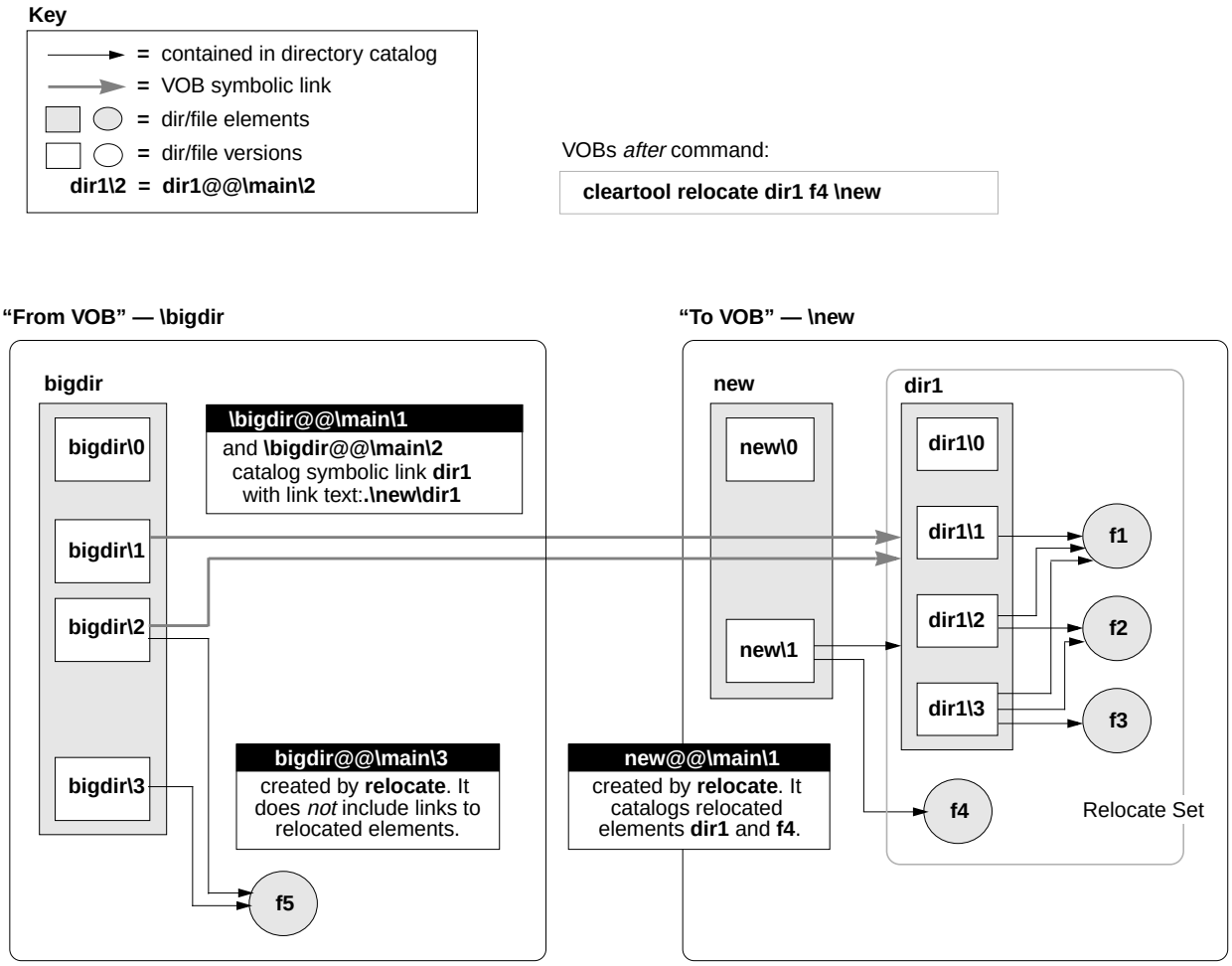
Figure 21 Elements Cataloged by Directory Versions Before Relocate Operation



The **relocate** command defines a selection set that includes **dir1**, **f1**, **f2**, **f3**, and **f4**.

Figure 22 shows the VOBs after **relocate** runs.

Figure 22 Directory Version Cataloging After Relocate Operation



Cataloging in the Source VOB

In the source VOB, after **relocate** completes, preexisting parent directory versions (**bigdir@@\main\1** and **bigdir@@\main\2** in Figure 22) include symbolic links to the moved elements. These links provide stability for historical views, which can continue to view the VOB as it existed before the relocate operation.

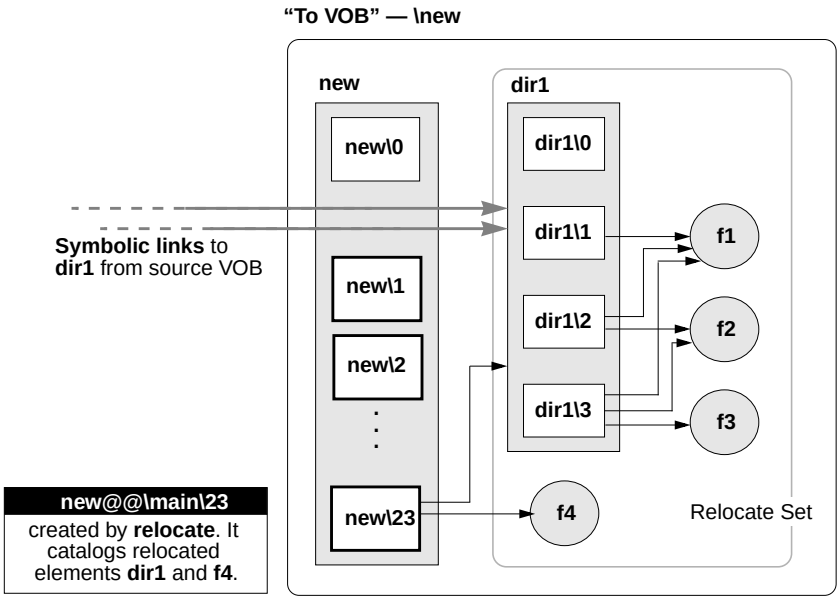
relocate checks in a new version of each relocated element's containing directory (**bigdir@@\main\3** in Figure 22). The new directory version created by **relocate** does not catalog

any relocated elements. In general, this result is desirable; it forces you to address any anomalies in your active development environment that may have resulted from the relocate operation. A guiding principle is that as many views, scripts, and so on, as possible find relocated elements at their new locations, rather than through VOB symbolic links left behind in the original VOB. See *Symbolic Links* on page 296 for some reasons to avoid relying too heavily on VOB symbolic links. See *Updating Directory Versions Manually* on page 299 for information on adding symbolic links to relocated elements where circumstances warrant it.

Cataloging in the Target VOB

In the destination VOB, only the latest version of the target directory catalogs relocated elements. Figure 22 illustrates the common, recommended scenario involving a new destination VOB. However, even if the **new** directory has many versions, only the version created automatically by **relocate**—on the target directory branch selected by the current config spec—catalogs the moved elements. Figure 23 shows the destination VOB from Figure 22, expanded to include multiple versions of the target directory.

Figure 23 Destination VOB That Includes Multiple Versions

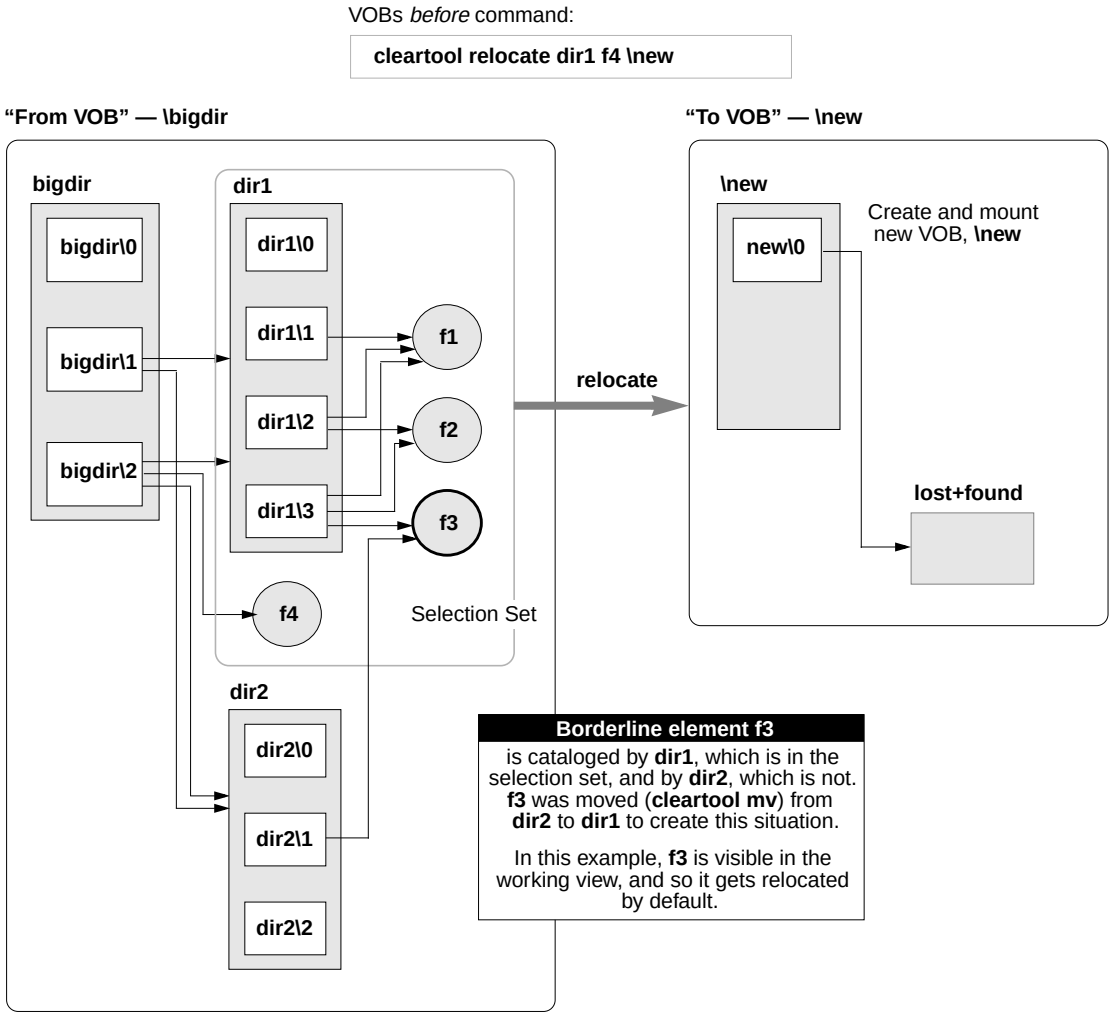


See *Updating Directory Versions Manually* on page 299 for information on adding symbolic links to relocated elements where circumstances warrant it.

Relocating Borderline Elements

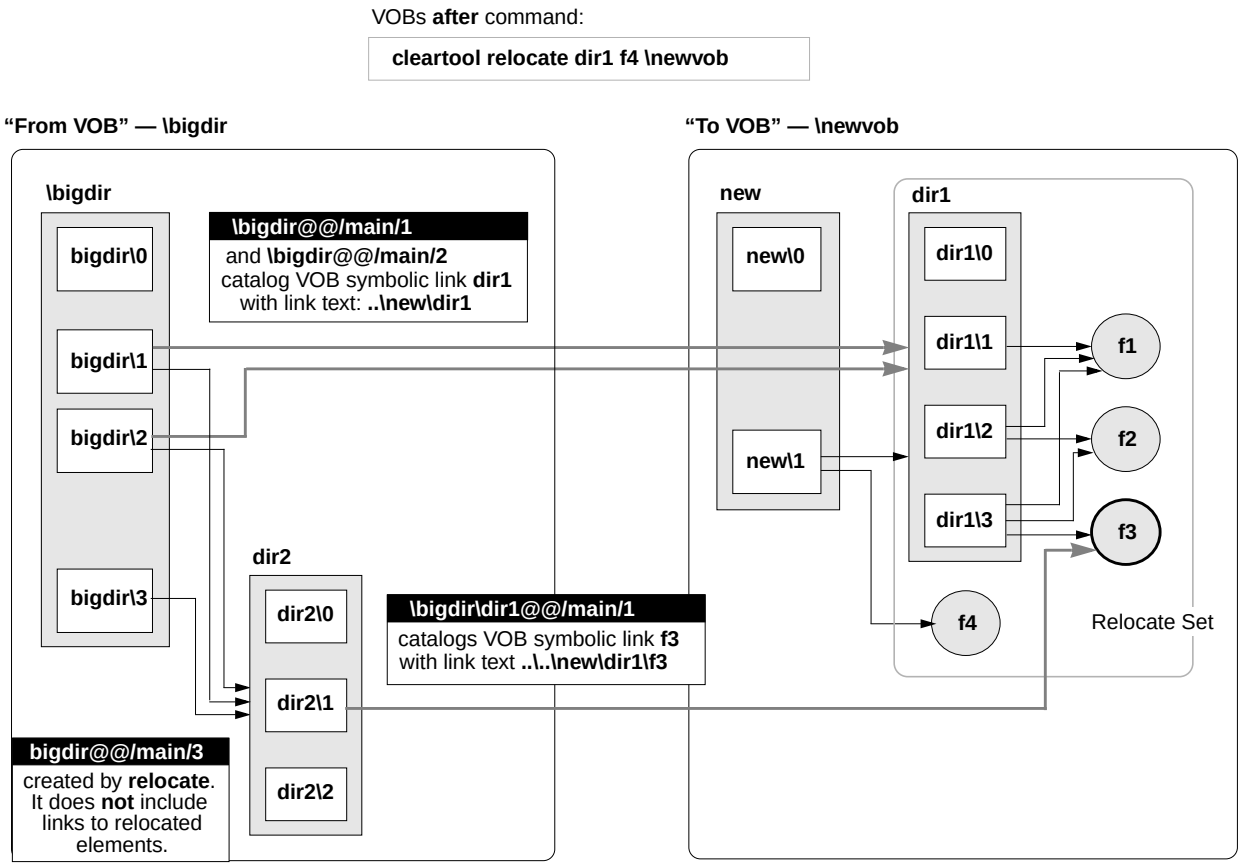
Figure 24 illustrates the relocate operation shown in Figure 21 and Figure 22, but this time the source VOB includes a *borderline element* (**f3**). This element is cataloged both in a version of a directory in the selection set and in some version of a directory outside the selection set (in a directory that stays behind). (See key in Figure 21 on page 286.)

Figure 24 Source VOB That Includes a Borderline Element



File element **f3** is cataloged in both **dir1** and **dir2**. **dir1** is in the selection set, but **dir2** is not. Assume for now that the config spec for the administrator's working view includes a **\main\LATEST** rule that makes **f3** visible as **\bigdir\dir1\f3**. Because **f3** is visible to the working view, **relocate** moves it by default, as shown in Figure 25.

Figure 25 Source and Destination VOBs with Borderline Element Relocated

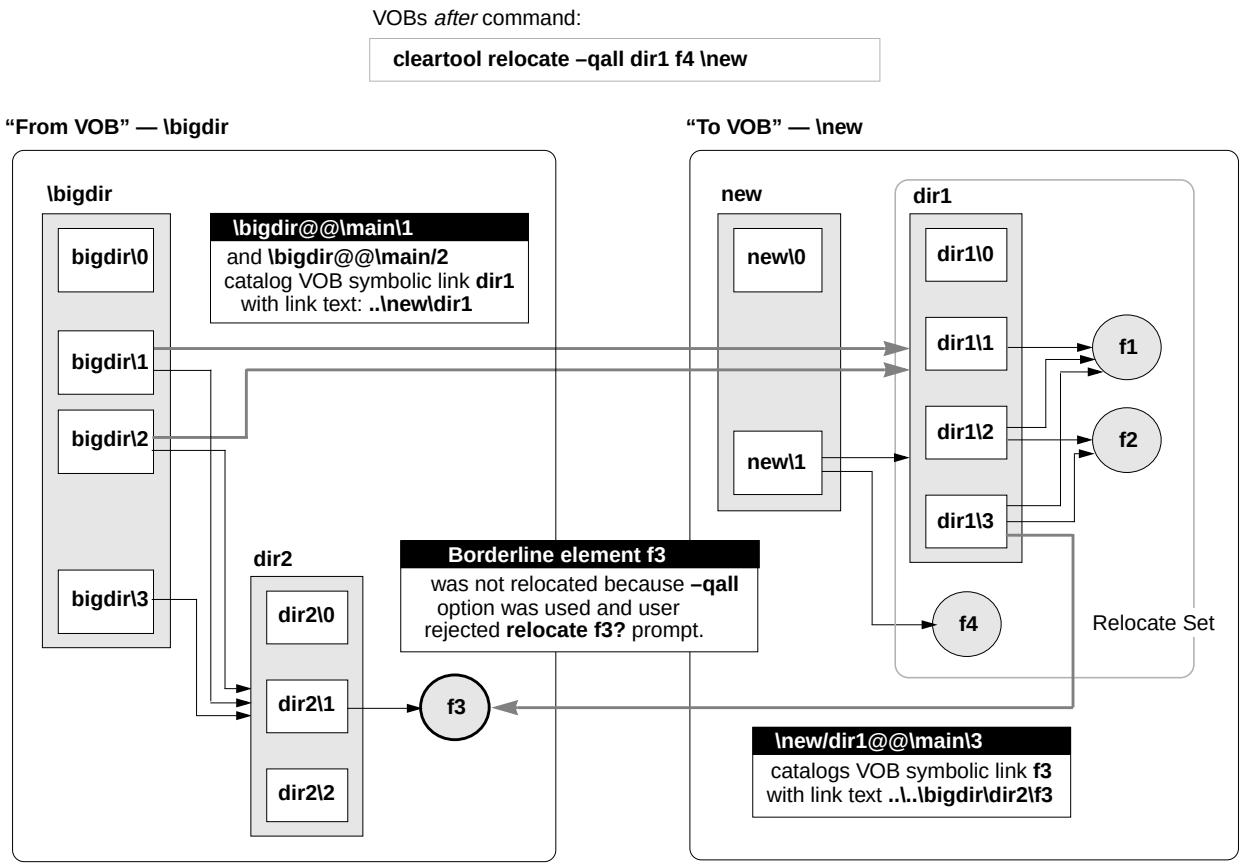


Element **f3** is relocated, and the directory version in the source VOB that referenced it (**dir2@@\main\1**) is updated with a VOB symbolic link to its new location.

Figure 26 shows borderline element **f3** left behind in the source VOB. These different scenarios may yield this result:

- The **–qall** option to **relocate** is used. In this case, each borderline element triggers the `relocate this element or not?` prompt.
- At relocate time, if the working view selects no version of **f3**, it stays behind by default. (In this case, using **–qall** yields an opportunity to relocate **f3** anyway.)

Figure 26 Source and Destination VOBs with Borderline Element Not Relocated



The next section follows on these examples to examine the administrator's role in a relocate operation.

15.3 Before Relocating Elements

Take the following steps before moving elements from one VOB to another:

1. **Inform users of your intentions**. The affected source and target VOB elements must be inactive during the relocate operation.

Inform users that relocated elements will cause rebuilding of DOs that include them as dependencies.

2. **Have users move view-private files out of directories that are to be relocated.** If view-private files are not moved from relocated directories, they become stranded.

   These files can be recovered to *view-stg-dir***.s\lost+found** with **recoverview –sync** *view-tag*. However, it is easier to move them to new locations before running **relocate**.

   Checked-out files are also view-private and must be resolved before running **relocate**. The command aborts if any files are checked out from a directory it is trying to relocate.

3. **Coordinate with administrators of all other VOB replicas, if any**. Affected elements must be inactive at all replica sites. See the section on replicated VOBs in the **relocate** reference page.

4. **Check for views with checkouts or DOs in the VOB.** Use the VOBs node in ClearCase Administration Console. This node has DOs and Referenced Views subnodes that list all views with checkouts and/or DOs in the VOB and allow you to manage these objects from the console window. You can also use the **cleartool lsdo** and **lscheckout** commands to list DOs and checkouts on a per-view basis.

5. **Resolve any checkouts.** Resolving checkouts typically involves notifying the appropriate users about the problem. **relocate** aborts if it encounters an active checkout in any directory it is trying to move.

6. **Establish a working view.** Use a working view whose config spec selects the branch (typically **\main**) on which the move is to occur.

   This step is very important. Your view must be able to see and check out elements in both the source and destination VOBs. Therefore, a working view configured without a **CHECKEDOUT** rule, for example, is inappropriate. Also, run **relocate** with the same view or with the same config spec that you will use to adjust makefiles, rebuild libraries, reset config specs, modify development tools, or complete any other work that may accompany the relocate task. See also *After Relocating Elements* on page 295.

7. **Run relocate in test mode.** Run the intended **relocate** command and monitor its output, but stop short of moving any elements by responding **no** at this prompt:

   ```
   Do you want to relocate these objects? [no]
   ```

   You may want to include the **–qall** option in your test run, to examine **relocate**'s potential handling of borderline elements:

cleartool relocate –qall dir1 \new

When **relocate** encounters a borderline element, its output looks like this:

```
Element "f3" is
  located outside the selection tree as "f3" in
  directory "\bigdir\dir2",
  located inside the selection tree as "f3" in
  directory "\bigdir\dir1".
Do you want to relocate it? [no]
```

15.4 Common Errors During a Relocate Operation

The following conditions are the most frequent causes of failed relocate operations:

- Checked-out files in relocated directories
- Locked type objects in the target VOB
- Triggers on **rmelem** that prevent **relocate** from removing elements from the source VOB after they have been created in the target VOB

In general, you can restart **relocate**. You fix the reported error and restart **relocate** with the same command line. Errors that occur during source VOB element removal require manual repair.

Errors Not Related to Source VOB Element Removal

In the event of an error:

1. **Stop and fix the problem.** For example, if **relocate** reports a locked type in the target VOB, unlock it. If it reports a checked-out version in the relocate set, resolve it.

2. **Restart relocate.** When invoked with an identical command line, **relocate** resumes processing from the interrupt point, provided that these conditions are met:

   - You do not release source VOB element locks that **relocate** sets automatically.
   - No user modifies the elements being moved (new checked-in versions, new labels, and so on).
   - (**–qall** only) You answer all `relocate this object?` queries the same way.

If any of these conditions is not met, **relocate** starts processing from the beginning, and it may encounter new problems that return you to Step #1 of this procedure.

Errors During Source VOB Element Removal

After **relocate** has re-created elements in the target VOB, it removes the elements from the source VOB. If this step fails (typically, due to a trigger on the **rmelem** operation), you must remove the elements manually, as follows:

1. **Find element OIDs from log file.** Examine the relocate log file (*view-stg-dir***relocate.log.***date-time*) and find the lines that specify the unique object IDs (OIDs) of the elements that **relocate** tried to remove but could not. You must remove these elements manually.

2. **Remove the elements.** For each element reported in the log file, run this command:

   cleartool rmelem oid:*OID-reported-in-relocate-output*

3. If necessary, remove the trigger that prevented **relocate** from removing the elements.

To avoid these errors, remove any **rmelem** triggers on elements before relocating them.

15.5 After Relocating Elements

Although **relocate** leaves behind symbolic links to keep VOB namespace consistent, you probably need to make some additional adjustments in your development environment. Check existing views (config specs), build scripts, triggers, and any other tools that may rely on access to the relocated elements. Update these tools to access relocated elements at their new location, rather than relying on symbolic links.

The section *Symbolic Links* addresses potential problems associated with symbolic links. The section *Cleanup Guidelines* outlines the steps you must take to stabilize the development environment. Finally, *Updating Directory Versions Manually* offers techniques for fine-tuning the symbolic links left behind by **relocate**.

Symbolic Links

VOB symbolic links provide a powerful mechanism for linking MVFS objects, but you must be aware of their limitations:

- In general, **cleartool** commands do not traverse VOB symbolic links. Instead, they operate on the link objects themselves. For example:
  - You cannot check out a VOB symbolic link, even if it points to an element.
  - A **describe** command lists information on a VOB symbolic link object, not on the object to which it points.
  - A **mklabel –recurse** command walks the entire subtree of a directory element, but it does not traverse any VOB symbolic links it encounters.
- Config specs do not follow symbolic links to other VOBs.
- Build scripts may include operations that fail on symbolic links.
- If you move a relocated element with **cleartool mv**, any symbolic links from the source VOB are broken.
- On UNIX hosts, broken symbolic links—those with nonexistent targets—are not visible to most file-system commands. These include those links that have accurate pathname information but point to elements not selected by the current view. The **cleartool ls** command lists these objects.

Upgrading Views That Rely on Symbolic Links

Views left to access relocated elements by means of symbolic links may have problems, even though they see relocated elements without difficulty. For example, you cannot check out a VOB symbolic link, even if it points to an element. There are several ways around this limitation, if a view with a more direct path to elements in the target VOB exists:

- Reset the view's config spec to use absolute pathnames to the new VOB. This is the most thorough and predictable approach. But it may not be practical when many elements have been relocated and the config spec needs rules that specify a large number of individual elements.
- Add labels to relocated versions, and configure the view to select these elements with a label-based rule.

- Apply a particular branch type to relocated elements, and configure the view to select this branch.

Cleanup Guidelines

To clean up after the relocate operation:

- **Use the view that was used for the relocate operation.** Before adjusting config specs, modifying build rules, and so on, activate the same view, or the same config spec, that was in effect at relocate time.

  In the source VOB, **relocate** completes its operation by checking in the parent directories of all relocated elements. Recall that this last checked-in directory version does not include symbolic links to relocated elements. Presumably, your view selects this version, in which relocated elements do not appear. Working in this view also allows you to track tools, build rules, and other potentially broken references to the relocated elements.

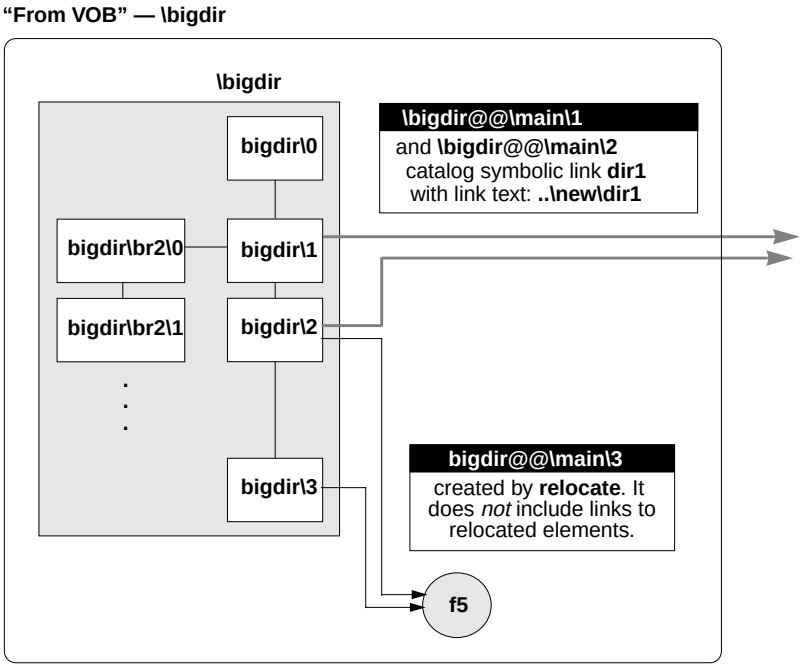
- **Check important and historical views to see whether symbolic links work.** Some kinds of config specs are likely to have trouble:

  - Config specs with explicit pathname rules to relocated elements. (Config specs do not follow symbolic links to other VOBs.)

  - Config specs that use predominantly label-based rules. In this case, you may choose to add labels to relocated elements and their containing directories in the target VOB.

  - Config specs that look for relocated elements on a branch other than that on which the relocate operation was performed. Figure 27 shows the source VOB from Figure 22, expanded to include a second branch on the directory that contained the relocated elements. Note that **relocate** adds symbolic links only to versions on the branch used to select the element at relocate time. (See the key in Figure 21 on page 286.)

Figure 27 Source VOB with Multiple Branches on Parent Directory



- **Fix broken views.** After you find the problem config specs, use one of the techniques listed in *Upgrading Views That Rely on Symbolic Links* on page 296 to make relocated elements visible again.

- **Recover any stranded view-private files.** Run (or have users run) **recoverview –sync** on each view used to access the source VOB. Any view-private files and DO data files are moved to the view storage directory's **lost+found** directory, where they appear under the expected names (**f2**, **test.c**, and so on). For example:

  cleartool recoverview –sync alh_main

  NOTE: **cleartool lsprivate** lists stranded objects by their object IDs (OIDs).

Updating Directory Versions Manually

You can modify the results of a **relocate** operation by adding and removing VOB symbolic links to specific directory versions manually. However, these operations alter the intended results of **relocate**, and they are rarely necessary.

WARNING: The techniques described here are powerful and potentially dangerous. Do not use **cleartool ln –nco** or its companion command **rmname –nco** carelessly; they make permanent VOB changes without leaving behind an event history that you can trace easily. To use these commands, you must be the VOB owner or the privileged user. Also, you cannot use these commands in a replicated VOB.

Fixing Symbolic Links Created by relocate

In some cases, the VOB symbolic links that **relocate** creates automatically may have to be modified to point to their intended targets. An incorrect symbolic link in a specific directory version can be removed with **cleartool rmname –nco** and replaced with **cleartool ln –nco**.

relocate has to make an educated guess about the relationship between the source and target VOB roots and about the relationship between the source and target directories. The local host map, VOB mounting and naming conventions on UNIX, as well as drive assignment, disk sharing, and naming conventions on Windows can sometimes lead to an incorrect guess.

To help identify the sources and targets for symbolic links, **relocate** connects a symbolic link object to the target element object with a hyperlink of type **HyperSlink**. Use the **cleartool describe** command on the symbolic link to display information about this hyperlink, which can help to repair the symbolic link.

After you relocate elements, if you move any of them again with **cleartool mv**, symbolic links are not updated automatically. You can use this technique to update the links manually.

The following commands replace a relative symbolic link created by **relocate** with an alternative absolute pathname to the target VOB.

```
cd \bigdir
cleartool rmname –nco \bigdir@@\main\2\dir1
Modify non-checkedout directory version "\bigdir@@\main\2"? [no] yes
Link removed: "\bigdir@@\main\2\dir1"

cleartool ln –nco \new\proj2\dir1 \bigdir@@\main\2\dir1
Modify non-checkedout directory version "\bigdir@@\main\2"? [no] yes
Link created: "\bigdir@\main\2\dir1"
```

Modifying Old Target Directory Versions to See Relocated Elements

In Figure 23 on page 288, **relocate** checks in a new version of the destination directory, and only that version catalogs the relocated elements. Now, consider this scenario:

- You have a view, **alh_port**, that selects a previous version of the target directory (**\new@@\main\2**, for example).
- You want the **alh_port** view to be able to see the newly relocated **dir1** element at its new home, **\new\dir1**, rather than at its old location, **\bigdir\dir1**.

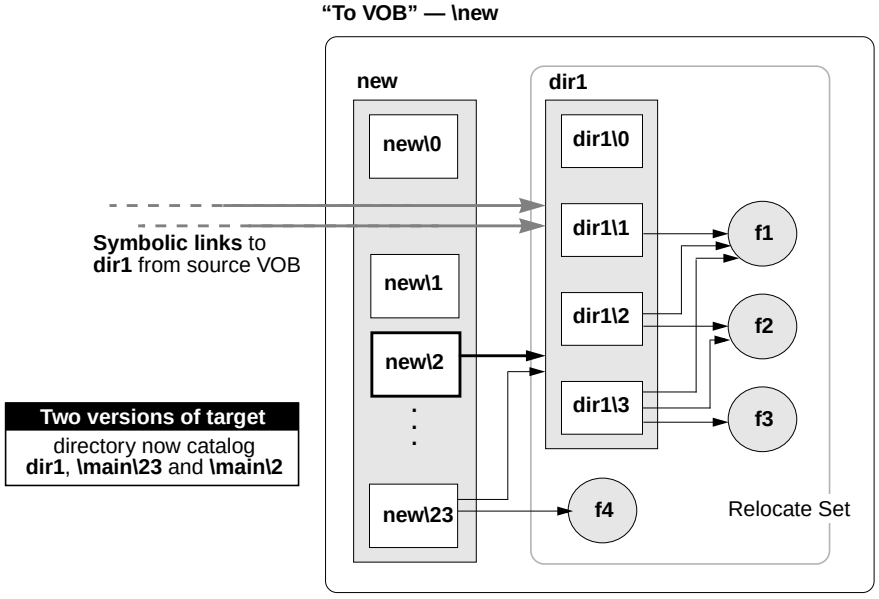
In a case like this, you can manually update previous versions of **relocate**'s destination directory to catalog relocated elements. For example, to add **dir1** to directory version **\new@@\main\2**:

1. Log on as the privileged user.
2. Create the VOB symbolic link. The following command requires special privileges because it modifies a directory version's contents without checking it out or changing its event history.

   cd \new *(and your working view must select some version of dir1)*
   cleartool ln –slink –nco dir1 \new@@\main\2\dir1
   `Modify non-checkedout directory version "\new@@\main\2"? [no] yes`
   `Link created: "\new@@\main\2\dir1"`

Figure 28 shows the effect of the **cleartool ln –nco** command. (See the key in Figure 21 on page 286.)

Figure 28 Destination VOB After Modifying Old Version of Destination Directory



Modifying Newest Version of Source Directory to See Relocated Elements

In Figure 22 on page 287 and Figure 25 on page 291, the latest version of a relocated element's parent directory does not catalog that relocated element. In some circumstances, you may want to add such cataloging manually, in the form of symbolic links. For example, the following command sequence updates the from-directory version **bigdir@@\main\3** (Figure 22) to see relocated directory **dir1** at its new location:

```
cd \new
cleartool ln –slink –nco dir1 \bigdir@@\main\3\dir1
Modify non-checkedout directory version "\bigdir@@\main\3"? [no] yes
Link created: "\bigdir@@\main\3\dir1"
```

16 Using Administrative VOBs and Global Types

This chapter describes how to use administrative VOBs and global types.

16.1 Overview of Global Types

An administrative VOB stores definitions of global types and makes them available to all client VOBs that link to the administrative VOB. You can use global types to increase the scope of a type object from a single VOB to a group of VOBs. For example, you can have all VOBs in your local area network use the same set of type objects by linking them to the same administrative VOB. You can create any number of global type objects in one or more administrative VOBs.

A client VOB uses global types from an administrative VOB as follows:

1. A developer attempts to create an instance of a type, but there is no type object in the client VOB. For example, a developer wants to create a **v3_bugfix** branch in a particular element, but branch type **v3_bugfix** does not exist in the client VOB.
2. Rational ClearCase determines which administrative VOB is associated with the client VOB by scanning for an **AdminVOB** hyperlink in the client VOB.
3. If it finds a global type (branch type **v3_bugfix** in this example) in the administrative VOB, ClearCase creates a copy of the type object in the client VOB. This capability is called *auto-make-type*.
4. ClearCase uses the *local copy* of the type object to create the instance that the developer wants. (In this case, it creates the **v3_bugfix** branch for the desired element in the client VOB.)

A local copy is linked to the global type object by a **GlobalDefinition** hyperlink. Operations performed on a global type affect all its local copies. Similarly, operations performed on a local copy affect the global type, and by extension, all other local copies.

16.2 Why Use Global Types?

Using global types offers the following benefits:

- **Automatic creation of types.** Local metadata types are created from global types as needed at client VOBs when you create instances of the types (with the **mkattr**, **mkbranch**, **mkelem**, **mkhlink**, and **mklabel** commands).
- **Centralized administration.** Groups of VOBs can share metadata type definitions. You can control global type objects and their local copies from the administrative VOB.

16.3 Working with Administrative VOBs

The following sections describe how to work with administrative VOBs.

Creating an Administrative VOB

To create an administrative VOB, follow the procedures described in *Creating a VOB* on page 147.

NOTE: An administrative VOB can also store elements.

To put a VOB into use as an administrative VOB:

1. Link client VOBs to it. See *Linking a Client VOB to an Administrative VOB* on page 305.
2. Create global types in it. See *Creating a Global Type* on page 312.

Linking a Client VOB to an Administrative VOB

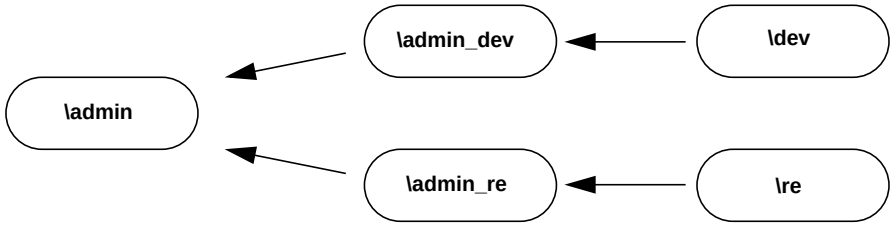
To associate a client VOB with an administrative VOB, create a hyperlink of type **AdminVOB** from the client VOB to the administrative VOB.

cleartool mkhlink –c "link to admin VOB" AdminVOB vob:\dev vob:\admin_dev
```
Created hyperlink "AdminVOB@40@\dev".
```

Administrative VOB Hierarchies

A client VOB can have only one administrative VOB. However, you can create administrative VOB hierarchies, in which a client VOB is linked to an administrative VOB, which is linked to another administrative VOB. (Circular relationships are prohibited.) For example, you can create an administrative VOB that contains global types used by all VOBs at your site, plus two other administrative VOBs, each containing global types specific to the needs of particular teams. Figure 29 illustrates this example.

Figure 29 Administrative VOB Hierarchy



You can add an administrative VOB to the middle of a hierarchy by removing an existing **AdminVOB** hyperlink and adding two new ones. This operation does not disrupt existing type definitions, because the hyperlink between a local copy and its associated global type remains intact.

To add an administrative VOB to a hierarchy:

1. Remove the **AdminVOB** hyperlink at the point where you want to add the new administrative VOB. For example, if you want to add an administrative VOB between **\admin** and **\admin_re**:

cleartool describe –l vob:\admin

```
...
  Hyperlinks:
    AdminVOB@40@\admin_re <- vob:\admin_re
```

cleartool rmhlink –c "insert admin VOB" AdminVOB@40@\admin_re

```
Removed hyperlink "AdminVOB@40@\admin_re"
```

2. Create the new administrative VOB.

3. Associate the new administrative VOB with its higher level administrative VOB. For example, if the new administrative VOB is **\admin_lb**:

   cleartool mkhlink –c "link admin_lb to admin" AdminVOB vob:\admin_lb vob:\admin

   ```
   Created hyperlink "AdminVOB@40@\admin_lb".
   ```

4. Associate the client VOB with the new administrative VOB.

   cleartool mkhlink –c "link re to admin_lb" AdminVOB vob:\re vob:\admin_lb

   ```
   Created hyperlink "AdminVOB@40@\re".
   ```

Listing an AdminVOB Hyperlink

Use the ClearCase Administration Console or the **cleartool describe** command. The **describe** command shows the hyperlink that associates a client VOB with an administrative VOB. The hyperlink always points from the client VOB to the administrative VOB. The following examples show **AdminVOB** hyperlinks.

- Client VOB **\dev**, whose administrative VOB is **\admin_dev**

  cleartool describe vob:\dev

  ```
  versioned object base "\dev"
  ...
    Hyperlinks:
      AdminVOB -> vob:\admin_dev
  ```

- Administrative VOB **\admin** with two client VOBs

cleartool describe vob:\admin

```
versioned object base "\admin"
...
  Hyperlinks:
    AdminVOB <- vob:\admin_dev
    AdminVOB <- vob:\admin_re
```

- A VOB that is both a client VOB and an administrative VOB

cleartool describe vob:\admin_dev

```
versioned object base "\admin_dev"
...
  Hyperlinks:
    AdminVOB -> vob:\admin
    AdminVOB <- vob:\dev
```

To display the hyperlink ID, use **describe –long**. The hyperlink ID includes the VOB-tag of the VOB in which the hyperlink was created. For example:

cleartool describe –long vob:\admin_dev

```
...
  Hyperlinks:
    AdminVOB@40@\admin_dev -> vob:\admin
    AdminVOB@40@\dev <- vob:\dev
```

Restrictions on Administrative and Client VOBs

The following restrictions apply to administrative and client VOBs:

- If you try to link a client VOB to an administrative VOB and any global type definitions in the administrative VOB would be eclipsed by ordinary types in the client VOB, the operation fails unless the **-acquire** option has been used. See the **mkhlink** reference page for more information.
- A VOB can have only one **AdminVOB** hyperlink pointing from a client VOB to an administrative VOB. The **mkhlink** command prevents the creation of a second **AdminVOB** hyperlink to any administrative VOB.
- If a client VOB is restored (from backup) to a different registry region, the client's administrative VOB must also be accessible in that region.

If an Administrative VOB Becomes Unavailable

If an administrative VOB becomes unavailable to a client VOB for any reason, attempts at the client VOB to create instances based on a now-inaccessible global type definition produce the following error:

`cleartool: Error: Unable to access administrative VOB "`*adminVOB*`" of` *clientVOB*

In addition, the output of **cleartool describe** for the client VOB may not show the administrative VOB.

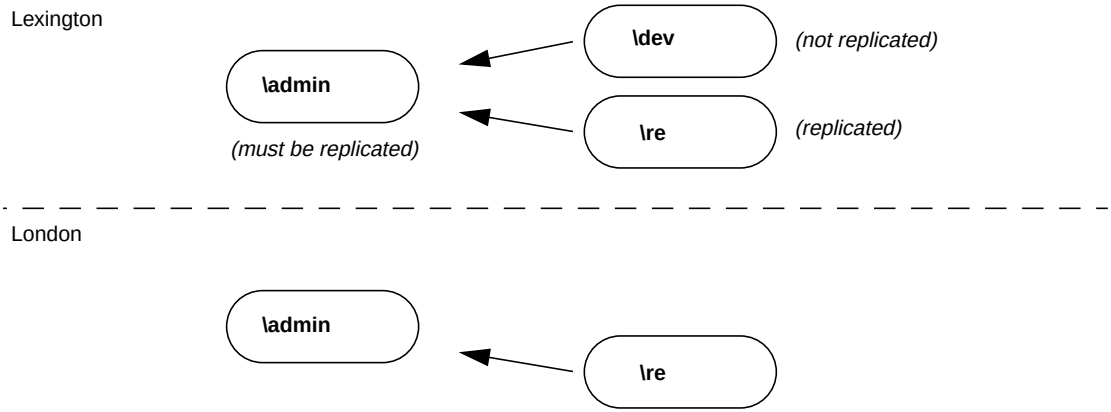
An administrative VOB does not have to be mounted to give client VOBs access to global type definitions. However, the administrative VOB must be registered and must have a VOB-tag.

Using Administrative VOBs with MultiSite

When you use administrative VOBs in a Rational ClearCase MultiSite environment, auto-make-type operations are logged as "make type" events at the client replica.

If a client VOB is replicated, the client's administrative VOB must also be replicated. In the example shown in Figure 30, **\re** is a client of **\admin**, **\re** is replicated, so all sites that have a replica of **\re** must also have a replica of **\admin**.

Figure 30 Replication Requirements of Administrative and Client VOBs



If you replicate a VOB that is linked to an administrative VOB, the MultiSite **mkreplica –export** command prints a reminder that you must replicate all administrative VOBs in the hierarchy above the VOB you are replicating. The output lists the administrative VOBs. The command does not check whether these administrative VOBs are replicated, so you can ignore the message if you have already replicated them

Because local type objects in a client VOB are linked to global type objects in the administrative VOB, we recommend that you synchronize a client VOB and its administrative VOB at the same time. If you do not, users may have trouble accessing type objects.

NOTE: In the example shown in Figure 30, a client VOB of **\admin**, **\dev**, is not replicated. Whenever an administrative VOB replica exists but some of its client VOBs do not, **mk**type** commands will result in error messages of the form:

```
Error: Unable to find replica in registry for VOB with object ID:"<VOB-oid>"
Error: Unable to locate versioned object base with object id:"<VOB-oid>"
```

These errors do not prevent creation of the type as specified.

Breaking a Link Between a Client VOB and an Administrative VOB

You can convert a client VOB to a regular VOB by removing the **AdminVOB** hyperlink and all **GlobalDefinition** hyperlinks between the client VOB and its administrative VOB. You must remove all such hyperlinks to sever the connection between a VOB and its administrative VOB. The following sections describe how to remove the hyperlinks using the command line. You can also use the ClearCase Administration Console.

Removing the AdminVOB Hyperlink

To remove the **AdminVOB** hyperlink between the client VOB and the administrative VOB:

1. Determine the name and ID of the **AdminVOB** hyperlink:

   cleartool describe vob:\dev

   ```
   versioned object base "\dev"
   ...
     Hyperlinks:
       AdminVOB@40@\dev -> vob:\admin_dev
   ```

2. Remove the hyperlink with the **rmhlink** command:

cleartool rmhlink AdminVOB@40@\dev

```
Removed hyperlink "AdminVOB@40@\dev".
```

Removing All GlobalDefinition Hyperlinks

To remove all **GlobalDefinition** hyperlinks that connect local copies in the client VOB to global types in the administrative VOB:

1. Determine the names of all local copies:

   cleartool lstype –local –fmt "%n\t%[type_scope]p\n" –kind attype –invob \dev

   ```
   Tested         local copy
   Feature Level  ordinary
   ...
   ```

   cleartool lstype –local –fmt "%n\t%[type_scope]p\n" –kind brtype –invob \dev

   ```
   ...
   ```

   cleartool lstype –local –fmt "%n\t%[type_scope]p\n" –kind eltype –invob \dev

   ```
   ...
   ```

   cleartool lstype –local –fmt "%n\t%[type_scope]p\n" –kind hltype –invob \dev

   ```
   ...
   ```

   cleartool lstype –local –fmt "%n\t%[type_scope]p\n" –kind lbtype –invob \dev

   ```
   ...
   ```

2. For each local copy, determine the name and ID of the hyperlink linking the local copy to its global type. For example:

   cleartool describe –local –long –ahlink GlobalDefinition attype:Tested

   ```
   Tested
     Hyperlinks:
       GlobalDefinition@58@\dev -> attype:Tested@\admin_dev
   ```

3. Remove each hyperlink with the **rmhlink** command:

   cleartool rmhlink GlobalDefinition@58@\dev

   ```
   Removed hyperlink "GlobalDefinition@58@\dev".
   ```

Removing an Administrative VOB

Remove an administrative VOB with the **rmvob** command or by using the ClearCase Administration Console. When you remove an administrative VOB:

- All **AdminVOB** hyperlinks connecting to the deleted VOB are removed.
- All **GlobalDefinition** hyperlinks connecting to global types in the deleted VOB are removed.
- All local copies in the deleted VOB's client VOBs are converted to ordinary types.

Fixing Global Type Problems After Restoring a VOB from Backup

Any time you restore an administrative VOB or any of its clients from backup, there is the possibility of a mismatch in global type information (**AdminVOB** hyperlinks) if the VOBs were backed up on different schedules. For example, if an administrative VOB is backed up before a new global type is created, its client VOBs will not be able to use instances of the new global type after that backup is restored. To prevent problems caused by this type of mismatch:

- After you restore an administrative VOB from backup, you should check for and fix any broken hyperlinks in that VOB and all of its client VOBs.
- After you restore a client VOB from backup, you must check for and clean up any broken hyperlinks from that VOB to its administrative VOB.

To remove broken hyperlinks, use **checkvob –hlink**. For more information, see *Checking Hyperlinks* on page 246 and the **checkvob** reference page.

16.4 Working with Global Types

In general, all operations on a global type or a local copy of a global type apply to the global type and all its local copies. ClearCase prevents attempts to eclipse global types (that is, it prevents creating an ordinary type with the same name as a global type).

Examples in this section use the **cleartool** command line. You can also use the Metadata subnode of a VOB node in the ClearCase Administration Console.

Creating a Global Type

The **cleartool** commands **mkattype**, **mkbrtype**, **mkeltype**, **mkhltype**, and **mklbtype** include the **–global** option, which creates a global type object in the current VOB. Client VOBs linked to this VOB can use the global types.

Local copies of global types are created in client VOBs only when a user creates an instance of the type in the client VOB.

The following command creates a global label type in VOB **\admin**:

cleartool mklbtype –c "final label for REL6" –global REL6@\admin
```
Created label type "REL6".
```

You cannot create a global type if any client VOB contains types with the same name. When you create a new global type, you can check for types with the same name in client VOBs. If the types are identical (except for comments and locks, which can be different), the creation operation converts the existing types to local copies of the global type and changes their comments to match. Use the **–acquire** option with the **mk**type** command to check for and acquire identical ordinary types.

For example:

cleartool describe –fmt "%n\t%[type_scope]p\n" lbtype:V3.2@\dev
```
V3.2    ordinary
```

cleartool mklbtype –c "Release 3.2" –global –acquire V3.2@\admin
```
Created label type "V3.2".
```

cleartool describe –local –fmt "%n\t%[type_scope]p\n" lbtype:V3.2@\dev
```
V3.2    local copy
```

If the types are not identical, the operation prints a warning and fails. If a type is locked, it is reported as not acquirable, and the operation continues with other types. To correct this problem, remove the lock and enter a new **mk**type** command with the **–replace –global –acquire** options, or use the **checkvob –global** command.

Use the **–replace –global –acquire** options either to acquire and replace eclipsing ordinary types that were created after the global type was first created or to convert an ordinary type in an administrative VOB to a global type.

Auto-Make-Type Operations

In general, when you create an instance of a global type in a client VOB, ClearCase creates a local copy of the global type in the client VOB. Specifically:

- When you create attributes, branches, elements, hyperlinks, or labels, ClearCase creates a local copy of the global type.
- When a checkout operation causes the creation of a branch (auto-make-branch), ClearCase creates a local copy of the global branch type.
- When you attach an attribute or a hyperlink to a local copy of a type, ClearCase creates the local copy if it does not already exist.
- If the global type has supertypes, ClearCase creates local copies of the supertypes and fires any **mk**type** triggers associated with them.

In addition, ClearCase sets the permissions and ownership of the local copy to be the same as those of the global type.

EXCEPTION: When you create a trigger type and specify a global type as an argument to a built-in action (the arguments **–mklabel**, **–mkattr**, and so on), ClearCase does not create a local copy of the global type. This behavior preserves the rule that built-in actions cannot cause cascading triggers. Therefore, if you create the trigger in a client VOB that does not contain a local copy of the global type, the **mktrtype** command fails.

The following example shows the creation of an instance of a global label type. The output of the command includes the VOB-tag of the administrative VOB.

cleartool mklabel –c "Release 6" REL6 \dev\file.c

```
Automatically created label type "REL6" from global definition in VOB
"\admin".
Created label "REL6" on "\dev\file.c" version "/main/rel6_main/31".
```

Auto-Make-Type of Shared Global Types

This section applies only if you use global types in replicated VOBs.

If a global type is shared, ClearCase can create a local copy of the type only if the type is mastered by the administrative VOB replica at the current site. If the shared global type is not mastered at the current site, you can create instances of the type only if the client VOB replica contains a local copy of the type. This restriction applies even if your current replica masters the object to which

you are attaching the instance. This mastership restriction prevents conflicting, simultaneous creation of a given type with a given name at multiple sites.

If the client VOB at your site does not contain a local copy of the type, you must create a local copy at the site that masters the type. Then, export an update packet from the client VOB at that site to the client VOB at your site and import the packet at your site.

For example, a release engineer at your site (London) tries to apply the **V2.1** label to a version in the **\dev** VOB. The command fails because the label type is shared, no local copy of the type exists, and the type is mastered at a different site.

cleartool mklabel –nc V2.1 \dev\file.txt
```
cleartool: Error: Type must be mastered in original replica "london" to use
copy type.
cleartool: Error: Unable to create label "V2.1" on "\dev\file.txt" version
"/main/3".
```

To create a local copy of the type in the replica at your site:

1. Determine the VOB-tag of the administrative VOB.

   cleartool describe vob:\dev
   ```
   versioned object base "\dev"
   ...
     Hyperlinks:
       AdminVOB -> vob:\admin
   ```

2. Determine which replica of the administrative VOB masters the type.

   cleartool describe –fmt "%n\t%[master]p\n" lbtype:V2.1@\admin
   ```
   V2.1     lex@\admin
   ```

3. At the site where the type is mastered, create a local copy of the type in the client VOB.

   **cleartool cptype –c "forcing creation of local copy" lbtype:V2.1@\admin **
   lbtype:V2.1@\dev
   ```
   Copied type "V2.1".
   ```

4. At the site where the type is mastered, export an update packet to the replica at your site.

   multitool syncreplica –export –fship london@\dev
   ```
   ...
   ```

5. At your site, import the update packet.

multitool syncreplica –import –receive

```
...
```

After the packet is imported, the engineer can create the label:

cleartool mklabel –nc V2.1 \dev\file.txt

```
Created label "V2.1" on "\dev\file.txt" version "/main/3".
```

Describing Global Types

By default, the **describe** command shows the description of the global type for the object selector you specify. You can enter the command in the context of a client VOB even if the client VOB does not contain a local copy of the type. To describe the local copy, use the **–local** option.

The following command describes a global type:

cleartool describe –long lbtype:REL6@\dev

```
label type "REL6"
  created 28-Jul-99.14:00:26 by Suzanne Gets (smg.user@neon)
  "final label for REL6"
  owner: smg
  group: user
  scope: global
  constraint: one version per element
  Hyperlinks:
    GlobalDefinition@47@\dev <- lbtype:REL6@\dev
```

The following command describes the local copy of a global type:

cleartool describe –local –long lbtype:REL6@\dev

```
label type "REL6"
  created 28-Jul-99.14:23:45 by Suzanne Gets (smg.user@neon)
  "Automatically created label type from global definition in VOB "\admin"."
  owner: smg
  group: user
  scope: this VOB (local copy of global type)
  constraint: one version per element
  Hyperlinks:
    GlobalDefinition@47@\dev -> lbtype:REL6@\admin
```

If you specify **–local** and no local copy exists, **describe** prints an error:

cleartool describe –local lbtype:NOLOCAL@\dev

```
cleartool: Error: Not a vob object: "lbtype:NOLOCAL@\dev".
```

The following command describes a global type in a replicated VOB. Note that because the master replica of the type is in a different VOB family than the replica in which you enter the command, the output includes the VOB-tag of the master replica in addition to the replica name.

cleartool describe –long lbtype:SHARED@\tests

```
label type "SHARED"
  created 03-Aug-99.12:29:01 by Pete Sharon (pds.user@argon)
  master replica: raleigh@\tests_admin
  instance mastership: shared
  owner: pds
  group: user
  scope: global
  constraint: one version per branch
  Hyperlinks:
    GlobalDefinition@43@\tests <- lbtype:SHARED@\tests
```

Listing Global Types

By default, the **lstype** command lists global types associated with local copies, even if you specify the client VOB in the **–invob** option. The output also includes global types from all administrative VOBs above this VOB in the administrative VOB hierarchy, even if the client VOB does not contain local copies of the type. To show client information only, use the **–local** option.

The following command lists all label types in the client VOB, including all global types from administrative VOBs in the hierarchy:

cleartool lstype –fmt "%n\t%[type_scope]p\n" –kind lbtype –invob \dev

```
BACKSTOP        ordinary
CHECKEDOUT      ordinary
LABEL1  global
LATEST  ordinary
REL6    global
```

The following command lists ordinary types and local copies of global types (if the specified VOB is an administrative VOB, global types are also listed):

cleartool lstype –local –fmt "%n\t%[type_scope]p\n" –kind lbtype –invob \dev

```
BACKSTOP        ordinary
CHECKEDOUT      ordinary
LATEST  ordinary
REL6    local copy
```

Listing History of a Global Type

By default, the **lshistory** command lists the history of the global type for the object selector you specify, even if there is no local copy of the type in the client VOB. To list the history of a local copy, use the **–local** option. Specifying **–all** or **–avobs** implicitly specifies **–local**.

The following command lists the history of a global label type:

cleartool lshistory –minor lbtype:REL6@\dev

```
28-Jul.14:00  smg        make hyperlink "GlobalDefinition" on label type
"REL6"
"Attached hyperlink "GlobalDefinition@47@\dev".
Automatically created label type from global definition in VOB "\admin"."
28-Jul.13:57  smg       create label type "REL6"
```

The following command lists the history of a local copy of a global label type:

cleartool lshistory –local –minor lbtype:REL6@\dev

```
28-Jul.14:00  smg        make hyperlink "GlobalDefinition" on label type
"REL6"
"Attached hyperlink "GlobalDefinition@47@\dev".
Automatically created label type from global definition in VOB "\admin"."
28-Jul.14:00  smg       create label type "REL6"
"Automatically created label type from global definition in VOB "\admin"."
```

Changing Protection of a Global Type

Changing the protection of a global type or of a local copy of a global type changes the protection of the global type and all its local copies. You must have permission to change the protection of the global type. You can enter the command in the context of a client VOB even if the client VOB does not contain a local copy of the type.

In this example, the owner of the label type **LABEL1** is changed to **jtg**. The **describe** command shows that the protection change is made to all local copies of the global type.

cleartool protect –chown jtg lbtype:LABEL1@\dev
```
Changed protection on "LABEL1".
```

cleartool describe –local lbtype:LABEL1@\re
```
label type "LABEL1"
...
  owner: jtg
  group: user
  scope: this VOB (local copy of global type)
...
```

If the protection cannot be changed on one or more of the local copies, the operation fails and the global type's protection is not changed. This failure leaves the global type and its local copies in inconsistent states. You must fix the problem and run the **protect** command again.

Locking or Unlocking a Global Type

Locking or unlocking a global type or one of its local copies locks or unlocks all local copies. The **describe** command does not list local copies as locked, but access checking on local copies checks for a lock on the global type.

For example, the following command locks the global label type **REL6** and its local copies:

cleartool lock –c "freeze" lbtype:REL6@\dev
```
Locked label type "REL6".
```

Attempts to create instances of the label type fail:

cleartool mklabel –c "last version" REL6 \re\tests.txt
```
cleartool: Error: Lock on label type "REL6" prevents operation "make
hyperlink".
cleartool: Error: Unable to create label "REL6" on "\re\tests.txt" version
"/main/5".
```

If you enter a **lock** command in a client VOB that does not contain a local copy of the specified type, ClearCase searches for the global type in the administrative VOB hierarchy.

By default, **lslock** lists the lock state of the global type. To list the lock state of the local copy, use the **–local** option.

Changing Mastership of a Global Type

Changing mastership of a global type does not change the mastership of its local copies. Likewise, changing the mastership of a local copy changes the mastership of the local copy only. Mastership of the global type and all other local copies is not changed.

For example, the global label type **V3.2** is mastered by the **london** replica in the VOB family **\admin**, and the local copy in the client VOB **\client** is mastered by the **london** replica in the VOB family **\client**:

cleartool describe –fmt "%n\n %[master]p\n %[type_scope]p\n" lbtype:V3.2@\admin
```
V3.2
  london@\admin
  global
```

cleartool describe –local –fmt "%n\n %[master]p\n %[type_scope]p\n" \ lbtype:V3.2@\client
```
V3.2
  london@\client
  local copy
```

When the mastership of the global type is transferred to the **lex** replica, the mastership of the local copy remains the same:

multitool chmaster lex@\admin lbtype:V3.2@\admin
```
Changed mastership of label type "V3.2" to "lex@\admin"
```

cleartool describe –fmt "%n\n %[master]p\n %[type_scope]p\n" lbtype:V3.2@\admin
```
V3.2
  lex@\admin
  global
```

cleartool describe –local –fmt "%n\n %[master]p\n %[type_scope]p\n" ^ lbtype:V3.2@\client
```
V3.2
  london@\client
  local copy
```

If you enter a **chmaster** command in a client VOB that does not contain a local copy of the specified type, the command fails with the message `type not found`. For example:

multitool chmaster lex@\client lbtype:DOC_SOURCE@\client
```
multitool: Error: Label type not found: "DOC_SOURCE".
```

For more information on mastership, see the **chmaster** reference page and the *Administrator's Guide* for Rational ClearCase MultiSite.

Changing the Type of an Element or Branch

You can use the **chtype** command to change the type of an element (convert the element from one type to another) or a branch (rename the branch). If the new type is a global type and a local copy does not exist in the client VOB, the **chtype** command creates the local copy.

For more information on changing a type, see the **chtype** reference page.

Copying a Global Type

When you copy a global type to the same name (in a different VOB), the **cptype** command preserves the global type associations of the copied global type when either of these conditions is true:

- The source VOB of the original type and destination VOB of the copy are both members of the same administrative VOB hierarchy. (The copy then points to that administrative VOB hierarchy.)
- The original global type resides in a VOB that is the administrative VOB of the copy's destination VOB (where **cptype** creates a local copy).

In all other cases, the type is created as an ordinary (that is, nonglobal) type.

Renaming a Global Type

Renaming a global type renames all its local copies. Also, renaming a local copy of the global type renames the specified local copy, all other local copies, and the global type itself. If you enter a **rename** command in a client VOB that does not contain a local copy of the specified type, ClearCase searches for the global type in the administrative VOB hierarchy.

All local copies are renamed first; then the global type is renamed. If any of the local copies cannot be renamed, the command fails and the global type is not renamed. This failure leaves the global type and its local copies in inconsistent states. You must correct the problem and enter the **rename** command again.

For more information on renaming types, see the **rename** reference page.

Changing the Scope of a Type

To convert an existing ordinary type to a global type, enter a **mkattype**, **mkbrtype**, **mkeltype**, **mkhltype**, or **mklbtype** command with the options **–replace –global –acquire**. These commands convert the type and convert any identical types in client VOBs to local copies of the type. For example:

1. An administrative VOB and one of its client VOBs contain identical ordinary label types named **IDENT**:

   cleartool describe lbtype:IDENT@\admin
   ```
   label type "IDENT"
     created 02-Aug-99.15:32:52 by Suzanne Gets (smg.user@neon)
     owner: smg
     group: user
     scope: this VOB (ordinary type)
     constraint: one version per element
   ```

   cleartool describe lbtype:IDENT@\dev
   ```
   label type "IDENT"
   created 01-Aug-99.15:33:00 by Suzanne Gets (smg.user@neon)
   owner: smg
   group: user
   scope: this VOB (ordinary type)
   constraint: one version per element
   ```

2. Convert the label type in the administrative VOB to be a global type:

   cleartool mklbtype –replace –global –acquire IDENT@\admin
   ```
   Replaced definition of label type "IDENT".
   ```

3. The output of the **describe** command shows that the label type in the administrative VOB is now global, and the label type in the client VOB is now a local copy of the global type:

cleartool describe –local lbtype:IDENT@\admin lbtype:IDENT@\dev

```
label type "IDENT"
  created 02-Aug-99.15:32:52 by Suzanne Gets (smg.user@neon)
  owner: smg
  group: user
  scope: global
  constraint: one version per element
  Hyperlinks:
    GlobalDefinition <- lbtype:IDENT@\dev
label type "IDENT"
  created 02-Aug-99.15:32:52 by Suzanne Gets (smg.user@neon)
  owner: smg
  group: user
  scope: this VOB (local copy of global type)
  constraint: one version per element
  Hyperlinks:
    GlobalDefinition <- lbtype:IDENT@\dev
```

To convert an existing global type to an ordinary type, enter a **mkattype**, **mkbrtype**, **mkeltype**, **mkhltype**, or **mklbtype** command with the options **–replace –ordinary**. These commands convert the type and all its local copies to ordinary types. You must specify the global type in the command; you cannot specify a local copy of the type. For example, to convert the global element type **doc_file** to an ordinary type, and the administrative VOB is **\admin**, enter the following command:

cleartool mkeltype –replace –ordinary –nc eltype:doc_file@\admin

You can also use the **–replace** option to change the constraints of a type if the normal ClearCase restrictions allow the change.

Removing a Global Type

Removing a global type removes all the local copies. Also, removing a local copy removes the specified copy, all other local copies, and the global type itself. The **rmtype** command lists the client VOBs that have local copies of the global type, then prompts for confirmation of the removal. You must use the **–rmall** option with the **rmtype** command.

For example:

cleartool rmtype –nc lbtype:LABEL1@\dev

```
cleartool: Error: There are labels of type "LABEL1".
cleartool: Error: Unable to remove label type "LABEL1".
```

cleartool rmtype –nc –rmall lbtype:LABEL1@\dev

```
There are 1 instance(s) of label type "LABEL1" in \re.
There are 1 instance(s) of label type "LABEL1" in \dev.
Remove all instances of label type "LABEL1"?  [no] yes
Removed label type "LABEL1".
```

Notes on removing global types:

- If you enter a **rmtype** command in a client VOB that does not contain a local copy of the global type, ClearCase tries to find a matching global type in the administrative VOB hierarchy.
- All local copies are deleted first; then the global type is removed. If any of the local copies cannot be removed, the command fails and the global type is not removed. You must correct the problem and enter the **rmtype** command again.

For more information on removing types, see the **rmtype** reference page.

Cleaning Up Global Types

Use **checkvob –global** to check and fix global types that are in an inconsistent state. For more information, see Chapter 14, *Using checkvob*.

Administering Views

Understanding Views and View Storage

17

This chapter describes the operational details and storage requirements of views. See also the **mkview** reference page for additional information about views.

17.1 Introduction to Views and View Administration

Any ClearCase development environment requires one or more *views*. A view provides a workspace where users access versions of file and directory elements that are under ClearCase control, as well as ordinary file-system objects.

A typical view is created and used by an individual or a small group working on a common task. Other views—for example, UCM integration views—may be created by a project leader or administrator and shared by many users. Administrative responsibilities associated with views include:

- View creation and access control
- Backing up and recovering views
- Moving, removing, and managing the storage used by views

CAUTION: Moving a view requires several steps. You must follow these steps carefully or you risk losing or corrupting view data. See *Moving a View* on page 361.

There are two kinds of views:

- Dynamic views use the MVFS (multiversion file system) to provide transparent access to versions of elements in the VOB as well as view-private objects. Dynamic views also support ClearCase build-auditing and build-avoidance tools and can contain derived objects (DOs). Developers work in dynamic views when they want immediate access to the latest versions of elements on a given branch, or when they need to take advantage of audited builds and build-avoidance. Dynamic views provide more functionality, require more frequent use of the network, and need more administrative support than snapshot views.

- Snapshot views use the host's native file system to hold copies of versions of specified elements as well as view-private objects. Snapshot views do not support build-auditing and build-avoidance tools. Developers work in snapshot views when they want a simplified environment for editing, compiling, and debugging (even when disconnected from the network), do not need immediate access to the latest versions of elements, and do not need audited builds and build-avoidance. Snapshot views provide less functionality, require less frequent use of the network, and need less administrative support than dynamic views.

17.2 Dynamic Views

A dynamic view is an MVFS directory tree that enables dynamic access to VOB elements. Dynamic views contain nearly all the artifacts created during the software development process, whether or not they are under ClearCase control. These artifacts include the following:

- Selected versions of elements (actually stored in VOB storage pools)

- Files that are being modified (checked-out file elements, stored in the view's private storage area)

- Directories that are being modified (checked-out directory elements, maintained in the VOB database)

- Shareable and unshared derived objects built by users working in this view (stored in the view's private storage area) and configuration records that correspond to these derived objects

- Shared derived objects originally built in another view and then winked in to this view (stored in VOB storage pools)

- View-private objects: miscellaneous files, directories, and links that are not under Clearcase control and appear only in this view (stored in the view's private storage area).

View Root

Each dynamic view on a host exists as a directory under the view root directory. On UNIX computers, the default view root directory is **/view**. On Windows computers, the default view root directory is drive M.

In addition to the various view storage directories, the view root contains the special file **.specdev**. If this file is missing or damaged, attempts to access dynamic views on the host will generate this error message:

```
cleartool: Error: Unable to open file "viewroot": ClearCase object not found.
```

View Storage Directory

A dynamic view is implemented as a standard directory tree, whose top-level directory is termed the view storage directory. The directory contains these files and subdirectories, all of which are created and modified ClearCase commands and should never be modified in any other way:

.access_info	A file of view access event information that is periodically updated by the view server.
.pid	A one-line text file that lists the process ID of the view's **view_server** process.
admin	A directory that contains administrative data related to the amount of disk space a view is using. Use **space –view** to list this data.
config_spec	A file that stores the view's current config spec, in the form displayed by **catcs**.
.**compiled_spec**	A modified version of **config_spec**, which includes accounting information.
.**identity**	On UNIX, a subdirectory whose zero-length files establish the view's owner and group memberships.
identity.sd	On Windows, a security descriptor created for views stored in a FAT or FAT32 file system. Views stored in NTFS file systems include security descriptors in the file system ACL and do not need this file.
.s	A subdirectory that implements the view's private storage area.
db	A subdirectory containing the files that implement the view's embedded database.
.view	A file that lists the view's universal unique identifier (UUID) and other attributes

View-Private Storage

Subdirectory **.s** of the view storage directory is the root of a subtree that implements the view's private storage area. On UNIX platforms, **.s** can be either a local directory or a UNIX symbolic link to a directory on another UNIX computer or Network Attached Storage device.

The private storage area holds several kinds of objects:

- **View-Private objects.** A view-private object is a file-system object—file, directory, or UNIX link—created by a standard program within a VOB directory. Such objects are stored only within the view's private storage area. No VOB maintains any record of such objects.

  NOTE: In a dynamic view on UNIX, you cannot create any of the UNIX special file types (sockets, named pipes, character device files, or block device files).

- **Checked-out versions.** A checked-out version is a file created by the **checkout** command. This file is an editable copy of the version being checked out. A checked-out version is very much like a view-private file, except that there is a corresponding object in the VOB database: the special "placeholder" version with the CHECKEDOUT version label.

- **Unshared derived objects.** An unshared derived object is a data container created by execution of a build script by **clearmake**, **omake**, or by any program invoked by **clearaudit**. When the DO becomes shareable, it is promoted and a corresponding derived object is created in the VOB database.

  NOTE: Even after the DO becomes shared, a copy of it remains in the view's private storage area. DOs can consume a great deal of space and should be scrubbed when they are no longer needed. The **winkin** command and **view_scrubber** utility remove unshared derived objects from a view's private storage area.

- **Nonshareable derived objects.** A nonshareable derived object is a data container created by execution of a makefile build script by **clearmake**, **omake**, or by any program invoked by **clearaudit**, from a dynamic view. No information about the DO is stored in the VOB database. When you use **winkin** or **view_scrubber –p** to convert a nonshareable DO to a shareable DO, the command promotes the DO's data container to the VOB, and removes the data container from view storage.

- **Configuration records.** The file **view_db.crs_file** in the **.s** subdirectory is actually part of the view's database, as described in the following section. It is the part that stores the configuration records (config recs) of derived objects built in the view.

- **Stranded files.** The directory **lost+found** in the **.s** subdirectory contains stranded files, that is, files that were view-private and are no longer accessible through normal ClearCase or

Attache operations. A file becomes stranded when there is no VOB pathname through which it can be accessed. For example:

- A VOB can become temporarily unavailable, for example, by being unmounted.
- A VOB can become permanently unavailable, for example, by being deleted.
- A VOB directory can become permanently unavailable when it is deleted with a **rmelem** command.

See the description of the **recoverview** command for more information about recovering stranded files.

View Database

The view database subdirectory, **db**, contains these files, all of which are created and modified by ClearCase commands and should never be modified in any other way:

view_db.dbd	A compiled database schema, used by embedded DBMS routines for database access. The schema describes the structure of the view database.
view_db_schema_version	A schema version file, used by embedded DBMS routines to verify that the compiled schema file is at the expected revision level.
view_db.d0*n* **view_db.k01**	Files in which the database's contents are stored.
vista.*	Database control files and transaction logs.
view_db.crs_file	Stores the configuration records of nonshareable and unshared derived objects. This file resides in subdirectory **.s** of the view storage directory, allowing it to be remote. Compressed copies of the configuration records are cached in a view-private file, **.cmake.state**, located in the directory that was current when the build started. This speeds up configuration lookup during subsequent builds in the view.

The view database keeps track of the objects in its private storage area: view-private objects (files, directories, and links), checked-out versions, nonshareable derived objects, and unshared derived objects.

How a Dynamic View Selects Versions

A dynamic view provides transparent access to versions of elements. Each time you access an element, the **view_server** evaluates the view's config spec and selects a version of the element. It uses the following procedure for resolving element names to versions.

1. User-level software (for example, an invocation of the C compiler) references a pathname. The ClearCase MVFS, which processes all pathnames within VOBs, passes the pathname to the appropriate **view_server** process.
2. The **view_server** attempts to locate a version of the element that matches the first rule in the config spec. If this fails, it proceeds to the next rule and, if necessary, to succeeding rules until it locates a matching version.
3. When it finds a matching version, the **view_server** selects it and has the MVFS pass a handle to that version back to the user-level software.

How a Dynamic View Manages Derived Objects

In addition to storing view-private files, a dynamic view's private storage area contains derived objects built in that view by **clearmake (**and, on Windows, **omake).** Nonshareable and unshared derived objects typically consume the most disk space in a view's private storage area. When a derived object is created, both its data container file and its configuration record are stored in the view. The first time the derived object is *winked in* to another view or promoted to the VOB, the view interacts with the VOB as follows:

- The configuration record is moved to the appropriate VOB database or databases. If the build script creates derived objects in several VOBs, each VOB database gets a copy of the same configuration record.

- The data container is copied (not moved) to a VOB storage pool. If the winkin was done by a **clearmake** or **omake** build, the original data container remains in view storage, to avoid interference with user processes that are currently accessing the data container. If the winkin was done with the **winkin** or **view_scrubber –p** command, the data container in the view is removed after it is promoted to the VOB storage pool.

  From time to time, you (or the view owner) may find it worthwhile to remove the redundant storage containers from views with the **view_scrubber** utility. (See Chapter 20, *Administering View Storage*.)

17.3 The Multiversion File System (MVFS)

The multiversion file system (MVFS) is a feature of Rational ClearCase that supports dynamic views. Dynamic views use the MVFS to present a selected combination of local and remote files as if they were stored in the native file system when accessed by your application. The selected files are versions of VOB files and view-private files. Before accessing ClearCase data using the MVFS, you must activate a view and mount one or more VOBs. The VOB is mounted as a file system of type MVFS.

Snapshot views do not use the MVFS.

The MVFS is installed as an extension to a host's native operating system. On UNIX computers, code that implements the MVFS is linked with a host's operating system. It can be linked statically, which requires generating a new version of the operating system that includes the MVFS, or dynamically, which means the MVFS code is loaded at system startup time. How the MVFS is linked depends on the type and version of the operating system.

On Windows computers, the MVFS is a file system driver. It is loaded by the Service Control Manager at system start time.

The MVFS is not supported on Windows 98 and Windows Me.

Supported File Types

The MVFS supports the following file types:

- Files
- Directories
- Symbolic links (on UNIX only)

You cannot create other file types within a VOB.

The MVFS and Audited Builds

When you build software in a dynamic view and a build tool (for example, a compiler) references a pathname, the MVFS passes the pathname on to the appropriate **view_server** process. During build script execution, **clearmake** works with the MVFS to audit low-level system calls that

reference ClearCase data, recording every instance when a file or directory is created, deleted, or opened for read access. Calls involving these objects are monitored:

- Versions of elements used as build input
- View-private files used as build input—for example, the checked-out version of a file element
- Files created within VOB directories during the build

Known Limitations of the MVFS on Windows

On Windows, the MVFS has the following known limitations:

- File attributes such as System and Hidden are not supported.
- OS/2 Extended Attributes (EAs) are not supported.
- DOS sharing modes are not supported.
- If your application queries an MVFS volume for the amount of disk space, the MVFS always returns the value 512 MB.

  The reason for this behavior is as follows: the application may be about to perform operations that require space in the view storage directory or the VOB storage directory. The MVFS does not know whether the application needs to know how much disk space is available for view storage or for VOB storage. Therefore, the MVFS always returns a constant equal to 512 MB, so that the application always tries the operation. Thus, MVFS never causes an operation that may succeed to fail.
- Alternate, or short, names inside a VOB on an MVFS file system on Windows are not always valid.

  The MVFS cannot guarantee that a file name mapping from a particular long name to a particular short name (a name that is 8.3 compliant) is always valid. For example, a short name may already exist in another version of the given directory. In this case, ClearCase may return the wrong file data. As a result the MVFS does not return a short name for file names that are not 8.3 compliant.

  You can run applications that require short names on MVFS in one of the following ways:

- By using pathnames that are entirely 8.3 compliant, including view and VOB tags and directory names
- By using a VOB symbolic links to create 8.3 compliant names as needed

The MVFS and Case-Sensitivity

On Windows, the MVFS can be configured to do case-sensitive or case-insensitive name lookups. In the default configuration, the MVFS performs case-insensitive name lookups, which is the behavior that Windows applications expect. When using dynamic views in mixed networks of Windows and UNIX computers, you may need to change case-sensitivity setting of the MVFS on Windows. See *Case-Sensitivity* on page 82 for details.

Running Executables in the MVFS

If you add an executable to source control and want to run it in a dynamic view, you must give it explicit ClearCase execute permission. Use the **cleartool protect** command, as shown in this example:

cleartool protect –chmod +x *executable_filename*

MVFS Performance

The MVFS has several caches that it uses to provide improved performance. For many users, the default cache sizes will provide the best balance between MVFS performance and memory requirements. You may change most of theses caches to help tune the MVFS to better serve special needs. See *Examining and Adjusting MVFS Cache Size* on page 502 for more details.

17.4 Snapshot Views

A snapshot view uses a host's native file system to hold versions of file and directory elements that have been loaded from a VOB. After the snapshot view has been created, versions of file and directory elements must be copied, or loaded, into the view's snapshot view directory. The snapshot view directory is usually on the local host but can be located on any host that the view

server can access over the network, even if that host does not have ClearCase installed (see the **mkview** reference page for information on the **-vws** option).

In addition to copies of versions, the snapshot view directory can contain view-private file-system objects that are not under ClearCase control. It also contains some files that ClearCase creates to help manage the view.

Any snapshot view storage directory contains two subdirectories:

- **View database.** The **db** subdirectory contains the binary files managed by the embedded DBMS. The database keeps track of the loaded VOB objects and checked-out versions in the view.
- **Administrative directory.** The **admin** directory contains data on disk space used by the view. A job that the ClearCase scheduler runs by default generates this data periodically.

Snapshot views cannot contain derived objects. You can run **clearmake** and **omake** in a snapshot view, but none of their build auditing and build avoidance features will be enabled.

A snapshot view must have an associated **view_server** process. Some ClearCase hosts cannot run **view_server** processes. Snapshot view directories can reside on these hosts, but the view storage directories for these snapshot views must reside on a host that can run a **view_server** process.

For administrative purposes, it is important to know whether the view storage directory of a snapshot view is a subdirectory of the snapshot view directory. For example, when you back up or move a snapshot view, you must take account of both the snapshot view directory and the view storage directory. For more information, see Chapter 19, *Backing Up and Restoring Views* and Chapter 21, *Moving Views*.

Snapshot View Directory Tree

The snapshot view directory tree is part of the host's native file system (as opposed to the directory tree of a dynamic view, which is part of the MVFS, or multiversion file system). In addition to copies of elements, the root of this directory tree (referred to as the snapshot view's root directory) contains the following files and subdirectories, which are created and modified ClearCase commands and should never be modified in any other way:

view.dat A read-only text file used to identify the current directory as part of a view. (**.view.dat** on UNIX.)

view.stg or a generated directory name	A directory used to maintain the view. (**.view.stg** on UNIX.) For a colocated view storage directory only, the default name of this directory is named **view.stg**; for any other view storage directory, this directory has a generated name. Certain view configurations require that this directory be located somewhere outside the snapshot view's root directory. (Refer to the **mkview** reference page for information on view configurations.)

NOTE: When referring to a snapshot view, many ClearCase commands require the *snapshot-view-directory-pname* argument (rather than an argument specifying the view-tag). By reading the **view.dat** file, which is in the root directory of the snapshot view, ClearCase can find the view storage directory.

View Storage Directory

The snapshot view's view-storage directory is used by ClearCase to manage the contents of the snapshot view directory. It contains the following files and subdirectories, all of which are created and modified by ClearCase commands and should never be modified in any other way:

.access_info	A file of view access event information that is periodically updated by the view server.
.pid	A one-line text file that lists the process ID of the view's **view_server** process.
admin	A directory that contains administrative data related to the amount of disk space a view is using. Use **space –view** to list this data.
config_spec	A file that stores the view's current config spec, in the form displayed by **catcs**.
.**compiled_spec**	A modified version of **config_spec**, which includes accounting information.
.**identity**	On UNIX, a subdirectory whose zero-length files establish the view's owner and group memberships.
identity.sd	On Windows, a security descriptor created for views stored in a FAT or FAT32 file system. Views stored in NTFS file systems include security descriptors in the file system ACL and do not need this file.
.s	A subdirectory that implements the view's private storage area.
db	A subdirectory containing the files that implement the view's embedded database.
.view	A file that lists the view's universal unique identifier (UUID) and other attributes
view_db.state	A file that records the current state of the view.

View Database

The view database subdirectory, **db**, contains these files, all of which are created and modified ClearCase commands and should never be modified in any other way:

view_db.dbd	A compiled database schema, used by embedded DBMS routines for database access. The schema describes the structure of the view database.
view_db_schema_version	A schema version file, used by embedded DBMS routines to verify that the compiled schema file is at the expected revision level.
view_db.d0*n* **view_db.k01**	Files in which the database's contents are stored.
vista.*	Database control files and transaction logs.

For a snapshot view, the view database keeps track of the loaded VOB objects and checked-out versions in the view.

How a Snapshot View Selects Versions

A snapshot view has a config spec that, in conjunction with the view's load rules, determines which versions of elements are loaded into the snapshot view directory by the **cleartool update** command. Each time you update the view, the **view_server** evaluates the view's config spec, selects a version of each element defined in the view's load rules, and copies a new version of each element in the snapshot view directory if the one already there does not match the selected version. It uses the following procedure for resolving element names to versions.

1. The **view_server** attempts to locate a version of the element that matches the first rule in the config spec. If this fails, it proceeds to the next rule and, if necessary, to succeeding rules until it locates a matching version.
2. When it finds a matching version, the **view_server** selects it, updates the view's database, and passes a handle to that version to the CCFS server, which copies it into the snapshot view directory.

17.5 Remote View Storage

Like VOB storage, view storage may be located on a remote host (one that is not running the view's associated **view_server** process) using either of the following techniques:

- You may locate some or all of a view's storage on a supported Network Attached Storage (NAS) device. Not all NAS devices support remote location of view databases. See *Using Network Attached Storage with VOB Server and View Server Hosts* on page 375 for more information on using a NAS device for remote view database storage.
- On a UNIX host, a view's private storage area (but not its database) can be located remotely and accessed through a UNIX symbolic link. This arrangement resembles the remote VOB storage pool facility, discussed in *Creating Remote Storage Pools on UNIX Hosts* on page 214, but the facility for views is less elaborate.

18 Setting Up Views

This chapter discusses setting up views for individual users, views to be shared by groups of users, and views through which ClearCase data is made accessible to non-ClearCase hosts.

18.1 Setting Up an Individual User's View

In a typical ClearCase development environment, most views are created by individual developers on their own workstations for their own use. If a user's workstation has local storage, it makes sense for the user's views to reside in that storage. Alternatively, you can place the storage for some or all views on a file server host. In either case, view storage must be backed up regularly. There may be important view-private files, including checked-out files, in the view that do not exist in VOB storage.

In deciding where to place views, keep in mind these architectural constraints:

- Each view has an associated server process, its **view_server**, which executes on the host where the view's storage directory is created.
- Rational ClearCase must be installed on the host where a view storage directory is created and the **view_server** process runs.
- If a host is to keep several views (and their several **view_server** processes) active concurrently, it must be configured with more main memory.

View Storage Requirements

Each ClearCase view is associated with a *view storage directory*, a directory tree that holds a database, along with a private storage area. In a dynamic view, the private storage area contains view-private files, checked-out versions of elements, and unshared derived objects. In a snapshot view, the private storage area does not contain data; copies of versions and files that are not under ClearCase control reside in the snapshot view directory tree, not in the view storage directory.

View Database

The view database is a set of ordinary files, located in subdirectory **.db** of the view storage directory.

View's Private Storage Area

A view's private storage area is implemented as a directory tree named **.s** in the view storage directory. On UNIX computers, **.s** is an actual subdirectory, so that all data stored in the view occupies a single disk partition.

When deciding where to create view storage for a dynamic view, consider that nonshareable and unshared derived objects typically make the greatest storage demand on the view. To obtain a useful estimate of the maximum disk space required for a view, calculate the total size of all the binaries, libraries, and executables for the largest software system to be built in that view. If several ports (or other variants) of a software system will be built in the same view, it must be able to accommodate the several kinds of binaries.

For a snapshot view, the snapshot view directory must be located on a partition with enough space to accommodate all copies of versions loaded into the view as well as all file-system objects in the view that are not under ClearCase control. The view storage directory may or may not reside within the snapshot view directory. The view storage directory must reside on a ClearCase host that is configured to run **view_server** processes. You may use one or more such ClearCase hosts as central locations for snapshot view storage directories.

18.2 Setting Up a Shared View

Views can be shared by multiple users. For example, a project may designate a shared view in which all of its software components are built in preparation for a release. The entire application may be built each night in such a view.

An ideal location for a shared view is a dedicated host that is configured similarly to a client workstation. If no dedicated host is available, distribute shared views around the network on the least-used (or most richly configured) client workstations. Avoid placing too many views on any single machine; avoid placing shared views on VOB hosts unless you do so for the specific purpose of supporting non-ClearCase access.

Here is a simple procedure for setting up a shared view:

1. **Determine who will use the view**. In particular, determine whether all of the view's prospective users belong to the same group.

2. **(If necessary) Change your group.** If all of the view's prospective users belong to the same group, make sure that you are logged on as a member of that group. Make sure that you have all necessary groups in your group list. Use the UNIX **id** command, or on Windows, *ccase-home-dir***etc****utils****creds**, to verify group membership.

3. **On UNIX, set your umask appropriately.** A UNIX view's accessibility is determined by the **umask**(1) of its creator. If the view's users are all members of the same group, temporarily set your umask to allow writing by group members:

   umask 2

   Otherwise, you must set your umask to allow any user write access:

   umask 0

4. **Choose a location for view storage directory.** Use the discussion in *View Storage Requirements* on page 342 to decide where to locate the view storage directory. If a server storage location for views has been created in your registry region, it will be used as the default location for view storage

5. **Choose a view-tag**. Choose a name that indicates the nature of the work to be performed in the view. For example, you may select **integ_r1.3** as the tag for a view to be used to produce release 1.3 of your application.

6. **Create the view storage directory.** Use the View Creation Wizard, or run the **mkview** command:

cleartool mkview –tag integ_r1.3 /net/ccsvr05/viewstore/integr13.vws

```
Created view.
Host-local path:      ccsvr05:/viewstore/integr13.vws
Global path:          /net/ccsvr05/viewstore/integr13.vws
It has the following rights:
User : vobadm   : rwx
Group: dvt      : rwx
Other:          : r-x
```

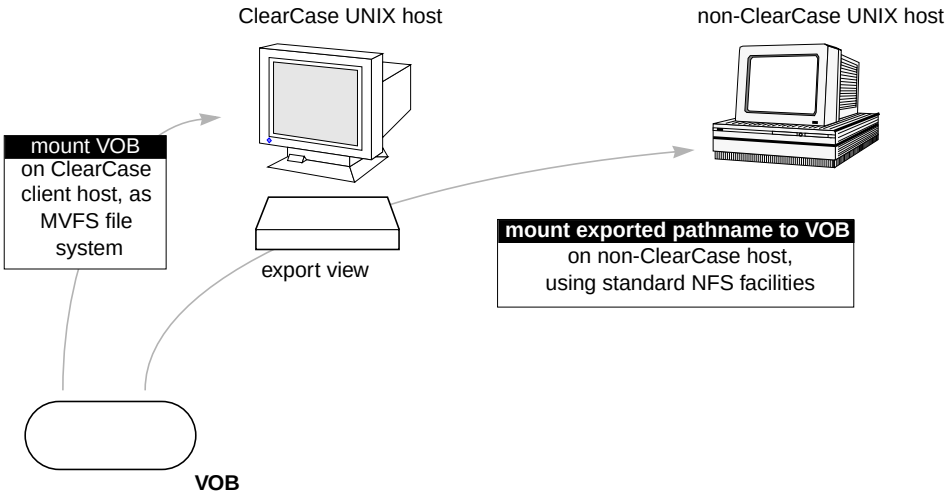
(See *View's Private Storage Area* on page 342 for a command that creates a view with a remote private storage area.)

7. **If you used mkview, verify your work.** Examine the **mkview** command's output to verify that the access permissions are in accordance with your decisions in Step #1–Step #3. In addition, examine the host-local path and global path. You may need to make adjustments similar to those discussed in *Ensuring Global Access to the VOB—Special Cases for UNIX* on page 151.

18.3 Setting Up an Export View for Non-ClearCase Access

A VOB on a UNIX computer can be made available to UNIX hosts on which ClearCase cannot be installed (for example, a machine whose architecture ClearCase does not support). This *non-ClearCase access* feature involves setting up a dynamic *export view*, through which the VOB is seen on the non-ClearCase host (Figure 31).

Figure 31 Export View for Non-ClearCase Access



NOTE: Export views are to be used only for non-ClearCase access to UNIX VOBs. To make a view accessible on a remote host, use the **startview** or **setview** command on that host. An export view can be mounted on a ClearCase host, but not on the viewroot directory **/view**.

The general procedure for exporting a view/VOB combination is as follows:

1. A ClearCase client host that is configured to use the MVFS activates (mounts) the VOB. The VOB must have been marked for export using the **–ncaexported** option to **mkvob** or **mktag**.
2. The host starts an export view, through which the VOB is accessed by non-ClearCase hosts. The view must have been marked for export using the **–ncaexported** option to **mkview** or **mktag**.
3. The host uses an **/etc/exports.mvfs** file to export a view-extended pathname to the VOB mount point—for example, **/view/exp_vu/vobs/proj**.

   NOTE: Any symbolic link in this VOB mount point must be a relative symbolic link. Any absolute target of a symbolic link that includes the VOB mount point must be changed to relative for the export to work.
4. One or more non-ClearCase hosts in the network perform an NFS mount of the exported pathname.

See the **exports_ccase** reference page for the procedure specific to your operating system. It describes the simplest (and recommended) setup, in which the VOB and the export view are

located on the same host. The following sections discuss this issue in greater detail, including advice on how to proceed if you don't want to locate the export view on the VOB server host.

NOTE: If you modify an export view's config spec, make sure that all users who may currently have the view mounted for non-ClearCase access unmount and then remount the view. Remounting the view ensures access to the correct set of files as specified in the updated config spec.

Exporting Multiple VOBs

If you choose to put each VOB and its export view on the same host, it is likely that developers working on a non-ClearCase host will access several export views at the same time. For example, a project may involve three VOBs located on three different hosts. Because the three VOB/view pairs are located on different hosts, three export views are involved. On the non-ClearCase host, the NFS mount entries may be these:

```
saturn:/view/beta/vobs/proj /vobs/proj nfs rw,hard 0 0
neptune:/view/exp_vu/vobs/proj_aux /vobs/proj_aux nfs rw,hard 0 0
pluto:/view/archive_vu/vstore/tools /vobs/tools nfs rw,hard 0 0
```

The three VOBs can be accessed on the non-ClearCase host as subdirectories of **/vobs**. But developers must keep in mind that three views are involved, for such operations as checkouts. Developers need not be concerned with multiple-view issues when building software on the non-ClearCase host.

Multihop Export Configurations

Accessing data from a non-ClearCase host can involve three hosts:

- The host on which the VOB storage directory resides
- The host on which the view storage directory of the export view resides
- The non-ClearCase host

This configuration requires MVFS-level communication, which is slower than NFS communication, between the two ClearCase hosts. Creating a multihop configuration introduces the possibility of access cycles, in which two of the hosts depend on each other for network-related services, or such a dependency is created through third-party hosts. Such

situations result in time-outs (if VOBs are soft-mounted) or deadlocks (if VOBs are hard-mounted).

A sure way to avoid access cycles is to avoid multihop configurations.

- Locate the storage directory of the export view on the same host as the storage directory for the VOB.
- Make sure that neither the VOB nor the view has remote data storage. That is, the VOB cannot have any remote storage pools, and the view's private storage area (**.s** directory tree) must be an actual subdirectory, not a symbolic link to another host.

Restricting Exports to Particular Hosts

In a multihop situation, we recommend using an **–access** option in each entry in the ClearCase exports file, **/etc/exports.mvfs**. This option restricts the export to specified non-ClearCase hosts and/or netgroups. This restriction greatly reduces the likelihood of creating access cycles. For example:

```
/view/exp_vu/usr/src/proj –access=galileo:newton:bohr:pcgroup
```

When combining **–access** with other options, be sure to specify options as a comma-separated list that begins with a single hyphen.

NOTE: Be sure to read the reference pages for your operating system's **nfs** options.

19 Backing Up and Restoring Views

This chapter describes procedures for backing up and restoring a view. For information on backing up a VOB, see Chapter 10, *Backing Up and Restoring VOBs*. In particular, when restoring a view, see *VOB and View Resynchronization* on page 200.

Usually, backing up VOBs is more important than backing up views. Views are expendable and often short-lived work areas, not data repositories. Encourage users to check in files regularly so that views do not contain irreplaceable data.

19.1 Backing Up a View

Backing up views is similar to backing up VOBs, but simpler:

- Users can create views under their home directories. In this case, whatever backup regimen you have in place to back up users' home directories picks up their view storage directories as well.
- Views do not have multiple storage pools. A dynamic view has a single private storage area, its **.s** subdirectory. If the view is on a UNIX host, this directory can be located on a remote computer. Otherwise it must be located on the host where the **view_server** runs. A snapshot view's files and directories reside in the snapshot view directory tree.
- It never makes sense to attempt a partial backup of a view storage directory (or, for a snapshot view, a view directory tree); all the data is important, because it's the only copy of one or more users' current work.

If you are backing up a snapshot view, you must back up both the view directory tree and the view storage directory. If the view storage directory is located outside the view's directory tree, you must be sure to back up both.

Use the following procedure to back up a view:

1. **Determine the location of the view storage directory.** Use the ClearCase Administration Console or run **lsview** to display view storage information. If your backup program runs over the network, you need the `Global path`. If your backup program runs locally, you need the `View server access path`:

   cleartool lsview –long akp_vu

   ```
   Tag: akp_vu
       Global path: /net/neptune/home/akp/views/akp.vws
    ...
       Region: dvt
    ...
   View on host: neptune
   View server access path: /home/akp/views/akp.vws
    ...
   ```

2. **Ensure integrity and consistency of the backup**. To keep the view inactive while it is backed up, warn ClearCase users not to use it during the backup, or use the **chview** command to prevent users from updating the view database.

   cleartool chview –readonly akp_vu

   ```
   Properties: readonly
   ```

   This command does not prevent changes to the view's config spec. To keep the config spec from being changed during backup, rename the view storage directory before backing it up, and then stop the **view_server** with **cleartool endview –server** *view-tag*.

3. **On Windows, stop ClearCase on the view host.** Common Windows backup utilities do not back up files that are open for write. Because the view database files are typically held open for write while Rational ClearCase is running, your backup operation skips these files, unless you stop ClearCase before performing the backup. Unless your backup software is known to capture files open for write access, *you must stop ClearCase on the view host before performing a backup.* Use the ClearCase program in Control Panel to stop ClearCase on the view host. If you are backing up a snapshot view, ensure that no users are working with files in the view's directory tree.

4. **On UNIX, determine whether the view has remote storage.** You can use a standard **ls(1)** command:

cd /home/akp/views/akp.vws
ls –ld .s

```
...  .s -> /net/ccsvr04/viewstore/akp.stg
```

A symbolic link indicates remote private storage area.

5. **Enter the backup commands.** For a snapshot view, back up the entire view directory tree. For a dynamic view or for a snapshot view whose view storage directory is outside the view's directory tree, back up the entire view storage directory tree. Use the local address or the networkwide address listed by **lsview** in Step #1.

   If you are backing up a snapshot view and its view storage directory is outside the view's directory tree, be sure to back up both the view directory tree and the view storage directory.

   NOTE: When you back up and later restore a snapshot view, it is important that the utility you use for the backup maintains the original modification times and ownership of all files and directories in the view. If it does not, loaded files become hijacked.

   If the view's private storage area is remote, you need to perform a second backup (typically, using a different backup tape):

6. If you made the view read-only in Step #2, make it writable.

   cleartool chview –readwrite akp_vu

   ```
   Properties: readwrite
   ```

7. If you renamed the view storage directory in Step #2, rename it back to its registered location.

19.2 Restoring a View from Backup

Use the following procedure to restore a backup view storage directory. The view is the same one discussed in *Backing Up a View* on page 349.

If you are restoring a snapshot view, you must restore both the view directory tree and the view storage directory. If the view storage directory is located outside the view's directory tree, you must be sure to restore both.

NOTE: You can restore a view to a new location, on the same host or on another host. If you are restoring the view storage directory to a new location, you must re-register the view at its new location (Step #7). If you are restoring a snapshot view's directory tree to a new location, but the

location of the view storage directory (outside the view directory tree) does not change you do not need to re-register the view.

1. **Log on to the view host.** Log on to the host where the view storage directory (or, for a snapshot view, the directory tree) resides.

2. **Check disk space availability**. Make sure that there is enough free space in the view's disk partition to load the backup copy. If necessary, delete the view storage directory (or, for a snapshot view, the directory tree), or use other means to make enough space available.

3. **Stop the view server.** Use **endview –server** to stop the **view_server** process:

   cleartool endview –server akp_vu

4. **Move the original view aside.** For a snapshot view, rename or delete the view directory tree. For a dynamic view or for a snapshot view whose view storage directory is outside the view's directory tree, rename or delete the view storage directory:

   If you are restoring a snapshot view and its view storage directory is outside the view's directory tree, rename or delete both the view directory tree and the view storage directory.

5. **Make sure that the restored view will have the correct ownership.** Depending on your platform and your backup tool, you may have to observe one or more precautions now to ensure that the view is restored with the correct owner and group identities.

   On UNIX platforms, each view storage area includes a directory named **.identity**, which stores files with special permissions: the setuid bit is set on file **uid**; the setgid bit is set on file **gid**. You must preserve these special permissions when you restore a view backup:

   - If you used **tar** to back up the view, use the **–p** option when restoring the view. In addition, make sure to enter the **tar** command as the **root** user. If you do not, the **–p** flag is ignored.

   - If you used **cpio** to back up the view, no special options are required in the **cpio** command that restores the backup data.

   On Windows, if your backup tool does not maintain ACLs correctly, you may need to fix them after the restore with **fix_prot**. See Chapter 35, *Repairing VOB and View Storage Directory ACLs on Windows*, for details.

6. **Restore the backup.** For a snapshot view, restore the view directory tree from the backup medium. For a dynamic view or for a snapshot view whose view storage directory is outside the view's directory tree, restore the view storage directory from the backup medium.

If you are restoring a snapshot view and its view storage directory is outside the view's directory tree, be sure to restore the backups of both the view directory tree and the view storage directory.

NOTE: When you restore a snapshot view, the utility you use to restore the backup must maintain the original modification times and ownership of all files and directories in the view. If it does not, loaded files become hijacked.

7. **Re-register the view.** This is necessary only if you restored the view storage directory to a new location. In the ClearCase Administration Console, you can use the View Tags node for the tag's regions to change the properties of view-tags, and you can use the View Objects subnode of the ClearCase Registry node to change the properties of a view object entry. You can also use **cleartool** commands. For example, if you restored the view storage directory to new location **/usr2/akp.vws**:

   cleartool unregister –view /usr2/akp.vws
   cleartool register –view /usr2/akp.vws
   cleartool mktag –view –replace –tag akp_vu /usr2/akp.vws

8. **Run cleartool recoverview.** Use the following command to update the view database:

   cleartool recoverview –tag akp_vu

The view is now ready for use.

Administering View Storage

20

This chapter discusses procedures for managing disk storage used by views.

20.1 View Storage Maintenance

View storage maintenance includes two principal tasks:

- Removal of unneeded views. Views can outlive their usefulness and should be regularly considered as candidates for removal using **rmview**. Any view can be completely reconstructed from information stored in VOBs, so it's easy to undo the removal of a view if you discover that it is still needed. In addition to consuming storage, inactive views can have an adverse impact on build performance if they are still being searched for candidate DOs.
- Removal of unneeded view-private objects. Like any other isolated work area, a view's private storage area tends to accumulate some unneeded files: temporary files, text-editor backup files, excerpts from mail messages and source files, and so on.

Encourage users to review, remove, and clean up their own views periodically; for shared views, the cleanup task may fall to you. See *Cleaning Up a View Manually* on page 357.

Getting Information on View Contents

The ClearCase Administration Console displays information on disk space used in views:

- The Derived Objects subnode of a VOB storage node shows disk space used by shared derived objects in the VOB. The display shows which views have references to these DOs.
- The view storage node for a view (a subnode of the host node for the host where the view storage directory resides) shows current and historical disk space used for the view.
- The Private Files subnode of the view storage node for a dynamic view lists view-private objects, including files and derived objects, in the view.

Several **cleartool** subcommands also display information on disk space used in views:

- The **dospace** command shows disk space used by shared derived objects in a VOB. The display shows which views have references to these DOs.
- The **space –view** command shows current and historical disk space used for a view.

The ClearCase scheduler runs several jobs that gather data on view disk space use:

- Daily data gathering on view disk space use
- Weekly data gathering on disk space used by shared derived objects
- Daily and weekly execution of jobs that you can customize to run your own programs

For more information on the ClearCase scheduler, see Chapter 28, *Managing Scheduled Jobs*.

From an administrator's standpoint, limiting the growth of a dynamic view storage directory typically involves one issue: removing redundant derived object (DO) data containers. When a DO is first built by **clearmake**, **omake**, or **clearaudit**, its data container is placed in the private storage area of the user's view. The first time a DO is *winked in* during a **clearmake** or **omake** build, the data container is copied to a VOB's derived object storage pool. (Moving it may disrupt user processes that are currently accessing the DO.) This leaves a redundant copy of the data container in view-private storage. (When you wink in a derived object with the **winkin** or **view_scrubber –p** command, the data container in the view is removed after it is promoted to the VOB storage pool.)

Typically, you need not do anything about these redundant copies:

- In a view that is frequently used for builds, old (and potentially redundant) DO data containers are replaced by newer ones by the execution of build scripts.
- There can be at most one redundant copy of each DO in a view. (Contrast this with the situation for VOBs: if the **scrubber** utility never runs, the VOB accumulates many DOs that are no longer used.)

Unless disk storage is extremely scarce, you may conclude that it is not worth the effort to clean up redundant data containers in view-private storage. Accordingly, ClearCase does not include any automated procedures for removing them.

Scrubbing View-Private Storage

If you decide that redundant DO data containers must be removed from a view's private storage area, use the **view_scrubber** utility. You can also use this utility to migrate the data containers of unshared or nonshareable DOs to VOB storage.

The following example shows how some DOs can be built and then transferred immediately to VOB storage:

clearmake hello
<build messages>
*ccase-home-dir***bin\view_scrubber –p hello hello.o util.o**
```
Promoted derived object "hello"
Scrubbed view-resident data container for "hello"
Promoted derived object "hello.o"
Scrubbed view-resident data container for "hello.o"
Promoted derived object "util.o"
Scrubbed view-resident data container for "util.o"
```

See the **view_scrubber** reference page for more information.

20.2 Cleaning Up a View Manually

Users can remove derived objects from their views using standard tools (**rm** on UNIX, **del** on Windows, or the `make clean` targets in *makefiles*. You may also want to use a procedure like the one described here to analyze the files in a view's private storage area and select the ones that should be removed.

NOTE: This procedure applies only to dynamic views. For a snapshot view, you can use the **cleartool ls –recurse –view_only** command to inspect files in the view.

Suppose the view's view-tag is **r2integ**.

1. **Establish the view context.** On UNIX, use the **setview** command:

cleartool setview r2integ

On Windows, use the **net use** command:

net use * \\view\r2integ

In Windows Explorer, use **Tools** > **Map Network Drive**.

2. **Take inventory of the view's private files with lsprivate**. The Private Files subnode of the view storage node in the ClearCase Administration Console or the **lsprivate** command lists view-private files using the pathnames at which they appear in VOBs.

   cleartool lsprivate >C:\tmp\r2integ.lsp
   type C:\tmp\r2integ.lsp
   ```
   \proj\lib\pick.o
   \proj\lib\spar.o
   \proj\lib\get.c  [checkedout]
   \proj\lib\get.c~
   \proj\lib\querytty.c  [checkedout]
   \proj\lib\querytty.c~
   \proj\lib\strut.c  [checkedout]
     .
     .
     .
   ```

   Be sure to place the output in a scratch inventory file, as in this example. Don't worry if some `not available - deleted perhaps?` error messages appear. Such messages are also captured in the scratch file.

3. **Extract the names of unneeded files**. Use a text editor or any text filtering tool to extract from the scratch file the names of files that can safely be deleted. Write this list to another file—for example, **c:\tmp\r2integ.deleteme**. Exclude from the this list any checked-out files. Such files are annotated with `[checkedout]` in the **lsprivate** output, as shown in Step #2.

4. **Double-check the list**. Make sure it contains only files to be deleted.

5. **Delete the view-private files**.

   NOTE: The following steps are appropriate only if `not available - deleted perhaps?` error messages appeared in Step #2.

6. **Decide which stranded files to delete**. The error messages, and corresponding lines with `VOB-` or `DIR-` in the inventory file, describe stranded view-private files. Such files belong to VOBs or directories that are not currently accessible—and, in some cases, may never become accessible again. Consult the **lsprivate** reference page to learn more about stranded files, and

to decide which files to delete. In general, you don't select individual files, but entire directories or entire VOBs, all of whose view-privates files are to be deleted.

7. **Collect the appropriate UUIDs**. Determine the UUID of each VOB directory and each VOB whose files are to be deleted. For example, the following lines from **lsprivate** output describes a stranded file named **hello.c.ann**:

   ```
   <VOB-beeb313c.0e8e11cd.ad8e.08:00:69:06:af:65>^
        <DIR-375b5ca0.0e9511cd.ae20.08:00:69:06:af:65>\hello.c.ann
   ```

   (The line is split here so that you can read it easily; it is not split in **lsprivate**'s output.) The VOB from which the file is stranded has this UUID:

   ```
   beeb313c.0e8e11cd.ad8e.08:00:69:06:af:65
   ```

   The VOB directory in which the stranded file was created has this UUID:

   ```
   375b5ca0.0e9511cd.ae20.08:00:69:06:af:65.
   ```

8. **Move stranded files to the view's lost+found directory**. To remove a set of stranded files, first transfer them to the view's **lost+found** directory, using the **recoverview** command. For example, this command transfers all stranded view-private files created in the same directory as **hello.c.ann:**

   cleartool recoverview –dir 375b5ca0.0e9511cd.ae20.08:00:69:06:af:65 –tag r2integ
   ```
   Moved file ccsvr03:\vus\integ\.s\lost+found\57FBB6DF.0418.util.c.ann
   Moved file ccsvr03:\vus\integ\.s\lost+found\2203B56D.00C2.hello.c.ann
   ```

   In this example, **recoverview** transfers two files, **util.c.ann** and **hello.c.ann**, to the **lost+found** directory.

9. **Delete the files from the lost+found directory**. You can now use a standard file removal command to delete the stranded files:

   cd \vus\integ\.s\lost+found
   ```
   c:\vus\integ\.s\lost+found> del 57FBB6DF.0418.util.c.ann
   c:\vus\integ\.s\lost+found> del 2203B56D.00C2.hello.c.ann
   ```

You may want to adapt this procedure to your own organization's needs, and then present it to all ClearCase users.

21 Moving Views

This chapter presents procedures for moving views.

21.1 Moving a View

WARNING: When moving a VOB or view storage directory, make sure that the copy or backup software you use does not change file and directory ownership and access control information.

This section presents a procedure for moving a view to another location, either on the same host or on another host with the same architecture. For a snapshot view, you can move the entire view; if the view storage directory is outside the view directory tree, you can move either the view directory tree, the view storage directory, or both. (To move a view to a host of a different architecture, see *Moving a View to a UNIX Host with a Different Architecture* on page 366.) For clarity, this section uses an example:

- The current location of the view storage directory to be moved is **/users/sue/viewstore/sue.vws**, on a host named **earth**.
- The new location for the view storage directory is **/public/sue.vws**. We consider these cases:
  - The new location is also on **earth**.
  - The new location is on another host, named **ccsvr04**.

Moving a View on UNIX

To move the view:

1. **Go to the view's host**. Log on to the view host, **earth**, as the view's owner:

   rlogin earth –l sue

2. **Determine whether the view has a nonlocal private storage area.**

   ls –ld /users/sue/viewstore/sue.vws/.s
   ```
   ...   .s -> /public/view_aux/sue
   ```

   The symbolic link indicates that the private storage area is remote.

3. **Deactivate the view.** Use **cleartool endview –server** to deactivate the view.

4. **(If necessary) Validate the private storage area's global pathname**. This step is required only if the view's private storage area is remote, and you are moving the view to another host. You must verify that the view's new host can access the private storage area using the same global pathname as the view's current host.

   rlogin ccsvr04
   ls /public/view_aux/sue
   .
   . *(this command should succeed)*
   .
   exit

   If the intended destination host cannot access the view's private storage area in this way, select and validate another host.

5. **Back up the view storage directory**. Use the procedure in *Backing Up a View* on page 349.

6. **Copy the view**. First, make sure that the desired parent directory of the target location exists and is writable. Then, if you are moving a snapshot view directory tree, copy the entire directory tree to the new location. If you are moving a dynamic view, or if you are moving the view storage directory for a snapshot view and the view storage directory is outside the view directory tree, copy the entire view storage directory tree (but not a remote private storage area) to the new location.

   - To the same host (dynamic view or snapshot view storage directory outside the view's directory tree):

<verify that /public already exists>

cd /users/sue/viewstore
tar –cf – sue.vws | (cd /public ; tar –xBpf –)

➢ To a different host (dynamic view or snapshot view storage directory outside the view's directory tree):

<verify that '/public' already exists on remote host 'ccsvr04'>

cd /users/sue/viewstore
tar –cf – sue.vws | rsh ccsvr04 'cd /public; tar –xBpf –'

NOTE: The **-B** option to the **tar** command may not be supported on all architectures. Also, the **rsh** command may have a different name, such as **remsh**, on some platforms. Refer to the reference pages for your operating system.

If you are moving both the view directory tree and the view storage directory for a snapshot view whose view storage directory is outside the view's directory tree, copy both the view directory tree and the view storage directory to the new locations.

NOTE: If you are moving a snapshot view, it is important that the utility you use to copy the view maintain the original modification times and ownership of all files and directories in the view. Otherwise, loaded files become hijacked.

7. **Ensure that the old view cannot be reactivated**. Remove it from the ClearCase storage registries.

   cleartool rmtag –view –all sue
   cleartool unregister –view /users/sue/viewstore/sue.vws

   This step is not necessary for a snapshot view if the view storage directory has not moved.

   This prevents reactivation by client hosts.

8. **Register the view at its new location** (without starting the **view_server**).

   cleartool register –view /public/sue.vws
   cleartool mktag –nstart –view –tag sue /public/sue.vws

   This step is not necessary for a snapshot view if the view storage directory has not moved.

   If your network has several network regions, you need to make additional registry entries. This procedure is essentially similar to the one in *Ensuring Global Access to the VOB—Special Cases for UNIX* on page 151.

9. **Reactivate the view.** For a dynamic view, start the view:

   cleartool startview sue

   For a snapshot view:

   - If the new snapshot view directory is on a local drive, access any file in the view.
   - If the new snapshot view directory is on another computer, right-click the root directory of the view in Windows Explorer.

10. **Delete the old view storage directory.** If you did not overwrite the existing view storage directory, delete the old one. Be sure to first verify that the view can be accessed at its new location.

    Moving a view does not modify the **.view** file in the view storage directory. The information in this file always describes the view's first incarnation.

Moving a View on Windows

To move the view:

1. **Go to the view's host**. Log on to the view host, **earth**, as the view's owner.
2. **Back up the view storage directory**. Use the procedure in *Backing Up a View* on page 349.
3. **Verify that the view server on the view's host is not running.** If necessary, stop the **view_server** with **cleartool endview –server** *view-tag*.
4. **Copy the view**. First, make sure that the desired parent directory of the target location exists and is writable. Then, if you are moving a snapshot view directory tree, copy the entire directory tree to the new location. If you are moving a dynamic view, or if you are moving the view storage directory for a snapshot view and the view storage directory is outside the view directory tree, copy the entire view storage directory tree to the new location.

   - To the same host (dynamic view or snapshot view storage directory outside the view's directory tree):

     <verify that 'c:\public' already exists>

     `c:\>` **cd \users\sue\vwstore**
     `c:\users\sue\vwstore>` *ccase-home-dir***etc\utils\ccopy sue.vws \public\sue.vws**

➢ To a different host (dynamic view or snapshot view storage directory outside the view's directory tree):

<verify that 'c:\public' already exists on remote host 'ccsvr04'; for simplicity, you might share that directory and, on earth, assign a drive (here, w:) to it>

```
c:\> cd \users\sue\vwstore
c:\users\sue\vwstore> net use w: \\earth\public
c:\users\sue\vwstore> ccase-home-dir\etc\utils\ccopy sue.vws w:\sue.vws
```

If you are moving both the view directory tree and the view storage directory for a snapshot view whose view storage directory is outside the view's directory tree, copy both the view directory tree and the view storage directory to the new locations.

NOTE: If you are moving a snapshot view, it is important that the utility you use to copy the view maintain the original modification times and ownership of all files and directories in the view. Otherwise, loaded files become hijacked. We recommend that you use **scopy** (a Windows NT Resource Kit command) rather than **ccopy** to move a snapshot view.

5. **Ensure that the old view cannot be reactivated**. Remove it from the ClearCase storage registries. In the ClearCase Administration Console, you can use the View Tags node for the tag's regions to remove view-tags, and you can use the View Objects subnode of the ClearCase Registry node to remove a view object entry. You can also use the following commands:

   cleartool rmtag –view –all sue
   cleartool unregister –view \\earth\users\sue\vwstore\sue.vws

   This step is not necessary for a snapshot view if the view storage directory has not moved.

6. **Register the view at its new location (without starting the view_server).** In the ClearCase Administration Console, you can use the View Tags node for the tag's regions to create view-tags, and you can use the View Objects subnode of the ClearCase Registry node to create a view object entry. You can also use the following commands:

   cleartool register –view \\earth\public\sue.vws
   cleartool mktag –nstart –view –tag sue \\earth\public\sue.vws

   This step is not necessary for a snapshot view if the view storage directory has not moved.

   If your network has several network regions, you need to make additional registry entries. This procedure is essentially similar to the one in *Ensuring Global Access to the VOB—Special Cases for UNIX* on page 151.

7. **Reactivate the view.** For a dynamic view, run the **net use** command or, in Windows Explorer, use **Tools** > **Map Network Drive.**

   For a snapshot view:

   - If the new snapshot view directory is on a local drive, access any file in the view.
   - If the new snapshot view directory is on another computer, right-click the root directory of the view in Windows Explorer.

8. **Delete the old view storage directory.** If you did not overwrite the existing view storage directory, delete the old one. Be sure to first verify that the view can be accessed at its new location.

   Moving a view does not modify the **.view** file in the view storage directory. The information in this file always describes the view's first incarnation.

21.2 Moving a View to a UNIX Host with a Different Architecture

This section documents the procedure for moving a view between UNIX hosts with different binary formats for the files that implement the view database. For the procedure to move a view on the same host or between hosts with the same format for view database files, see *Moving a View* on page 361.

WARNING: When moving a VOB or view storage directory, make sure your copy/backup software preserves ownership and access control information unchanged. For example, the **cp** command does not preserve file attributes (permissions, modify times).

Moving a view to a UNIX host with a different architecture includes converting the binary-format files that implement the *view database*. For clarity, we use an example:

- The current location of the view storage directory to be moved is **/users/sue/viewstore/sue.vws**, on a host named **earth**.
- The new location for the view storage directory is **/public/sue.vws** on host **ccsvr04**, whose architecture differs from **earth**'s.

To move the view:

1. **Go to the view's host.** Log on to the view host, **earth**, as the view's owner:

rlogin earth –l sue

2. **Determine whether the view has a nonlocal private storage area.**

   ls –ld /users/sue/viewstore/sue.vws/.s

   ```
   ...   .s -> /public/view_aux/sue
   ```

   The symbolic link indicates a remote storage pool.

3. **Deactivate the view.** Use **cleartool endview –server** to deactivate the view.

4. **(If necessary) Validate the private storage area's global pathname.** This step is required only if the view's private storage area is remote, and you are moving the view to another host. You must verify that the view's new host can access the private storage area using the same global pathname as the view's current host.

   rlogin ccsvr04
   ls /public/view_aux/sue
   .
   . *(this command should succeed)*
   .
   exit

   If the intended destination host cannot access the view's private storage area in this way, select and validate another host.

5. **Back up the view storage directory**. Use the procedure in *Backing Up a View* on page 349.

6. **Dump the view's database to ASCII dump files.**

   cleartool reformatview –dump /users/sue/viewstore/sue.vws

   This command creates files **view_db.dump_file** and **view_db.state** in the view storage directory. It also renames the view database subdirectory to **db.dumped**.

7. **Copy the view storage directory**. First, make sure that the desired parent directory of the target location exists and is writable. Then, if you are moving a snapshot view directory tree, copy the entire directory tree to the new location. If you are moving a dynamic view, or if you are moving the view storage directory for a snapshot view and the view storage directory is outside the view directory tree, copy the entire view storage directory tree (but not a remote private storage area) to the new location.

   <verify that '/public' already exists on remote host 'ccsvr04'>

cd /users/sue/viewstore
tar –cf – sue.vws | rsh ccsvr04 'cd /public; tar –xBpf –'

NOTE: The **-B** option to the **tar** command may not be supported on all architectures. Check the **tar** reference pages for your operating system.

If you are moving both the view directory tree and the view storage directory for a snapshot view, and if the view storage directory is outside the view's directory tree, copy both the view directory tree and the view storage directory to the new locations.

NOTE: If you are moving a snapshot view, it is important that the utility you use to copy the view maintains the original modification times of all files and directories in the view. If it does not, loaded files become hijacked.

8. **Ensure that the old view cannot be reactivated.** Remove it from the ClearCase storage registries:

   cleartool rmtag –view –all sue
   cleartool unregister –view /users/sue/viewstore/sue.vws

   Removal prevents reactivation by ClearCase client hosts.

9. **Register the view at its new location.**

   cleartool register –view /public/sue.vws
   cleartool mktag –view –nstart –tag sue /public/sue.vws

   If your network has several network regions, you need to make additional view-tag entries. This procedure is essentially similar to the one in *Ensuring Global Access to the VOB—Special Cases for UNIX* on page 151.

   NOTE: The **mktag** command fails if you omit the **–nstart** option.

10. **Re-create the view database from the dump files.**

    cleartool reformatview –load –tag sue

11. **Reactivate the view.**

    cleartool startview sue

12. **On the new view host, delete the backup view database**. This backup, named **db.dumped**, was created on **ccsvr04** by **reformatview –load** in Step #6.

rm –fr /public/sue.vws/db.dumped

13. **Delete the old view storage directory**. If you did not overwrite the existing view storage directory, delete the old one. Be sure to first verify that the view can be accessed at its new location.

NOTE: Moving a view does not modify the **.view** file in the view storage directory. The information in this file always describes the view's first incarnation.

21.3 Moving a Dynamic View's Private Storage Area on UNIX

Use the following procedure on a UNIX host to move a dynamic view's private storage area to another location. For clarity, we use an example involving view storage directory **/users/sue/viewstore/sue.vws**, on host **earth**. The procedure works both when the private storage area is local (**.s** is an actual subdirectory of the view storage directory) and when it is remote (**.s** is a UNIX-level symbolic link to a remote location).

1. **Log on to the view's host as the view's owner.**

   rlogin earth –l sue

2. **Deactivate the view.** Use **cleartool endview –server** to deactivate the view.

3. **Go to the private storage area.** The private storage area is a standard UNIX directory tree, with **.s** as its root.

   cd /users/sue/viewstore/sue.vws/.s

4. **Copy the entire directory tree.** You can copy the directory tree to a new location using **cp**, **rcp**, **tar**, or other commands. For example:

   mkdir –p /public/view_aux/sue.priv
   cp –r * /public/view_aux/sue.priv

   Be sure to select a new location that is globally accessible.

5. **Replace the old .s directory with a symbolic link**. It doesn't matter whether the existing **.s** is an actual subdirectory or a symbolic link. Move it aside and create a (new) symbolic link in its place.

```
cd ..
mv .s .s.MOVED
ln –s /public/view_aux/sue.priv .s
```

6. **Reactivate the view**. Use **startview** or **setview**.

7. **Remove the private storage area.** When you have verified that the private storage pool is working well in its new location, you can remove the old one:

   - If old private storage area **.s.MOVED** is an actual directory:

     ```
     rm –fr /users/sue/viewstore/sue.vws/.s.MOVED
     ```

   - If old private storage area **.s.MOVED** is a UNIX symbolic link:

     ```
     cd /users/sue/viewstore/sue.vws/.s.MOVED
     rm –fr *
     cd ..
     rmdir .s.MOVED
     ```

22 Removing Views

This chapter presents procedures for rendering a view inaccessible.

22.1 Taking a View Out of Service

The procedure for taking a view out of service temporarily is essentially equivalent to the VOB procedure described in *Taking a VOB Out of Service* on page 241. The primary difference is in the way you terminate the supporting process. For a view, you use **cleartool endview** to stop the single view-related server process, the **view_server**, which runs on the host where the view storage directory resides (the *view host*):

cleartool endview –server alh_main

Restoring the View to Service

The procedure for restoring a view to service is similar to that described in *Restoring the VOB to Service* on page 242.

22.2 Permanent Removal of a View

To permanently remove a view, use the ClearCase Administration Console:

1. Navigate to the view storage node for the view. This is a subnode of the host node for the host where the view storage directory resides.

2. Click **Action** > **All Tasks** > **Remove View**.

You can also use the **rmview** command to remove a view permanently. These commands remove all relevant entries from the ClearCase storage registry. The procedure for removing a view also removes references to the view from VOBs.

If you have tried to remove a view by removing its storage directory, you may need to remove references to the view (checkouts and derived objects) from some VOBs. Use the following procedure:

1. Use the following command, and note the view's UUID from the list of views referenced by a VOB:

   cleartool describe –long vob:*vob_tag*

   If the view-tag still exists, you can use the **lsview –long** command to find the view UUID.

2. If the view-tag still exists, remove the tag from the registry. In the ClearCase Administration Console, you can use the View Tags node for the tag's regions to remove view-tags. You can also use the following commands:

   cleartool endview –server *view_tag*
   cleartool rmtag –view *view_tag*

3. Unregister the view. In the ClearCase Administration Console, you can use the View Object node to remove a view object. You can also execute the following command, using the view's UUID from Step #1:

   cleartool unregister –view –uuid *uuid*

4. For each VOB that holds references to the view, remove the view-related records from the VOB. In the ClearCase Administration Console, you can use the Referenced Views subnode of a VOB storage node to remove a view's records from a VOB. You can also execute the following command, using the view's UUID from Step #1:

   cleartool rmview –all –uuid *uuid*

After you have removed references to the view from all VOBs, remove the view storage directory if any of it remains.

Administering Network Attached VOB and View Storage

23 Using Network Attached Storage with VOB Server and View Server Hosts

Network attached storage (NAS) is a term used to describe shared storage devices that communicate with other hosts on a local area network using a network file system protocol like the Network File System (NFS) or the Common Internet File System (CIFS). Any NAS device can provide storage for ordinary files—for example, VOB storage pools, view-private files and directories, snapshot view directories, and networkwide release areas—that are created and used with Rational ClearCase. In addition, several NAS devices have been certified by Rational Software to provide storage, when properly configured and used, for VOB and view databases in addition to ordinary files.

23.1 NAS and ClearCase

Putting view and (especially) VOB storage on a certified NAS device can provide several advantages:

- **Enhanced scalability**. VOB or view storage can grow well beyond the physical limits typically imposed when the VOB or view is stored on a ClearCase server host.
- **Enhanced flexibility.** By separating the VOB server or view server process from the VOB storage, server hosts can be upgraded more easily
- **Simplified administration.** NAS devices often have enhanced backup and restore features that can simplify this process for ClearCase administrators. When you use the **mkstgloc**

command to create ClearCase server storage location on NAS devices, VOB and view creation and administration can be further simplified.

CAUTION: Every certified NAS device must be specially configured to support remote VOB or view databases. Configuration requirements for each certified device are described in the *Release Notes* for Rational ClearCase and ClearCase MultiSite. If you do not configure a certified NAS device as described in that document, any VOB or view data stored on that device is at risk. If you put a VOB or view database on a NAS device that has not been certified for this purpose, the data is at risk.

Configuring Network Access to the NAS Device

A NAS device used for VOB or view storage should be on a robust network, preferably on the same subnet as the ClearCase VOB or view server hosts that use it, but at most no more than one hop away. Network access to the NAS device can be configured as follows:

- UNIX VOB or view server hosts must mount the NAS device using an NFS hard mount (the default for most systems). If a soft mount is used, the VOB or view server will fail at startup and write an error message in its log file.
- Windows hosts must establish access to the NAS device with the **net use** command (or Map Network Drive in the Windows Explorer).

The examples in this chapter assume that you have configured a NAS device on your local area network, and that it can be accessed by UNIX hosts at **/net/nasdevice** and by Windows hosts at **\\nasdevice**.

NOTE: Rational only supports use of the NFS protocol to connect a UNIX VOB server host with a VOB database on a NAS device. You must use the CIFS protocol to connect with NAS devices from Windows hosts. Use of NFS software to connect Windows hosts to NAS devices is not supported by Rational.

Changes Are Required in Some Procedures

When a UNIX VOB or view has its database on a NAS device, the ClearCase server process that manages access to the VOB or view runs on a ClearCase host and accesses its storage over the network. This configuration requires several few changes to the standard procedures that we recommend for creating and managing VOBs and views.

Most of the procedural changes described in this chapter are necessary because **cleartool** commands that deal with creating, registering, or tagging VOB or view storage—including **mkvob, mkview, register**, **mktag**, and **mkstgloc**—need to be invoked with the **-host**, **-hpath**, and **-gpath** options when the VOB or view has its storage on a NAS device.

When run on a UNIX computer, some of these commands generate an informational message indicating that the storage pathname may not reside on the local host.

23.2 Creating a Storage Location on NAS

Creating ClearCase server storage locations on a NAS device provides an easy way to start taking advantage of the device's storage capacity. This example uses the **cleartool mkstgloc** command to create a VOB storage location named **ccnasvobstg** in a UNIX region.

```
cleartool mkstgloc -vob -host ccvobsvr1 -gpath /net/nasdevice/vobstg/nasvobstg \
-hpath /net/nasdevice/vobstg/nasvobstg ccnasvobstg /net/nasdevice/vobstg/nasvobstg
```

A similar example creates a storage location in a Windows region:

```
cleartool mkstgloc -vob -host ccvobsvr1 -gpath \\nasdevice\vobstg\nasvobstg ^
-hpath \\nasdevice\vobstg\nasvobstg ccnasvobstg \\nasdevice\vobstg\nasvobstg
```

Use **cleartool mkstgloc -view** with similar options to create a view storage location.

The ClearCase processes serving VOBs or views in a server storage location that resides on a NAS device run on the host you name in the **-host** option to **mkstgloc**. Choose a host that has enough processing power to handle the VOBs or views you intend to create in a NAS-based server storage location.

NOTE: You cannot use the ClearCase Server Storage Wizard to create a server storage location on a NAS device.

23.3 Creating a VOB on NAS

We recommend creating one or more VOB storage locations on your NAS device and then using the **mkvob -stgloc** option to create new VOBs with storage on the NAS device. The following

command would create a VOB with storage in the **ccnasvobstg** storage location created in *Creating a Storage Location on NAS* on page 377:

cleartool mkvob -tag /vobs/nasvob -stgloc ccnasvobstg

You can also use the **mkvob** command to create a VOB that has all of its storage on a NAS device as long as you specify the host name, global path, host-local path, and VOB-storage pathname. For example, the following command creates a new VOB in a UNIX region with the VOB-tag **nasvob**. The VOB is served by a **vob_server** process running on ClearCase host **ccvobsvr1** and has all of its storage on NAS device mounted by **ccvobsvr1** at **/net/nasdevice**.

**cleartool mkvob -tag /vobs/nasvob -host ccvobsvr1 **
**-gpath /net/nasdevice/vobstg/nasvob.vbs -hpath /net/nasdevice/vobstg/nasvob.vbs **
/net/nasdevice/vobstg/nasvob.vbs

To create a similar VOB in a Windows region with a Windows VOB server host:

cleartool mkvob -tag \nasvob -host ccvobsvr2 -gpath \\nasdevice\vobstg\nasvob.vbs ^
-hpath \\nasdevice\vobstg\nasvob.vbs \\nasdevice\vobstg\nasvob.vbs

23.4 Moving a VOB to NAS

All of the procedures for moving VOBs described in Chapter 12, *Moving VOBs*, refer to the architecture of the VOB host. VOB database formats are architecture-dependent, and the database must be reformatted if the VOB is moved from a host of one architecture to a host of another architecture (for example, from Solaris to HP-UX).

When a VOB's database resides on a NAS device, the host architecture is determined by the architecture of the VOB server host, not the NAS device. You need to reformat a VOB database only if you are changing the architecture of the server host. If you move a VOB from one NAS device to another one—even if the device comes from a different manufacturer—you do not have to reformat the VOB database as long as the VOB server host architecture does not change.

Moving a VOB That Has No Remote Pools

To move a VOB that has no remote pools from a ClearCase host running UNIX to a NAS device, follow the procedures described in *Moving a VOB on UNIX* on page 226, but remember to use the **-host**, **-hpath**, and **-gpath** options to the **register** and **mktag** commands. The example here has

been modified to register the VOB **libpub** that has been moved to **/net/nasdevice/vobstg** and is served by the UNIX host **ccvobsvr1**.

```
cleartool register –vob -replace -host ccvobsvr1 -hpath /net/nasdevice/vobstg/libpub.vbs \
-gpath /net/nasdevice/vobstg/libpub.vbs /net/nasdevice/vobstg/libpub.vbs
cleartool mktag –vob -replace –tag /vobs/libpub -host ccvobsvr1 \
-hpath /net/nasdevice/vobstg/libpub.vbs -gpath /net/nasdevice/vobstg/libpub.vbs \
/net/nasdevice/vobstg/libpub.vbs
```

A similar change is required when moving a VOB from a Windows VOB server host to a NAS device. Follow the procedure described in *Moving a VOB Within a Domain* on page 222, but modify the **register** and **mktag** commands as shown here:

```
cleartool register –vob -replace -host sol -hpath \\sol\vobstore2\libpub.vbs ^
-gpath \\sol\vobstore2\libpub.vbs \\sol\vobstore2\libpub.vbs
cleartool mktag –vob -replace –tag \libpub -host ccvobsvr1 ^
-hpath \\sol\vobstore2\libpub.vbs -gpath \\sol\vobstore2\libpub.vbs ^
\\sol\vobstore2\libpub.vbs
```

Consolidating Remote Pools

A VOB hosted on a UNIX platform can have one or more of its storage pools located on a remote UNIX host and accessed by means of a symbolic link. If you move a VOB with this configuration to a NAS device, you may want to consolidate the remote pools by replacing the symbolic links with local directories. As long as the remote pools are accessible to the VOB server host (see *If the VOB Has Remote Pools* on page 227*)* you do not need to consolidate them, but doing so will simplify VOB backups and other administrative tasks.

23.5 Backing Up a VOB on NAS

Any of the VOB backup procedures described in Chapter 10, *Backing Up and Restoring VOBs* are applicable to a VOB that has its database on a NAS device. In addition, many NAS devices provide platform-specific features that allow you to back up the contents of a NAS volume to another NAS volume or similar local device. See the information about certified NAS devices in the *Release Notes* for Rational ClearCase and ClearCase MultiSite for information about NAS device backup tools.

With any VOB backup method, it is imperative that you do the following:

- Lock the VOB before you back it up.
- Stop ClearCase on the VOB server host if your backup software cannot capture files that are open for writing.
- Use backup software that preserves the VOB storage directory's ownership and protection information.

Restoring a VOB from Backup

You cannot restore a VOB from backup using **vob_restore** if the VOB database is stored on a NAS device. Use the procedure described in *Restoring a VOB from Backup* to restore a VOB to a NAS device. When you register the restored VOB and create a tag for it, you must supply the **-host**, **-hpath**, and **-gpath** options to the **cleartool register** and **mktag** commands. For example, if the VOB had been restored to the **/vobst_aux** directory on a NAS device, you would use the following **register** and **mktag** commands:

```
cleartool register –vob -host ccvobsvr1 -hpath /net/nasdevice/vobst_aux/flex.vbs \
-gpath /net/nasdevice/vobst_aux/flex.vbs /net/nasdevice/vobst_aux/flex.vbs
cleartool mktag –vob -replace -host ccvobsvr1 -tag /vobs/flex \
-hpath /net/nasdevice/vobst_aux/flex.vbs -gpath /net/nasdevice/vobst_aux/flex.vbs \
/net/nasdevice/vobst_aux/flex.vbs
```

23.6 Creating a View on NAS

We recommend that you create one or more view storage locations on a NAS device and use them for newly created views. See *Creating a Storage Location on NAS* for an example of the appropriate **mkstgloc** syntax. To make a server storage location for view storage, use the **-view** option to **mkstgloc**.

The following command creates a dynamic view with storage in a storage location named **ccviewstg**. It makes no difference whether the storage location is on a NAS device.

```
cleartool mkview -tag viewtag -stgloc ccnasviewstg
```

You can also use the **mkview** command with **-host**, **-hpath**, and **-gpath** options to create a snapshot or dynamic view that has all of its storage on a NAS device. The following example creates a new dynamic view on a UNIX host. The view is served by a view server process running

on the ClearCase host **ccviewsvr-ux** and has all of its storage on a NAS device mounted by **ccviewsvr-ux** at **/net/nasdevice**.

```
cleartool mkview -tag nasview -host ccviewsvr-ux \
 -gpath /net/nasdevice/viewstg/nasview.vws -hpath /net/nasdevice/viewstg/nasview.vws \
/net/nasdevice/viewstg/nasview.vws
```

To create a similar dynamic view on Windows, served by a **view_server** process running on ClearCase host **ccviewsvr-nt** but with all view storage on a NAS device at **\\nasdevice**:

```
cleartool mkview -tag nasview -host ccviewsvr-nt ^
-gpath \\nasdevice\viewstg\nasview.vws -hpath \\nasdevice\viewstg\nasview.vws ^
\\nasdevice\viewstg\nasview.vws
```

23.7 Moving a View to NAS

View databases, like VOB databases, have formats that are specific to the view server host architecture. As discussed in *Moving a VOB to NAS*, the host architecture is determined by the architecture of the view server host, and you need not reformat a view you are moving to a NAS device unless you are also changing the architecture of the view server host.

Moving a Dynamic View

To move a dynamic view from a ClearCase host running UNIX to a NAS device, follow the procedures described in *Moving a View* on page 361 for moving the view to different location on the same host. As with many other examples in this chapter, the only significant procedural change is the need to use the **-host**, **-hpath**, and **-gpath** options to the **cleartool register** and **mktag** commands when you register and make a tag for the view at its new location.

The **cleartool register** and **mktag** command lines used in the *Moving a View to a UNIX Host with a Different Architecture* procedure on page 366 can be modified as shown here to move the view to storage on the NAS device mounted by host **ccviewsvr1** at **/net/nasdevice**:

```
cleartool register –view -host ccviewsvr1 -hpath /net/nasdevice/viewstg/sue.vws \
-gpath /net/nasdevice/viewstg/sue.vws /net/nasdevice/viewstg/sue.vws
cleartool mktag -view –view -tag sue -host ccviewsvr1 -nstart \
-hpath /net/nasdevice/viewstg/sue.vws -gpath /net/nasdevice/viewstg/sue.vws \
/net/nasdevice/viewstg/sue.vws
```

Moving a Snapshot View

To move a snapshot view that has its view storage directory and snapshot view directory co-located, follow the procedure described in *Moving a View* on page 361 for moving the view to different location on the same host.

23.8 Backing Up a View on NAS

Any of the view backup procedures described in *Backing Up and Restoring Views* are applicable to a view that has its view storage or view database on a NAS device. In addition, many certified NAS devices provide platform-specific features that allow you to back up the contents of a NAS volume to another NAS volume or another local device. See the *Release Notes* for Rational ClearCase and ClearCase MultiSite for information about NAS device backup tools.

23.9 Replacing a VOB or View Server Host

When you locate your VOB or view storage on a NAS device, you can easily designate a different ClearCase host of the same architecture to run the VOB or view server processes that manage access to the VOB or view without actually moving the VOB or view storage.

Replacing a VOB Server Host

The following procedure replaces the UNIX VOB server host **ccvobsvr3** for the VOB **/vobs/libpub** with a different host of the same architecture, **ccvobsvr1**. The procedure locks the VOB, removes the old tag and registration, and then creates a new registration and tag specifying the replacement host and the existing storage.

1. **Deactivate the VOB**. Issue this command on each host where the VOB is currently active:

   cleartool umount /vobs/libpub

   NOTE: It may not be practical to unmount the VOB from all hosts. In this case, the VOB lock to be applied in Step #3 ought to prevent unintended VOB access.

2. (If applicable) **Disable VOB snapshots on the current host.** If VOB database snapshots are enabled for the VOB, disable them with the command:

   vob_snapshot_setup rmparam /vobs/libpub

3. **Lock the VOB**. Do this as the **root** user or VOB owner.

   ```
   # cleartool lock vob:/vobs/libpub
   Locked versioned object base "/vobs/libpub".
   ```

4. **Remove the VOB-tag and unregister the VOB.**

   # cleartool rmtag –vob –all /vobs/libpub
   # cleartool unregister –vob /net/nasdevice/vobstg/libpub.vbs

5. **Terminate the VOB's server processes on the current host**. Search the process table for the **vob_server** and **vobrpc_server** processes that service the old VOB. Use **ps –ax** or **ps –ef** and search for **libpub.vbs**. Use **kill(1)** to terminate any such processes.

6. **Register the VOB and create a new VOB-tag**. You can use the ClearCase Administration Console or the following commands. (In this example, the VOB-tag is public, so the tag registry password is required.)

   **cleartool register –vob -host ccvobsvr1 -hpath /net/nasdevice/vobstg/libpub.vbs **
   -gpath /net/nasdevice/vobstg/libpub.vbs /net/nasdevice/vobstg/libpub.vbs
   **cleartool mktag –vob -replace -host ccvobsvr1 -tag /vobs/libpub **
   **-hpath /net/nasdevice/vobstg/libpub.vbs -gpath /net/nasdevice/vobstg/libpub.vbs **
   /net/nasdevice/vobstg/libpub.vbs
   `Vob tag registry password:` *<enter password>*

7. **Reactivate the VOB**. On all client hosts:

   cleartool umount /vobs/libpub *(if not already done)*
   cleartool mount /vobs/libpub

8. **Unlock the VOB.** Do this as the **root** user or VOB owner.

   # cleartool unlock vob:/vobs/libpub
   ```
   Unlocked versioned object base "/vobs/libpub".
   ```

9. (If applicable) **Enable VOB snapshots on the new host.** If you want to enable VOB database snapshots on the new VOB host, do so with **vob_snapshot_setup modparam**, supplying the appropriate parameters.

Replacing a View Server Host

The process for replacing a view server host is similar. The following procedure replaces the UNIX view server host for dynamic view **V4.1_Int**. It stops the view, removes the old view-tag and registration (object), then creates a new registration and tag specifying the replacement host and the existing storage.

1. **Log on to the view's server host**. Log in as the view's owner.

2. **Deactivate the view.** Use the **cleartool endview** command to stop the view and terminate the view's view_server process:

   cleartool endview –server V4.1_Int

3. Delete the existing view-tag. You can use the ClearCase Administration Console or the following command.

   cleartool rmtag –view V4.1_Int

4. Create a new view object and tag specifying a new view server host and the existing storage. You can use the ClearCase Administration Console or the following commands.

   **cleartool register -view -replace -host ccviewsvr1 **
   **-hpath /net/nasdevice/viewstg/v4.1_int.vws **
   -gpath /net/nasdevice/viewstg/v4.1_int.vws /net/nasdevice/viewstg/v4.1_int.vws
   **cleartool mktag –view –tag V4.1_Int -host ccviewsvr1 **
   **-gpath /net/nasdevice/viewstg/v4.1_int.vws **
   -hpath /net/nasdevice/viewstg/v4.1_int.vws /net/nasdevice/viewstg/v4.1_int.vws

5. **Reactivate the view** on the replacement view server host.

   cleartool startview V4.1_Int

6. **Update corresponding VOB databases.** The view's old location is still recorded in the databases of all VOBs that the view accessed with **checkout** and/or **clearmake**. For each such VOB, update the view-location information by checking out one of the VOB's elements in that view. (You can cancel the checkout with **cleartool uncheckout** immediately if you want.)

23.10 Reformatting a VOB or View

Like other commands described in this chapter, **cleartool reformatvob** and **reformatview** need the **-host**, **-hpath**, and **-gpath** options when dealing with storage on a NAS device. The following example performs the dump phase of a VOB reformat on the VOB **libpub** that is stored at **/net/nasdevice/vobstg** and served by the UNIX VOB server **ccvobsvr1**.

**cleartool reformatvob -dump -host ccvobsvr1 -hpath /net/nasdevice/vobstg/libpub.vbs **
-gpath /net/nasdevice/vobstg/libpub.vbs /net/nasdevice/vobstg/libpub.vbs

Similar command options would be required to load a dumped VOB database or to dump or load a view database.

Administering ClearCase Licenses

24 Administering Licenses

This chapter provides an introduction to license administration for Rational ClearCase.

24.1 Floating License Architecture

ClearCase implements an active-user floating license scheme. To use ClearCase, a user must obtain a license, which grants the privilege to use ClearCase commands and data on any number of hosts in the local area network. When a user runs a ClearCase client utility, such as **cleartool** or a GUI program, that utility attempts to obtain a license. If it gets one, the user can keep it for an extended period. Entering any ClearCase command renews the license. If the user doesn't enter a ClearCase command for a substantial period—by default, 60 minutes—another user can take the license.

One or more hosts in the local area network are designated as ClearCase license server hosts. Each license server host maintains a list of license keys. UNIX hosts maintain this list in a file named **/var/adm/atria/license.db**. Windows hosts store keys in the **LicenseKeys** value in the Windows Registry. Each license entry defines a specified number of licenses, allowing that number of ClearCase users to be active at the same time. See *License Database Format* on page 394 for a description of the license database format.

When a user first attempts to use ClearCase software on any host in the network, a license-verification check is made:

- ClearCase client software looks for the name of the license server host. On UNIX, this name is stored in the file **/var/adm/atria/config/license_host**. On Windows, it is stored as the **LicenseHost** value in the Windows Registry key **HKEY_LOCAL_MACHINE\SOFTWARE\Atria\ClearCase\CurrentVersion**.

- ClearCase communicates with the license server process on the license server host, to verify the user's right to use ClearCase. (The license server process is actually **albd_server**, performing these duties in addition to its other tasks.)
- The license server process determines the user's rights and returns an appropriate message.
- Depending on the message the license server sends, the command either proceeds or is aborted.

Subsequently, similar license-verification checks are performed periodically.

License Priorities

Each user can (but need not) be assigned a license priority in the license database file. Each user specified in a `-user` line gets a priority number: the first user gets priority 1 (highest priority), the second user gets priority 2, and so on. All users who are not specified in any `-user` line share the lowest priority.

License Expiration

Each license entry can have an expiration date. (The expiration time is at 00:00 hours on that date.) During the 72-hour period before the expiration date, attempts to use a license from that license entry succeed, but a warning message appears. After the expiration time, attempts to use those licenses fail.

License Report Utility

The **clearlicense** utility produces a report on the licenses defined in the license database file and on current user activity. You can also use this utility to force a user to release a license, freeing it for use by another user.

24.2 Setting Up a License Server

The task of setting up a host to be a license server host is part of the overall ClearCase installation process. Initial license server setup is described in the *Installation Guide* for the ClearCase Product Family.

NOTE: If you are using a Windows computer to serve ClearCase licenses for both UNIX and Windows, the Windows license server host must be a member of a domain in which user accounts are defined for all UNIX users who will acquire licenses from this server. See *Managing User Accounts* on page 78 for more about matching UNIX and Windows user account names.

Adding New Licenses to an Existing License Server Host

Some organizations purchase an initial set of ClearCase licenses and purchase additional licenses later. Each time a new set of licenses is purchased, you receive a text line containing the new license authorization code from Rational.

1. **Determine the host name of the license server host.** If you do not know the name of the license server host, you can find out from any ClearCase client host.

   - On a UNIX client host, examine the contents of the **license_host** file.

     cat /var/adm/atria/config/license_host
     fermi

   - On a Windows host, click **Start** > **Settings** > **Control Panel**, and then start the ClearCase program. Click the **Licensing** tab to display the name of the license server host.

2. **Log on to the license server host.** Log on as **root** on a UNIX host or as a local administrator on a Windows host**.**

3. **Add the licenses**. On UNIX, you can use any text editor to append the license strings to the end of the **license_db** file. Be sure to enter this line exactly as it appears on the fax from Rational.

   On a Windows host, click **Start** > **Settings** > **Control Panel**, and then start the ClearCase program. Click the **Licensing** tab, and select the **The local system can act as a license server** check box. Enter the license key exactly as it appears on the fax from into the **License Keys** box. Click **Apply** or **OK**.

Setting Up Additional License Server Hosts

When you purchase a new set of ClearCase licenses, you can place them on another host, rather than adding them to the existing license server host. Having two or more license server hosts provides a redundant source of licenses.

NOTE: You must make this decision before you send the *ClearCase Product Family License Registration Form* to Rational; you must include the machine ID of the intended license server host on this form.

To set up a new license server host:

1. **Determine the machine ID of the new license server host.** You can use the **clearlicense** command:

   clearlicense –hostid
   XXXYYYZZZ *(architecture-dependent machine-ID string)*

   (If you need to determine the machine ID of a host on which ClearCase is not yet installed, follow the instructions on the License Registration Form to determine the machine ID.)

   On a Windows host, click **Start** > **Settings** > **Control Panel**, and then start the ClearCase program. Click the **Licensing** tab to display the licensing host ID.

2. **Fill out the** *ClearCase Product Family License Registration Form*. A copy of this form appears at the back of the *Installation Guide* for Rational ClearCase and ClearCase MultiSite. Fax the form to Rational and wait for a return fax that lists your license authorization code.

3. **Log on to the new license server host.** Log on as **root** on a UNIX host or as a local administrator on a Windows host**.**

4. **Add licenses to the new host's license database**. On UNIX, you can use **cat** to append the license strings to the end of the **license_db** file:

   # cat >> /var/adm/atria/license.db
   –license ClearCase sun *.19 19960419 xxxxx.yyyyy.zzzzz
   <CTRL+D>

   Or you can use any text editor. Be sure to enter this line exactly as it appears on the fax from .

   On a Windows host, click **Start** > **Settings** > **Control Panel**, and then start the ClearCase program. Click the **Licensing** tab and select the **The local system can act as a license server** check box. Enter the license key exactly as it appears on the fax from Rational into the **License Keys** box. Click **Apply** or **OK**.

5. Stop and restart ClearCase on the license server host.

6. Reconfigure ClearCase client hosts to use the new license server host. On UNIX hosts, edit **/var/adm/atria/config/license_host** to contain the name of the new license server host. On a Windows host, click **Start** > **Settings** > **Control Panel**, and then start the ClearCase program. Click the **Licensing** tab and enter the new license server's name in the **Hostname of the license server** box. Click **OK**.

You can also use the ClearCase Administration Console to change the license server used by any ClearCase host in your network:

- Go to the host node for the host whose license server you want to change. This can be the My Host node or a subnode of the ClearCase Network node in ClearCase Administration Console, or the top-level node in ClearCase Host Administration.

- Click **Action** > **Properties**. This command opens a dialog box in which you can change the host's license server. To change the license server for a remote host, the host must be configured to allow remote administration, and you must be a member of the ClearCase administrators group.

24.3 Moving Licenses to Another Host

This section presents a procedure for moving a set of licenses to another host. Note the following:

- If a license database contains more than one set of licenses (that is, more than one license line), you can move some sets and not move others.

- This procedure is not required if you merely change the hostname of a license server host. It is only required if the license hostid (as reported by **clearlicense –hostid**) changes for any reason. Common reasons include moving the license server host function to a new computer or replacing the network interface card of an existing host.

To move licenses to another host:

1. **Complete the** *Request to MOVE ClearCase Product Family Licenses* **form.** A copy of this form appears at the back of the *Installation Guide* for Rational ClearCase and ClearCase MultiSite. Fax the form to Rational and wait for a return fax that lists your replacement license authorization codes.

2. **Move the licenses.** If you are moving licenses to a host that is already a license server host, follow the procedure in *Adding New Licenses to an Existing License Server Host*. If you are

moving licenses to a host that is already a license server host, follow the procedure in *Setting Up Additional License Server Hosts*.

24.4 Renaming a License Server Host

Renaming a license server host does not invalidate its license authorization code; the code incorporates a hardware-level machine identifier, not its network host name. After renaming a host, switch the license server host assignments of some or all ClearCase hosts, as in Step #6 in the section *Moving Licenses to Another Host* on page 393.

24.5 License Database Format

The license database includes license keys and optional license management information. On UNIX hosts, the license database is a file in **/var/adm/atria/license.db**. On Windows hosts, the license database is stored as the **LicenseKeys** value in the Windows Registry key **HKEY_LOCAL_MACHINE\SOFTWARE\Atria\ClearCase\CurrentVersion.**

NOTE: On UNIX systems, all lines in the license database file must be terminated with a <NL> character.

A license database contains several kinds of lines. A line can define a multiuser license, specify users' license priorities, or enable auditing of licensing activity.

License Set Definition Lines

A ClearCase, Attache, or ClearCase MultiSite license consists of a single line of text, which defines a certain number of licenses. This line must be entered exactly as provided in the license file.

Most licenses are locked to their particular license server host. You cannot move the license to any other host without invalidating the license. If the vendor field is **TEMPORARY**, you can move the license to any license server host.

The license file can contain any number of **–license** lines. All the lines are effectively combined into a single license; the maximum numbers accumulate to determine the total number of license

slots. Alternatively, it may be better to split licenses among two or more license servers. This increases product availability: if one license server host goes down, the licenses on the other license server hosts can still be used.

User Priority Lines

The license file can contain any number of **–user** lines, each of which specifies one or more users (by name or by numeric ID). All these lines are effectively concatenated into a single license priority list. The first user on the list has the highest priority; each successive user has a lower priority. Users not listed can use the products, but they share the lowest priority.

Excluded User Lines

The license file can contain any number of **–nuser** lines, each of which specifies one or more users (by name or by numeric ID). The specified users cannot obtain a license and thus are completely forbidden from using the product.

–user and **–nuser** lines can be intermixed. If a user is named in both kinds of line, the first entry is used.

Audit-Enable Line

A line consisting of the single word **–audit** enables auditing of license activity. On UNIX, licensing audit messages are written in the file **/var/adm/atria/log/albd_log**. On Windows, these messages are written in the Windows event log. On either platform, the following license events are logged:

- A user is granted a new license.
- A user is denied a license because all licenses are in use.
- A user entered a **clearlicense –release** command (the success or failure of the command is also logged).

Time-Out Line

By default, a ClearCase license granted to a user expires in 60 minutes if the user does not enter any additional ClearCase commands. A **–timeout** line changes the expiration interval to the specified number of minutes. The minimum interval is 30 minutes; there is no maximum interval.

The time-out for Attache licenses is one week and cannot be changed.

Administering the ClearCase Registry

25 Understanding the ClearCase Registry

Because it is a distributed application, Rational ClearCase includes a mechanism that allows all ClearCase hosts in a network to access VOB and view data wherever it is stored. When a VOB, view, or server storage location is created, all the information that any ClearCase program needs to gain access to that VOB or view is registered in the ClearCase registry. Users can then refer to the VOB or view using simple names (called tags) and do not need to know the name of the host where the VOB or view is stored, the path to the storage directory, or any of the other information usually required to obtain access to a network resource.

This chapter introduces the ClearCase registry and describes some of the related administrative responsibilities.

25.1 Registry Hosts, Backup Registry Hosts, and Registry Regions

When you run the site preparation tool on a ClearCase networkwide release area, you designate one host in the local area network to be the ClearCase registry server host. The ClearCase **albd_server** program running on the registry server host acts as the registry server process: it responds to remote procedure call (RPC) requests from ClearCase hosts that need to read or modify registry data.

Access to the registry is critical for nearly all ClearCase operations. Because registry data is such an important resource, you can designate another ClearCase host as a backup registry server and periodically copy registry data to it using the **rgy_backup** command. If the primary registry server fails, you can run the **rgy_switchover** program to promote the backup registry server to be the primary registry server and reset all client hosts to use it.

Many registry entries include information that enables a ClearCase host to access a VOB or view over the network. Because the conventions for expressing network pathnames differ between UNIX and Windows, and because there may be other reasons why you need to register multiple network pathnames to a single VOB or view (perhaps the VOB or view is on a host that has multiple network interface cards and multiple host names), any ClearCase registry can support multiple registry regions. Each region is a consistent naming domain: all hosts in the same region must be able to access all VOB storage directories and view storage directories using the same network naming conventions. Registry regions are most often used when a mixed network of UNIX and Windows hosts need to access a common set of VOBs.

Every ClearCase host exists in exactly one network region. The **cleartool hostinfo –long** command displays a host's network region.

NOTE: Each VOB and view that resides on a host must have a tag in the host's registry region.

25.2 Registry Administration Tools

You can use the ClearCase Registry node of the ClearCase Administration Console to administer the registry server. You must be a member of the clearcase administrators group to modify data in the registry using the ClearCase Administration Console.

25.3 Storage Directories and Access Paths

Each ClearCase VOB and view has a physical location and a global name:

- **Physical location.** Each VOB storage directory and view storage directory is actually a directory tree, located on a ClearCase host in a regular file system. For daily work, developers need not know the actual locations of these storage directories.
- **Global name**. Each VOB and view also has a tag, a name that is associated with a global path to the VOB or view storage directory. In their daily work, developers use VOB-tags and view-tags to access the data structures.

Distributed VOBs and Views on UNIX

On UNIX computers, ClearCase allows you to distribute the data storage for a given VOB or view to more than one host. You can create any number of additional VOB storage pools that are remote from the VOB storage directory (**mkpool** command); similarly, you can place a view's private storage area on a remote host (**mkview –ln** command).

In both cases, remote data storage is implemented at the UNIX level. As far as ClearCase servers are concerned, the data is located within the VOB or view storage directory; standard UNIX symbolic links implement the reference to remote storage.

NOTE: Remote data storage is outside the scope of this chapter; see Chapter 8, *Understanding VOBs and VOB Storage*, for more information. The ClearCase storage registries discussed here are not used to resolve the symbolic links that implement distributed data storage.

25.4 Storage Registries

All VOB storage directories are registered in a database that constitutes the VOB registry; all view storage directories are registered in a database that constitutes the view registry. These storage registries record physical locations—host names and pathnames on those hosts. They also record the logical access paths that clients and servers use to access VOB and view data. These databases reside on a host on the network, called the ClearCase registry host, that is accessed by all ClearCase client and server applications.

A storage registry has two parts: an object registry and a tag registry. The following sections provide an overview of these components.

25.5 Object Registries

The VOB object and view object registries record the location of each VOB and view storage directory using a host-local pathname. That is, the pathname is valid on the host where the storage directory resides. These pathnames are used by the ClearCase server processes (**view_server**, **vob_server**, and so on), which run on that host.

An entry is placed in the appropriate object registry when a VOB or view is first created (**mkvob**, **mkview**). The entry is updated whenever the VOB or view is reformatted (**reformatvob**,

reformatview). You can also update or remove the entry manually (**register, unregister**) when you move a VOB or view or rename a server host.

Object registry entries are used mostly by ClearCase server processes.

25.6 Tag Registries

For most purposes (including virtually all daily development activities), VOBs and views are not referenced by their physical storage locations. Instead, they are referenced by their VOB-tags and view-tags.

Tag Registries on UNIX

- The view-tag of an active dynamic view appears as a subdirectory entry in a host's viewroot directory, **/view**. For example, a dynamic view with tag **oldwork** appears in the host's file system as directory **/view/oldwork**. To access ClearCase data, developers must use a view, either implicitly (by setting a dynamic view) or explicitly (by using a view-extended pathname for a dynamic view or by loading element versions into a snapshot view).
- In a dynamic view, the VOB-tag of a VOB is its mount point as a file system of type MVFS. Developers access all ClearCase data in dynamic views at pathnames below VOB mount points. In a snapshot view, a VOB-tag appears as a subdirectory of the snapshot view root directory.

Tag Registries on Windows

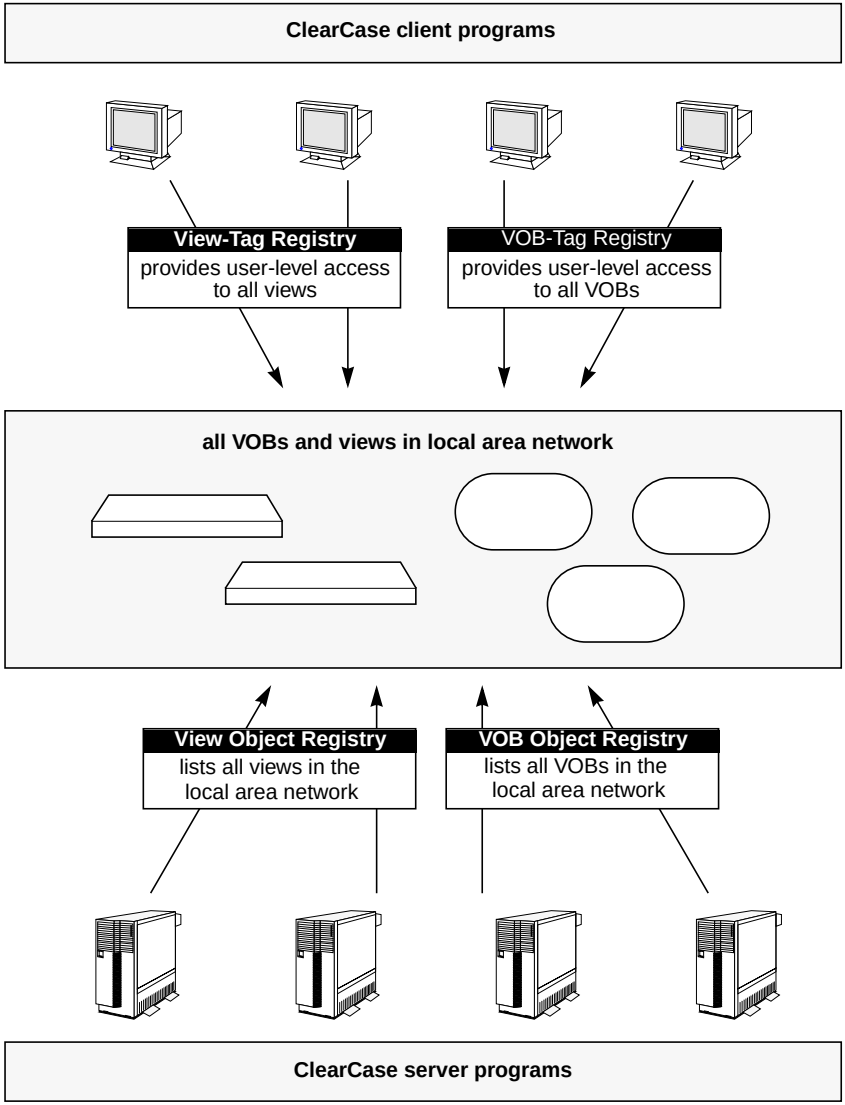
- The view-tag of an active dynamic view appears in the dynamic-views root directory (\\view by default) or the dynamic-views drive (drive M by default). For example, a view with tag **oldwork** appears in the file system as directory **\\view\oldwork** or **M:\oldwork**.
- The VOB-tag of a VOB is its registered name and its logical root directory. A VOB-tag has a single component and begins with a backslash (\). For example, **\myvob** and **\vob_project2** are legal VOB-tags. When a VOB is mounted, its VOB-tag appears as a subdirectory under each dynamic view's view-tag visible on drive M. In a snapshot view, the VOB-tag of any VOB configured in the view's load rules appears as a subdirectory of the

snapshot view root directory. Developers access all ClearCase data at pathnames below VOB-tags.

Thus, any reference to a ClearCase file-system object involves both a VOB-tag and a view-tag. ClearCase uses the networkwide VOB-tag and view-tag registries to resolve these logical locations to physical storage locations. Each tag registry entry includes a global pathname to the storage area—a pathname that is valid on all ClearCase client hosts. Figure 32 illustrates how tag registries and object registries are used to access the network's set of data storage areas.

In some networks, it is not possible to devise global pathnames to all ClearCase storage areas that are valid from every host at a site. The ClearCase registry region facility handles such situations; see Chapter 26, *Administering Regions*. Figure 32 illustrates a network that has a single network region.

Figure 32 ClearCase Object and Tag Registries (Single Network Region)



25.7 Networkwide Accessibility of VOBs and Views

Networkwide storage registries make all VOBs and views visible to all users. You can use the All VOBs and All Views nodes of the ClearCase Administration Console or the **lsvob** and **lsview** commands to list them all.

Typically, VOBs and views have different patterns of use:

- Most users require access to most (or all) VOBs.
- Most users require access to only a few views.

Accordingly, there are different schemes for activating VOBs and dynamic views on each client host.

- All public VOBs are usually activated (mounted) automatically when ClearCase starts on a client host.
- Users activate their views as needed, using explicit commands.

Public and Private VOBs

To provide control over how a VOB is activated, each VOB-tag is designated as public or private when it is created.

- On UNIX computers, all public VOBs are mounted as a group when ClearCase starts. To defeat this behavior, use the **noauto** mount option at VOB creation time (see **mkvob –options**).
- On Windows computers, all public VOBs are mounted as a group when you issue the following command:

  cleartool mount –all

  If you use the **–persistent** option to **cleartool mount**, the specified VOBs will be mounted automatically each time you log on. To force all public VOBs to be mounted automatically each time you log on, use the following command:

  cleartool mount –all –persistent

You can also arrange to have a VOB mounted automatically when you log on by selecting the **Reconnect at Logon** check box in the **Mount** dialog box when you first mount the VOB from the ClearCase shortcut menu.

NOTE: If you are using Unified Change Management, your project's VOBs are mounted automatically when you start a UCM view.

A password facility controls public VOB creation. When creating a public VOB or VOB-tag (with the ClearCase Administration Console or with **mkvob** or **mktag –vob**), you must enter a password that is usually established when ClearCase is installed. (For information on how to create or change the VOB registry password, see the **rgy_passwd** reference page.)

NOTE: Any user can mount any VOB, public or private. The private designation means only that a VOB will not be mounted by a **cleartool mount -all** command, but must be mounted explicitly, by name.

25.8 Managing VOB and View Registry Entries

ClearCase creates VOB-tag and VOB object registry entries when you create a VOB. It creates view-tag and view object registry entries when you create a view. You can use the ClearCase Registry node of the ClearCase Administration Console or various **cleartool** subcommands to inspect, create, and repair registry entries.

Viewing VOB and View Registry Entries

Use the VOB Objects and View Objects subnodes of the ClearCase Registry node in the ClearCase Administration Console to inspect VOB and view object entries:

1. Start the ClearCase Administration Console.
2. Navigate to the VOB Objects or View Objects subnode of the ClearCase Registry node.
3. Select a VOB object or view object in the details pane.
4. Click **Action** > **Properties**.

Use the VOB Tags and View Tags subnodes of a region in the ClearCase Registry node in the ClearCase Administration Console to inspect VOB-tag and view-tag entries:

1. Start the ClearCase Administration Console.
2. Navigate to the VOB Tags or View Tags subnode of a region in the ClearCase Registry node.
3. Select a VOB-tag or view-tag in the details pane.
4. Click **Action** > **Properties**.

You can also use **lsvob** or **lsview** with the **–long** option to report key registry information. If you cannot see a VOB with **lsvob** or a view with **lsview**, then no tag for the view is registered in the current network region (or for the region specified in the command). For a VOB or view with a registered tag, the output from **lsvob –long** and **lsview –long** includes this information:

- The VOB-tag or view-tag
- The host name for the host on which the storage directory resides
- The host-local access pathname (from the **vob_object** or **view_object** file), which the relevant VOB or view server uses to access the storage directory
- The global pathname (from the **vob_tag** or **view_tag** file), which is used to resolve references to the newly created VOB

For example:

cleartool lsvob –long

```
  .
  .
Tag: /vobs/src
  Global path: /net/venus/vobstore/src.vbs
  Server host: venus
  .
  .
  Vob server access path: /vobstore/src.vbs
  .
  .
```

cleartool lsview –long

```
  .
  .
Tag: main
  Global path: /net/venus/viewstore/main.vws
  Server host: venus
  .
  .
  View server access path: /viewstore/main.vws
  .
  .
```

If the global and server access paths are identical or if they don't look right to you, then you may anticipate problem reports regarding access to the VOB or view.

Creating VOB and View Registry Entries

The **mkvob** and **mkview** commands and the GUI tools that create VOBs and views create both the object and tag registry entries necessary for ClearCase client access. (There is one exception: if you create a VOB with a public tag, but the tag password fails, the VOB is created without the tag. You must create the tag in a separate operation with **mktag**.) **mkvob** and **mkview** output includes this information:

- The host-local access pathname (from the **vob_object** or **view_object** file)
- The global pathname (from the **vob_tag** or **view_tag** file)

Sample **mkvob** output:

```
  .
  .
Host-local path: venus:/vobstore/src.vbs
Global path:     /net/venus/vobstore/src.vbs
  .
  .
```

Sample **mkview** output:

```
  .
  .
Host-local path: venus:/viewstore/main.vws
Global path:     /net/venus/viewstore/main.vws
  .
  .
```

Creating VOB-Tags and View-Tags

Use the ClearCase Administration Console or **mktag** to add or replace tag entries for existing VOBs and views. These are two common uses:

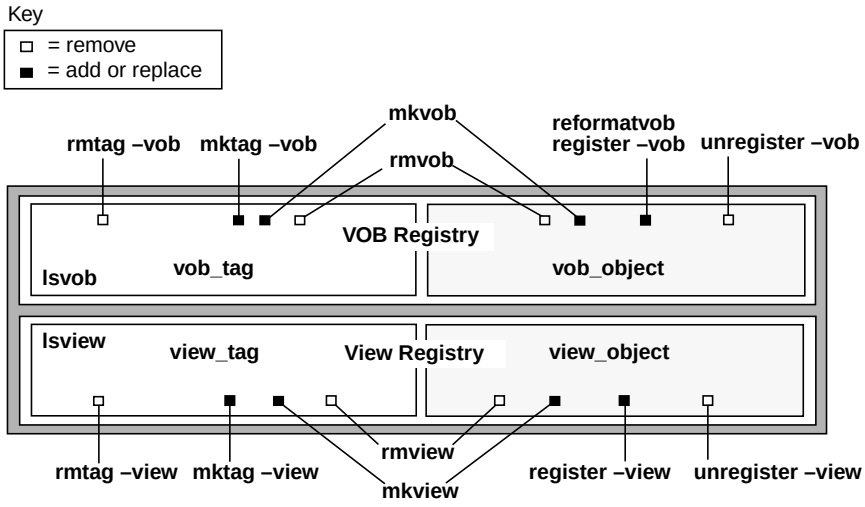
- Creating additional VOB-tags and view-tags to support multiple network regions
- Converting a private VOB to a public VOB

To change a tag's name or its assigned region, use the ClearCase Administration Console to remove the tag and create a new one, or use **rmtag** and then **mktag**, not **mktag –replace**. See the **mktag** and **rmtag** reference pages for details on tag creation and removal.

To change the assigned network region for a tag or to copy a tag in another region, you can drag the tag from one region to another using the Regions subnode of the ClearCase Registry node in the ClearCase Administration Console. If you change a tag's region, be sure that the global path is valid in the new region.

Figure 33 shows the **cleartool** commands that affect registry files.

Figure 33 cleartool Commands and the ClearCase Storage Registry



25.9 Creating Server Storage Locations

The ClearCase registry includes information about server storage locations for VOBs and views. A VOB server storage location is a shared directory on a ClearCase server that appears in a list of recommended VOB storage locations when a user creates a VOB. A view server storage location is a shared directory on a ClearCase server that appears in a list of recommended view storage locations when a user creates a view.

Each server storage location is valid for a particular region. It is a global path that must be valid for all ClearCase hosts in the region.

You can create an initial set of server storage locations after you install ClearCase on a server.

- On a Windows computer, if you specify during installation that locations on that server are to be available to ClearCase clients for creating VOB and view storage directories, the ClearCase Server Storage Configuration Wizard runs when you first log on after the installation restart. You can use the wizard to establish the initial a set of storage locations for VOBs and views.
- On a UNIX or Windows computer, you can use the **mkstgloc** command to create server storage locations for VOB and view storage.

You can also use the ClearCase Administration Console to add, change, or remove server storage locations for a given registry region:

1. Start the ClearCase Administration Console.
2. Navigate to the Storage Locations subnode of the ClearCase Registry node.
3. To create a new storage path, click **Action** > **New** > **Server Storage Location**.
4. To change the properties of an existing storage location, select one and click **Action** > **Properties**.
5. To remove an existing storage location, select one from the list and click **Action** > **Remove Server Storage Location.**

25.10 Registering Site-Wide Properties

The ClearCase registry maintains a set of properties for ClearCase. ClearCase uses the value for a site-wide property when you perform an operation that uses that property and you don't specify the property's value. For example, when you create a view and do not specify one of the shareable DOs options, ClearCase uses the site-wide value.

You can use the ClearCase Administration Console to view or edit site-wide properties on the ClearCase registry server for a region:

1. Start the ClearCase Administration Console.
2. Navigate to the ClearCase Registry node.
3. Click **Action** > **Properties**.

You can also use the **cleartool lssite** command to display the set of site-wide properties and their values. Use the **cleartool setsite** command to set new values for site-wide properties. For information about the available properties and possible values for them, see the reference page for the **setsite** command.

25.11 Registry Guidelines

Following are some general tips, warnings, and guidelines regarding ClearCase storage registry administration:

- You cannot access a VOB or view (even to remove it) unless it has both a tag registry entry and an object registry entry. Use the ClearCase Administration console or **lsvob** or **lsview** to see whether the tag is missing (no listing at all) or the object entry is missing (no storage paths appear in the **–long** output).

  If you cannot access a VOB or view, first make sure it has a tag. If it does not appear in the output of an **lsvob** or **lsview** command, it has no tag. Create one with the ClearCase Administration console or **mktag**.

  If it has a tag, list the tag with the ClearCase Administration console or **lsvob –long** or **lsview –long**. If the output includes incorrect pathnames (identical local and global pathnames usually mean trouble), you can try to re-register the object (with **mktag** and/or **register**) to supply correct pathnames. If everything looks correct and you still cannot access the VOB, contact Technical Support.

- When using UNIX symbolic links, make sure the links can be resolved by all hosts that need to access the VOB. For example:

  /usr/vobs -> /usr/vobstore *<--- wrong*

  When this link is resolved on a client host, the full pathname **/usr/vobstore** references the **/usr** directory on the client host.

  /usr/vobs -> ../vobstore *<--- right*

  When this link is resolved on a client host, the relative pathname **../vobstore** references a location on the VOB host.

  Similarly, beware of full pathnames in VOB symbolic links that point to locations in other VOBs.

- On UNIX VOB and view hosts, watch out for links to unexported disk partitions. If you cannot access a VOB and suspect a faulty registry pathname, follow the registered global pathname to the storage host and **pwd** to see where you are. Make sure a link does not point to a location in an unexported partition. For example:

  /usr/vobs -> ../vobstore

  This link causes failures if the location **/usr/vobstore** is in another partition that is not exported.

- Don't try to rename a tag; replace it using **mktag -replace**.

- Don't use operating system utilities such as **rm**, **rmdir**, or GUIs such as Windows Explorer to delete a VOB or view a storage directory; this doesn't clean up the registry entries.

- Don't delete tags before deleting the storage directory; let **rmvob** or **rmview** delete tags for you.

- When creating a VOB or view, creating a VOB-tag or view-tag, registering or unregistering a storage directory, or reformatting a VOB—especially when using the **–host –hpath –gpath** options together—execute the command on the host where the VOB or view storage directory resides. This enables ClearCase to validate some pathnames, which it cannot do when the command is executed from a remote host.

- Use the **rgy_check** utility to diagnose problems or for periodic cleanup of obsolete or stranded registry entries.

Multiple Registries

We do not recommend configuring multiple registry hosts to serve clients in the same network region. A network configuration that includes a separate registry server for each region can be used if organizational or other concerns require it. However, maintaining multiple registry servers can significantly increase administrative workload. Registry access does not usually create significant server load, and any benefit that might be achieved through registry server load-balancing will most likely be outweighed by the costs of maintaining registry data on multiple registry hosts.

If you decide to maintain multiple registry hosts, keep the following points in mind:

- If you want clients in separate registries to share one or more VOBs or views, create all shared VOBs and views in the same region before registering them in additional registries.

- When registering a VOB or view in an additional registry, run the **mktag** and **register** commands from a host assigned to that registry.
- The **rgy_check**, **rgy_switchover**, and Region Synchronizer commands cannot be used effectively in a multiple registry installation.
- Although you can create regions with the same name in different registries, this is likely to cause confusion and is not recommended.

Administering Regions

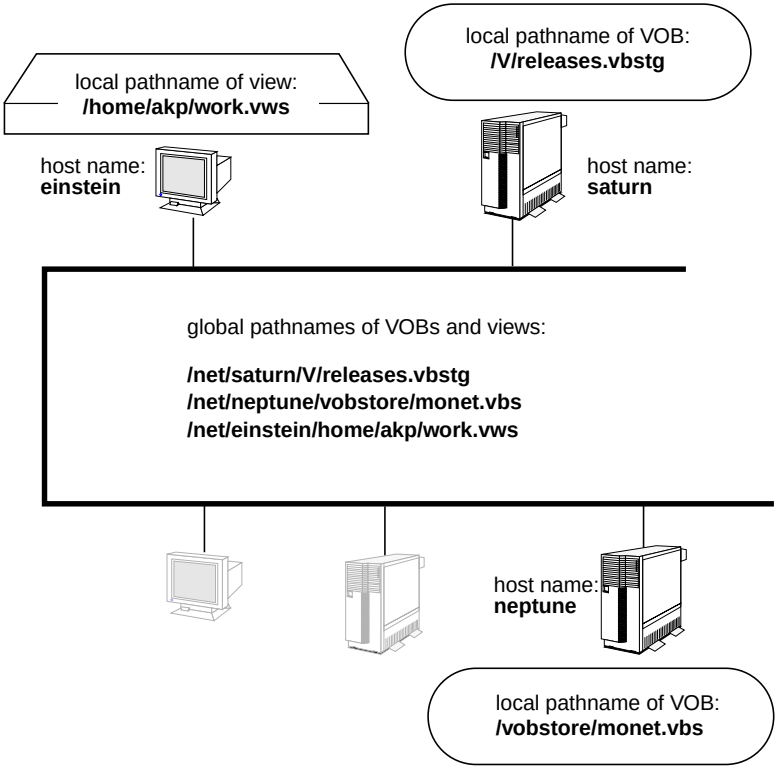
26

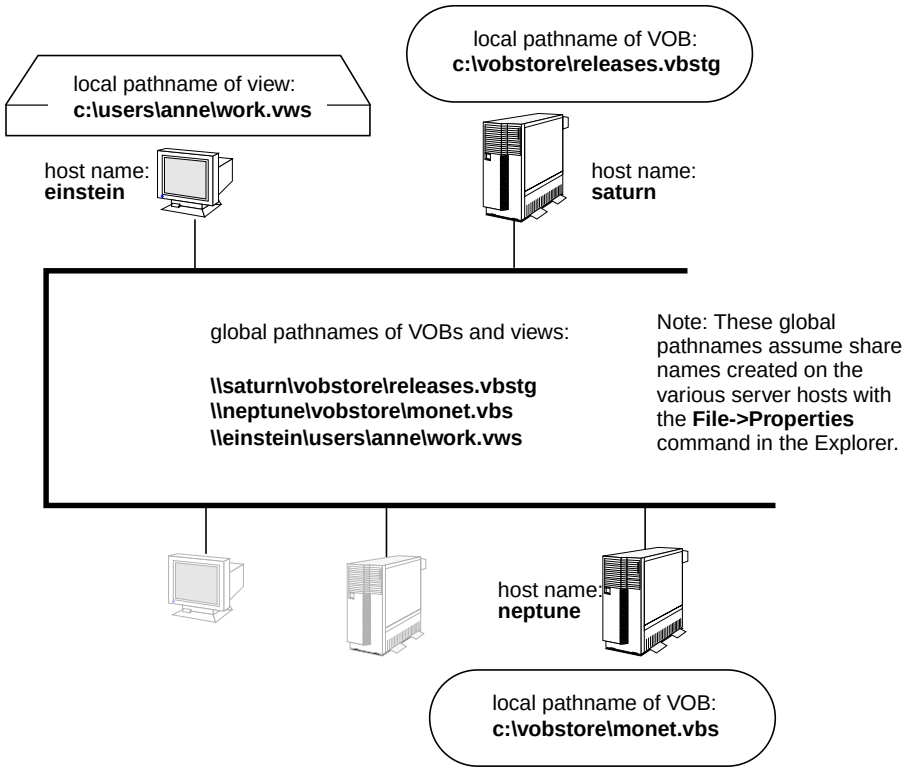
This chapter discusses administration of network regions. A region is a conceptual subset of a ClearCase registry in which hosts refer to shared resources using the same network naming conventions. You do not need to create multiple registry regions if all ClearCase hosts in your network can use the same pathname to access each VOB and view storage directory. In any mixed network of UNIX and Windows computers, differences between UNIX and Windows network naming conventions require that global pathnames and other information in VOB-tags and view-tags be entered in a platform-specific syntax. If you are administering a mixed UNIX/Windows network, or if your network includes ClearCase servers that have multiple network interfaces, you must define separate network regions for hosts with different naming conventions. Regions are maintained by the ClearCase registry.

26.1 Network Regions

Ideally, your network's VOB and view storage directories are accessible at the same pathnames throughout the network. Figure 34 shows a simple network in which global naming has been achieved.

Figure 34 Network with Global Naming





Uniform global naming may not be achievable if your network supports both Windows and UNIX hosts, hosts with multiple network interfaces, or UNIX computers with multiple aliases.

ClearCase servers require consistent pathnames to shared storage areas. If you cannot achieve global consistency, you must partition your network into a set of network regions, each of which is a consistent naming domain. Each region has the following characteristics:

- Each ClearCase host must belong to a single network region.
- All hosts in a given network region must be able to access ClearCase physical data storage (that is, all VOB storage directories and the storage directories of shared views) using the same full pathnames.
- All hosts in a given network region must use the same locale setting if VOB-tags or view-tags use multibyte characters.

- Developers access VOBs and views through their VOB-tags and view-tags. All hosts in a given network region use the same tags.
- Each VOB must have a tag in the region of the host on which the VOB storage directory resides. Each view must have a tag in the region of the host on which the view storage directory resides. A VOB or view can have tags in other regions as well.

For example, a VOB and a view may be accessed in different network regions as follows:

Region: **nt_dev**
VOB storage: **\\neptune\public\vega_project.vbs**
VOB-tag: **\vega**
View storage: **\\saturn\shared_views\int_43.vws**
View-tag: **int_43**

Region: **unix_dev**
VOB storage: **/net/neptune/public/vega_project.vbs**
VOB-tag: **/vobs/vega**
View storage: **/net/saturn/shared_views/int_43.vws**
View-tag: **int_43**

Use the Regions subnode of the ClearCase Registry node in the ClearCase Administration Console to create, view, and remove regions. You can also use the **mkregion**, **lsregion**, and **rmregion** commands to create, view, and remove regions.

Registries in a Multiple-Region Network

Conceptually, each network region has its own view-tag registry and VOB-tag registry. Each VOB can have at most one tag in a region. In a network with two regions, each VOB or view has at most two tag entries.

Not every VOB or view needs a tag in every region. VOBs or views that are not used by all hosts only need tags in the region(s) used by the hosts that access them. By selectively excluding VOB-tags or view-tags from certain regions, you can use network regions to limit access to VOBs and views. (However, a VOB must have a tag in the region to which the VOB server host belongs, and a view must have a tag in the region to which the view storage directory's host belongs.)

It will simplify administration if you use the same text in the tag name in all regions. For example:

Region	VOB-tag	Pathname to Storage Area in Region
nt1	**\project**	**\\neptune\public\vega_project.vbs**
unix1	**/project**	**/net/neptune/public/vega_project.vbs**

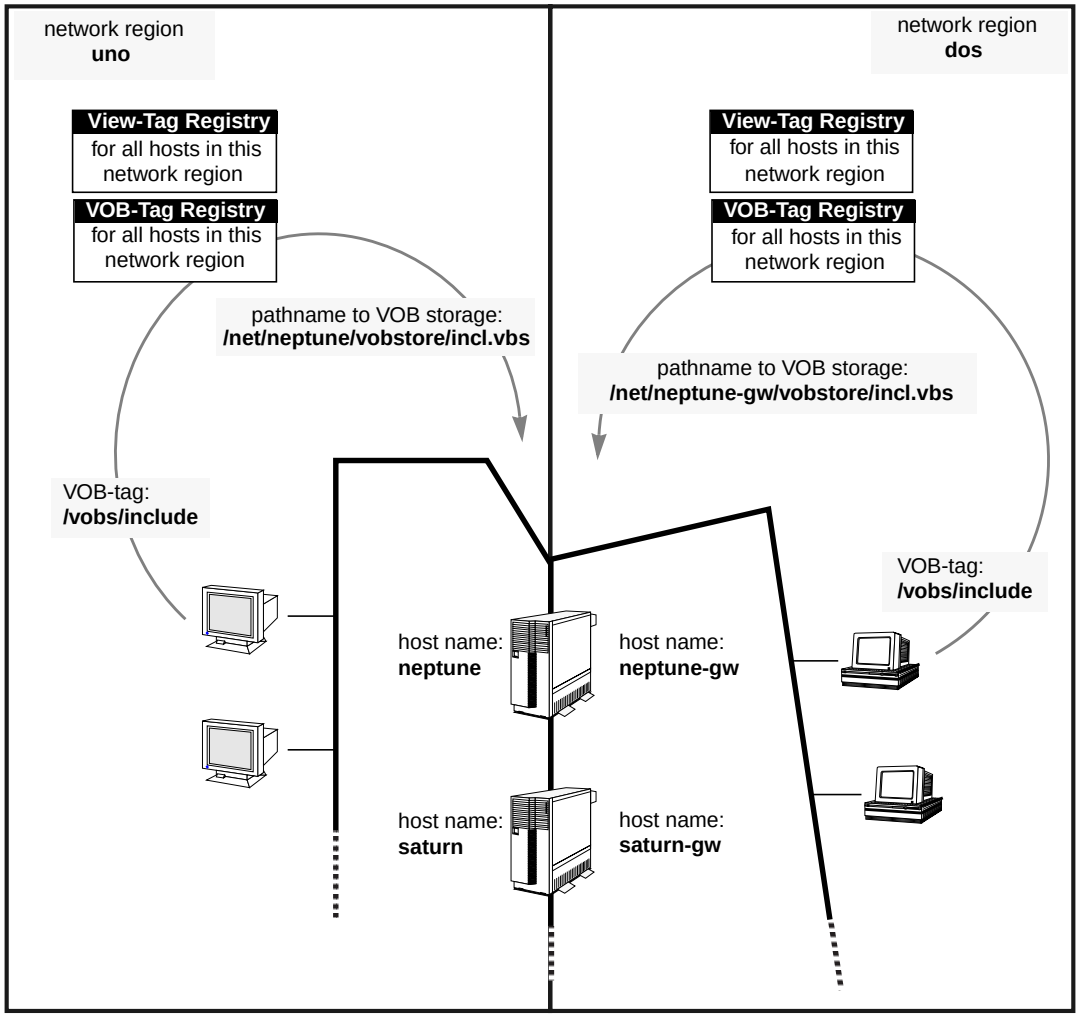
NOTE: In a mixed Windows and UNIX environment, VOB-tags that differ only in their initial directory separator character—backslash (\) or slash (/)— are equivalent.

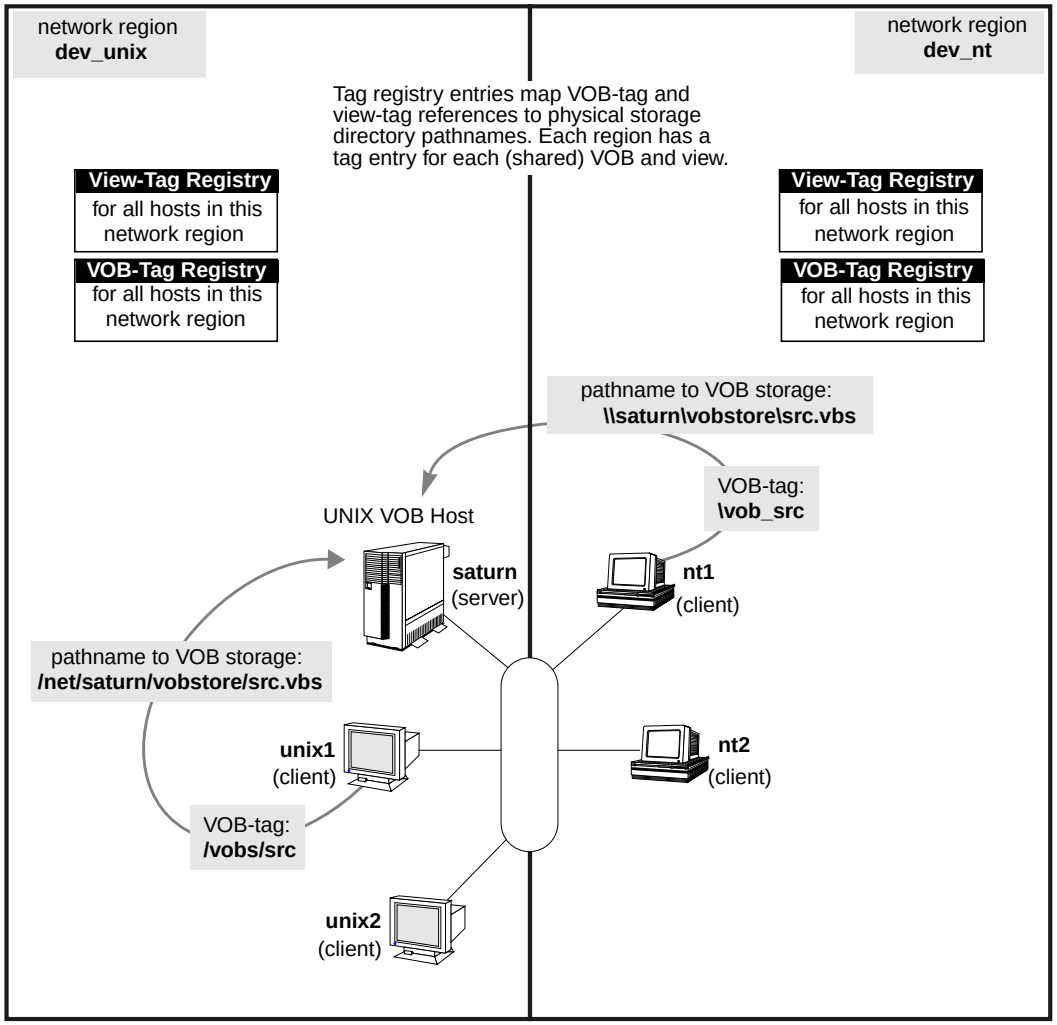
This set of tags provides a standard way for users to refer to a VOB by name, even though the network file naming conventions are different.

Tag Registry Implementation

Figure 35 illustrates a simple two-region network, each with its own logical set of tag registries. All hosts in a network region use the same VOB-tags and view-tags, and access ClearCase data storage areas using the same pathnames, provided by registry lookups.

Figure 35 Network Regions and Their Tag Registries





Establishing Network Regions

The site preparation program (described in the *Installation Guide* for the ClearCase Product Family) prompts you to specify the name of a network region. This name becomes the default region, which can be accepted or overridden during ClearCase installation on individual hosts. To list a host's network region, use the host node of the ClearCase Administration Console, the ClearCase program in Control Panel, or the **cleartool hostinfo –long** command.

26.2 Adding a Network Region

Ensuring Global Access to the VOB—Special Cases for UNIX on page 151 outlines the circumstances that may require you to adjust the registry entry generated for a VOB or view. That section presents some sample **mktag** commands that fix the storage registry by explicitly specifying, for a VOB or view, the host-local and global access paths. This section addresses the situation in which a single, global pathname to a VOB or view storage directory does not exist for all network hosts that must access it, so you must partition your network into at least two network regions.

NOTE: The most common multiple region scenario involves a mixed network environment of Windows and UNIX hosts. If you are working in, or planning, such an environment, read the remainder of this section to acquaint yourself with the procedure for adding a network region. Then use procedures described in Chapter 7, *Configuring VOB and View Access in Mixed Environments*, to perform the actual work of registering VOBs and views.

When to Create Additional Regions

There are several aspects of a computer network that may require you to create one or more additional registry regions:

- **Multiple host architectures.** Network naming conventions differ between UNIX and Windows. If you have to support ClearCase on both UNIX and Windows hosts, you will need at least two registry regions. For example, a VOB that is accessed as **/net/neptune/vobstore/incl.vbs** on a UNIX host may be accessed as **\\neptune\vobstore\incl.vbs** on a Windows host.

- **Multiple network interfaces.** A UNIX or Windows VOB host or view host may have two or more interfaces to the network, each corresponding to a different host name. A VOB with storage on such a host will have one global storage pathname for each network interface (and host name) the host supports. For example, for a host with two interfaces and two names (neptune and neptune-gw), the global storage path to a VOB with local storage at **/public/project.vbs** is different for each host name:

  ```
  /net/neptune/public/project.vbs
  /net/neptune-gw/public/project.vbs
  ```

- **UNIX hosts with multiple aliases.** The standard UNIX facilities for assigning names to hosts—file **/etc/hosts** or NIS map **hosts**—allow each host to have any number of alternate names, or aliases. This is a possible hosts entry:

```
195.34.208.17 betelgeuse bg                    (alias)
```

If shared storage resides on this host, ClearCase clients may be able to access the storage using either a **/net/betelgeuse/**... pathname or a **/net/bg/**... pathname.

There is another partitioning scenario with a different focus: you want to prevent, not promote, VOB and view sharing. You can create a separate region—or even a separate registry, served by a second registry host—to administer a cluster of hosts for which some or all VOBs and views visible in another region are not registered and, hence, not visible.

Multiple locales. ClearCase supports use of multibyte characters in VOB-tags and view-tags. Because the interpretation of multibyte characters is controlled by a host's locale setting (established on UNIX through the **LOCALE** environment variable and on Windows using the **Regional Options** tool in Control Panel), all hosts in a region must use the same locale setting or they will not be able to interpret multibyte VOB-tags and view-tags correctly.

No matter how many regions you have, each ClearCase host can belong to only one region.

Multiple Regions vs. Multiple Registries

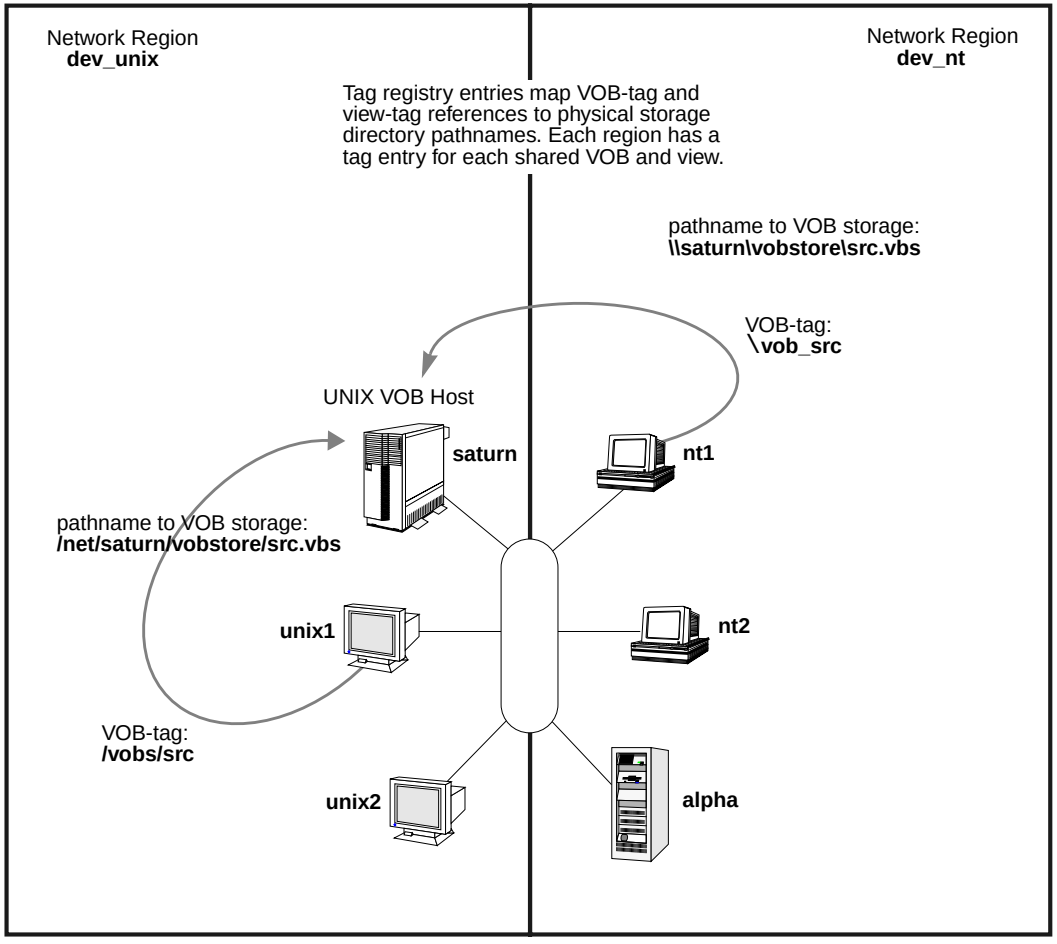
Instead of, or in addition to, creating multiple network regions in a single ClearCase registry, you can construct a network with multiple registry hosts, each serving separate clusters of ClearCase hosts that may or may not share VOBs and views. This approach complicates the administration process; it is not recommended unless specific circumstances require it.

The procedures here are intended primarily to support single registry installations and offer only basic guidance for multiple registry (as opposed to multiple region) sites. Some general guidelines are available in the section *Multiple Registries* on page 412.

A Example Using Network Regions

Figure 36 illustrates a mixed-architecture (Windows and UNIX) network. There are two network regions, one for Windows hosts and one for UNIX hosts. Two regions are required because UNIX servers store VOBs and views that must be accessed by *all* network hosts. In this example, hosts in both regions use the same view-tags, but not the same VOB-tags. Furthermore, each region's hosts access VOB and view storage using different pathnames. Therefore, separate tag registry entries are required.

Figure 36 Sample Network with Two Regions



Procedure for Adding a Network Region

Use this procedure to create one or more additional regions after your first region has been created. This procedure assumes that these conditions are true:

- ClearCase has been installed on each host.
- VOBs and views have been created on the region's VOB and view storage hosts.

To Create a New Region

Use the ClearCase Administration Console to create a new region (in this example, the region is named **dev_nt**):

1. Start the ClearCase Administration Console.
2. Navigate to the Regions subnode of the ClearCase Registry node.
3. Click **Action** > **New** > **Region Tag**. This command opens a dialog box in which you create the new region.

You can also use the **mkregion** command to create region **dev_nt:**

cleartool mkregion –tag dev_nt –tcomment "Windows ClearCase hosts"

To Move a Host into a New Registry Region

A ClearCase host's default region and registry server are established when ClearCase is installed. To move the host into a different region served by the same registry server:

- On a UNIX host, edit the file **/var/adm/atria/rgy/rgy_region.conf** to contain the name of the new region. You must be logged in as **root** to change this file.
- On a Windows host use the **Registry** tab of the ClearCase program in Control Panel to specify the new region.
- Stop ClearCase on the host.
- Restart ClearCase on the host.

To Change a Host's Registry Server

To move the host into a region served by a different registry server:

- On a UNIX host, edit the file **/var/adm/atria/rgy/rgy_hosts.conf** to contain the name of the new registry host and optional backup registry host, then edit the file **/var/adm/atria/rgy/rgy_region.conf** to contain the name of a valid region on the new host. You must be logged in as **root** to change these files.
- On a Windows host, run Control Panel and click the **Registry** tab of the ClearCase program to specify the new Registry server host and region.
- Stop ClearCase on the host.

➤ Restart ClearCase on the host.

You can verify that the new region assignment is in effect by running the **hostinfo** command to display the current registry host and network region.

```
cleartool hostinfo –long
```

NOTE: If a host has been configured to allow remote administration, you can also use the host node of the ClearCase Administration Console to change the host's region, though you cannot use the ClearCase Administration Console to stop or start ClearCase on a host.

To Create VOB-tags and View-tags in a New Network Region

There are several ways to populate a newly created registry region with VOB-tags and view-tags:

➤ The Region Synchronizer, a Windows GUI, makes it easy to import VOB-tags and view-tags from a UNIX region to a Windows region. To start the Region Synchronizer, click **Start** > **Programs** > **Rational ClearCase Administration** > **Region Synchronizer**.

➤ The ClearCase Administration Console provides a more general interface to regions and tags. The ClearCase Administration Console is a Windows GUI that runs on Windows. It can be used to manipulate tags regardless of whether the registry host is running UINX or Windows. You can use it to create and delete tags, and also to copy tags to another region. When you use ClearCase Administration Console to manipulate tags, you must be careful to change the global paths of the new tags you create in this way to ensure that they are valid in the new regions. (The Region Synchronizer automates this operation for the specific case of importing a tag from a UNIX region to a Windows region.) To start the ClearCase Administration Console, click **Start** > **Programs** > **Rational ClearCase Administration** > **ClearCase Administration Console**.

➤ You can use the **cleartool mktag** command, as described in *Using mktag*.

Using mktag

VOB-tags and view-tags are created for the new region using **mktag** commands of the form:

cleartool mktag –vob –tag *vob-tag* **–region** *new-network-region*
–host *host name*
–hpath *host-local-pathname*
–gpath *global-pathname*
storage-dir

cleartool mktag –view –tag *view-tag* **–region** *new-network-region*
–host *host name*
–hpath *host-local-pathname*
–gpath *global-pathname*
storage-dir

For example, host **nt1** in Figure 36 accesses a UNIX VOB through VOB-tag **\vob_src**, which was created for the **dev_nt** region with the following command:

```
cleartool mktag –vob –tag \vob_src –region dev_nt ^
  –host saturn ^
  –hpath /vobstore/src.vbs ^
  –gpath \\saturn\vobstore\src.vbs ^
   \\saturn\vobstore\src.vbs
```

From this point on, each new shared VOB or view created on the network requires a tag entry for each region. That is, if a new VOB or view is created anywhere on the network, and it must be visible to hosts in both the **dev_unix** and **dev_nt** regions, you must use the ClearCase Administration Console or an additional **mktag** command to create a new tag in the second region. For example:

- After creating VOB **/vobs/lib** on **saturn** in the **dev_unix** region

  ```
  cleartool mktag –vob –tag \lib ^              (Create, for all Windows hosts
      –region dev_nt ^                             in the  dev_nt region, a VOB-tag
      –host saturn ^                               registry entry for the VOB
      –hpath /vobstore/lib.vbs ^                   whose storage directory resides
      –gpath \\saturn\vobstore\lib2.vbs ^          at \\saturn\vobstore\lib.vbs)
      \\saturn\vobstore\lib.vbs
  ```

  The **mktag** command can be executed on a UNIX host. But the final argument, used by **mktag** itself to find the storage directory, is different on UNIX—**/vobstore/lib.vbs**, for example, rather than **\\saturn\vobstore\lib.vbs**.

- After creating view **view4** on host **nt2** in the **dev_nt** region

  Do nothing. UNIX hosts cannot use Windows views, so there is no need to create a new tag for the **dev_unix** region.

  NOTE: There must be separate tag entries for each region, but actual tag *names* (**\src** or **\vob_src**, **myview** or **r2.1_view**, for example) should, if possible, be the same for all regions. The ideal is consistent, transparent VOB access from any network region. However, this ideal may be impractical in some environments, because Windows VOB-tags are limited to a single pathname component.

If the New Region Is Served by a Different Registry Host

If the new region belongs to a different ClearCase registry (that is, the region is served by a separate registry host):

- You cannot use the Region Synchronizer to create tags for the new region.
- In addition to **mktag**, you must also use the ClearCase Administration Console or the **register** command to add entries to the second registry's VOB or view object file (**vob_object** or **view_object**). For example:

  cleartool register –view \\saturn\viewstore\view1.vws

Guidelines for Multiple Network Regions

- If possible, use the same VOB-tags in all network regions. Each VOB or view that must be visible in multiple network regions must have a separate tag entry in each region. Making the name the same for all regions provides consistent, transparent access from any network region.
- Use consistent naming conventions for directories that hold UNIX VOB mount points and for directories that store VOB or view storage directories.
- Don't use remote VOB storage pools for a UNIX VOB that must be accessed by hosts in more than one network region. If you use a remote storage pool for a shared VOB, the pool must be accessible from all hosts, in all regions, using the same global pathname.
- You can isolate an arbitrary group of hosts either with a separate network region or by setting up a separate registry host with its own registry files and assigning the desired hosts to the new registry. It is more common (and easier to administer) to use a network region for this purpose.
- A VOB's first tag (the one created by the VOB Creation Wizard or **mkvob**) must be in the home region—the region in which the VOB host resides. The same restriction applies to a view's first tag. You can then create additional tags for other regions, but make sure that a home region tag always exists.

26.3 Removing a Network Region

At some point, you may want to dissolve a network region and reincorporate its hosts into one or more existing regions. Move each host to its new region as described in *Adding a Network Region* on page 422. Then, use the ClearCase Administration Console to delete the region:

1. Start the ClearCase Administration Console.
2. Navigate to the subnode for the region you want to remove under the ClearCase Registry node.
3. Click **Action** > **All Tasks** > **Remove Region Tag**.

You can also remove the region with the **rmregion** command:

cleartool rmregion –tag dev_nt –rmall

27 Moving, Renaming, and Backing Up the ClearCase Registry

This chapter describes procedures for changing ClearCase registry server hosts and for backing up the registry.

27.1 Backing Up Registry Data

ClearCase registry data is kept in a group of files in the **rgy** directory on the registry server host. These are ordinary files that can, and should, be backed up regularly.

- On UNIX hosts, the registry directory is **/var/adm/atria/rgy**. All of the files in this directory should be backed up together and, if necessary, restored together.
- On Windows hosts, the registry directory is *ccase-home-dir***var\rgy.**

On either Windows or UNIX, all of the files in the registry directory should be backed up together and, if necessary, restored together. We recommend using a Windows backup utility that can back up files that are open for writing.

27.2 Setting Up a Backup Registry Host

From time to time the registry server host may become unavailable; you then need to designate a new registry server. At that time, you may or may not have a backup host prepared to become the new registry server. This section uses two examples of these conditions:

- You have a functioning backup registry host, on which **rgy_backup** has been running at regular intervals.
- No designated backup registry host is available.

In both cases, the **rgy_switchover** utility does the key work.

Moving the Registry to an Active Backup Registry Host

In this scenario, primary registry host **rgy1** fails, and the ClearCase administrator makes backup registry host **rgy2** the new primary server. (**rgy_backup** has been executing successfully on **rgy2**.) While **rgy1** is down and **rgy2** is the primary registry server, **rgy3** becomes the backup registry server. Later, **rgy1** becomes available again, and the administrator reverts to **rgy1** as the primary registry server.

Switching to a Backup Registry Server

Use this procedure to switch the registry server. You must have write permission to the directory *ccase_var_dir***rgy** to run **rgy_backup**.

1. **Run rgy_switchover.** Make **rgy2** the primary registry server. Make **rgy3** the new backup registry server:

   rgy_switchover –backup rgy3 rgy1 rgy2

2. **Handle unreachable clients.** Record the names of any client hosts for which the switchover fails. You will reset these hosts by hand (or have their owners do so) when they become available. Later, when a failed client becomes available, take the following steps:

   a. Log on to the client.

   b. Configure the client to use the new registry host. On UNIX clients, set the first line of its **rgy_hosts.conf** file to **rgy2**. On Windows clients, use the **Registry** tab of the ClearCase program in Control Panel. Click **Use registry server on host**. In the **Use registry server on host** box, enter **rgy2**. On the **Registry** tab, enter **rgy3** in the **Backup registry host** box. Click **OK** or **Apply**.

   c. Stop ClearCase.

   d. Restart ClearCase.

NOTE. ClearCase hosts with client-only installations and ClearCase Attache clients cannot be reconfigured by **rgy_switchover** and always appear on the list of unreachable clients.

Switching Back to the Primary Registry Server

Because registry contents can change frequently as VOB-tags and view-tags are created and deleted, you cannot simply restart a failed registry host after a period of using a backup registry host. Use this procedure if you have switched to a backup registry server (**rgy2** in our example) and want to switch back to using the primary registry server **rgy1**. You must have write permission to the directory *ccase_var_dir***rgy** to run **rgy_backup**.

1. Host **rgy1** becomes available again.

2. **Deactivate rgy1. rgy1** is still configured as a registry host. Reconfigure it to recognize **rgy2** as the registry host. Then make **rgy1** a backup registry host, so that it takes a registry snapshot in preparation for returning to its role as primary registry server:

   a. Log on to **rgy1**.

   b. Reconfigure **rgy1** as a backup registry server. On UNIX, edit **rgy_svr.conf** to remove the string **master**, then edit **rgy_hosts.conf** to change its first line to **rgy2** and its second line to **rgy1**. On Windows Control Panel, click the **Registry** tab of the ClearCase program. Click **Use registry server on host**. Enter **rgy2** in the **Use registry server on host** box. On the **Registry** tab, enter **rgy1** in the **Backup registry host** box. Click **OK** or **Apply**.

   c. Stop ClearCase.

   d. Restart ClearCase.

3. **Copy the active registry files to rgy1.** Run **rgy_backup** manually on **rgy1**, forcing it to take a snapshot of the active registry files on **rgy2**, in preparation for returning **rgy1** to service as the primary registry server. On **rgy1**, run **rgy_backup**

4. **Run rgy_switchover.** Make **rgy1** the primary registry server host. Return **rgy2** to its former role as the backup registry host with the following command:

   rgy_switchover –backup rgy2 rgy2 rgy1

5. **Handle unreachable clients.** Any **rgy_switchover** operation is likely to require this step. See Step #2 on page 432 for details.

Moving the Registry to a Host Not Configured for Registry Snapshots

In this scenario, either your site has failed to configure or maintain a backup registry host, or the backup registry host has failed along with the primary registry host. You want to move the ClearCase registry from host **rgy1** to host **rgy2**. When you do so, the primary registry host, **rgy1**, may or may not be available. The procedures presented here handle both cases.

No Backup Host: Primary Registry Host Is Available

You must have write permission to the directory *ccase-var-dir***rgy** to run **rgy_backup**.

1. **Configure rgy2 as a backup registry host.** Follow the procedure in *Changing Backup Registry Host Without rgy_switchover* on page 436.

2. **Copy the registry files to rgy2.** Run **rgy_backup** on **rgy2**:

   rgy_backup

3. Follow the switchover procedure in Step #1 on page 432.

No Backup Host: Primary Registry Host Is Down

Primary host **rgy1** is unavailable; prospective registry host **rgy2** is not configured as a backup registry host. You must restore the **rgy** directory backup from **rgy1** to the **rgy** directory tree on **rgy2** and reconfigure all hosts, as described in the **registry_ccase** reference page.

The following procedure is a potentially time-saving alternative, in which you restore and re-create registry-related files on the target registry host, **rgy2**, making it possible to run **rgy_switchover** as if **rgy2** were a real backup registry host.

1. **Restore registry files to target registry host, rgy2, from backup**. Retrieve the ClearCase **rgy** directory and **client_list.db** file from backup and load its files into *ccase-var-dir***/rgy/backup.** When you are finished, the **backup** subdirectory includes all the registry data files listed in the **registry_ccase** reference page.

   Look for the client_list.db file. A registry host stores its **client_list.db** file alongside (not in) the **rgy** directory in *ccase-var-dir*. If you do not have this file, **rgy_switchover** cannot reconfigure clients for you. You must do it by hand by editing the **rgy_hosts.conf** file on UNIX clients or, on Windows, running Control Panel and using the **Registry** tab of the ClearCase program.

2. **Create a backup_list file.** Create a text file named **backup_list** and put it into the **backup** directory. The first line of **backup_list** must be the name of the primary registry server, in this case **rgy1**. The remaining lines of **backup_list** must be the names of all the registry data files listed in the **registry_ccase** reference page, one file name per line. List only the name of each file, not the path to the file.

3. Follow the switchover procedure in Step #1 on page 432.

27.3 Renaming the Registry Server Host

ClearCase client hosts cache the name of the registry server host. To rename the network's registry server host:

1. **Shut down ClearCase on each client host.**

2. **Switch registry server host assignments.** Do this on all ClearCase hosts, as described in Step #2 on page 432.

3. **Rename the registry server host.** Make the change using the vendor-supplied procedure or tool.

4. **Restart ClearCase on all hosts.**

27.4 Changing the Backup Registry Host

You can change the backup host as part of a **rgy_switchover** operation or without changing the primary registry host.

Changing Backup Registry Host Using rgy_switchover

You are promoting the current backup registry host to primary host, as described in *Moving the Registry to an Active Backup Registry Host* on page 432. In this case, the **–backup** argument to **rgy_switchover** specifies the new backup registry host. In addition, **rgy_switchover** updates all reachable clients to recognize the new configuration.

Changing Backup Registry Host Without rgy_switchover

You are changing the backup registry host, without changing the primary registry host with **rgy_switchover**. The following procedure makes host **rgy3** the backup registry host while leaving **rgy1** the primary registry host:

1. **Log on as the privileged user on each ClearCase host.**
2. **Stop ClearCase.**
3. **Reconfigure the host** to use rgy3 as the backup registry host. On UNIX, open **/var/adm/atria/rgy/rgy_hosts.conf** and change its second line to **rgy3**. On Windows, use the **Registry** tab of the ClearCase program in Control Panel. Enter **rgy3** in the **Backup registry host** box. Click **OK** or **Apply**.
4. **Restart ClearCase**.

27.5 Renaming a VOB or View Host

If you rename a host that holds the physical storage for one or more VOBs or views, the existing registry entries for those VOBs and views become invalid. Until you re-register those VOBs and views and replace their old tags, the VOBs and views will be inaccessible. From the registry perspective, the rename-host procedure is quite similar to the move-storage-directory procedures described in Chapter 12, *Moving VOBs* and Chapter 21, *Moving Views*.

1. **Make sure that the storage directories are not being used.** If the host is home to one or more VOBs, make sure that all clients unmount those VOBs (**cleartool umount**). If the host is home to one or more views, terminate all processes using the views.
2. **Shut down ClearCase on the host.**
3. **Rename the host.** Make the change using the vendor-supplied procedure or tool. In most cases, this involves a restart of the operating system, which also restarts ClearCase processing. In any event, make sure that ClearCase processing is restarted on the host.

   NOTE: If the host is a license or registry server host, you must reconfigure the host's clients to know its new name.

4. **Create new registry entries for each VOB and view on the host.** Use **register –replace** to update object registry entries, use **mktag –replace** to update tag entries, and use **mkstgloc** to update server storage locations.

5. **Update view information in VOBs as needed.** If any dynamic views have their storage directories on the host, you must update the information that each VOB keeps about dynamic view storage directory locations. To do this, use each dynamic view on the renamed host to check out a single element from each VOB that the view has ever accessed. You can cancel the checkout (**uncheckout**) immediately if you want.

Administering Scheduled Jobs

28 Managing Scheduled Jobs

The ClearCase job scheduling service runs programs periodically. Using the scheduler, you can define jobs to be run one or more times at specified intervals or in specified sequences. The scheduler also provides the following features:

- E-mail notifications of job-related events
- Remote administration using the ClearCase Administration Console
- An access control list (ACL) that controls access to the schedule and to the ACL itself
- A predefined set of jobs for managing disk space used by VOBs and views

The scheduler runs on any host where the **albd_server** is installed.

28.1 Tasks and Jobs

The scheduler manages ClearCase jobs and arranges to run them at specified times. A job consists of an executable program, or task, that the scheduler runs one or more times with a given set of arguments. A task is a program that is available for scheduling. A job is a combination of a task with a schedule that specifies when and under what conditions the task actually runs. For a job to run, two conditions must exist:

- The task must be defined for the scheduler.
- A job that runs the task must be defined and given a schedule (and possibly other attributes).

This section discusses how ClearCase distinguishes and initializes tasks and jobs. For information on creating, editing, and deleting tasks and jobs, see *Managing Tasks* on page 445 and *Managing Jobs* on page 447.

Task and Job Storage

The scheduler relies on two data repositories:

- A database of tasks available for scheduling
- A database of jobs, or scheduled tasks

The database and the jobs, along with various other ClearCase administrative tools, are installed under the directory represented here as *ccase-var-dir*. On UNIX, this directory is **/var/adm/atria**. On Windows, the file is in *ccase-home-dir***var**.

A task must be defined in the task database before you can schedule it. The task database is a single text file *ccase-var-dir***scheduler\tasks\task_registry**. You can add task definitions to the task database by editing this file in a text editor. You must not change the definitions of standard ClearCase tasks, but you may add your own task definitions at the end of the file. For more information, see *Managing Tasks* on page 445.

Standard ClearCase tasks reside in the directory *ccase-home-dir***config\scheduler\tasks**. You cannot edit these tasks. Tasks that you define can reside anywhere in the file system, but the recommended location is the directory *ccase-var-dir***scheduler\tasks.** This directory initially contains two task placeholder scripts that run on a regular basis but by default do nothing. To change this default:

- Edit **ccase_local_day.[sh | bat]** to add any user-defined operations to be run daily.
- Edit **ccase_local_wk.[sh | bat]** to add user-defined tasks to be run weekly.

The database of jobs is a binary file (*ccase-var-dir***scheduler\db)** that you can read and edit only by using the Scheduled Jobs node of the ClearCase Administration Console or the **cleartool schedule** command. For more information, see *Managing Jobs* on page 447.

Task and Job Database Initialization

ClearCase installs a template for an initial task database, containing definitions for standard tasks, as the file *ccase-home-dir***config\scheduler\tasks\templates\task_registry**. The **albd_server** uses this template to create the first version of the actual task database, *ccase-var-dir***scheduler\tasks\task_registry**.

ClearCase installs templates for two customized tasks, **ccase_local_day.bat** and **ccase_local_wk.bat**, in the directory *ccase-home-dir***config\scheduler\tasks\templates**. The **albd_server** uses these templates to create initial versions of these tasks in the directory *ccase-var-dir***scheduler\tasks**.

ClearCase installs an initial set of job definitions as the text file *ccase-home-dir***config\scheduler\initial_schedule**. These job definitions rely on task definitions in the task registry template. The **albd_server** uses these job definitions to create the first version of the job database, *ccase-var-dir***scheduler\db**.

NOTE: Do not edit or delete any files in the directory tree whose root is *ccase-home-dir***config\scheduler**.

Job Execution Environment

Each task runs in a separate process started by the **albd_server**. A task has the following execution environment:

- The task runs with the identity of the **albd_server** (**root** on UNIX and usually the **clearcase_albd** account on Windows).
- The standard input stream is set to an empty file.
- Standard output and error messages are redirected to a file and captured by the scheduler as part of the job's last completion information.
- The current directory is undefined.
- Environment variables are those in effect for the **albd_server** identity on Windows and for **root** on UNIX. In addition, on Windows, **ATRIAHOME** is set to *ccase-home-dir*.

28.2 The Default Schedule

Rational ClearCase has a set of standard jobs, most of which manage disk space in VOB and view storage directories. Some of these jobs run daily. Others run weekly.

Daily jobs:

- Scrub cleartext and derived object storage pools of all local VOBs, using **scrubber**.
- Copy the VOB database for all local VOBs that are configured for snapshots, using **vob_snapshot**.
- Copy the ClearCase registry from the primary registry server host (when run on a backup registry server host), using **rgy_backup**.
- Run user-defined daily operations in **ccase_local_day.[sh | bat]**.
- Generate and cache data on disk space used by all local views, using **space**.
- Generate and cache data on disk space used by all local VOBs, using **space**.

Weekly jobs:

- Scrub some ClearCase logs.
- Scrub the databases of all local VOBs, using **vob_scrubber**.
- Run user-defined weekly operations in **ccase_local_wk.[sh | bat].**
- Generate and cache data on disk space used by derived objects in all local VOBs, using **dospace**.

For information about how these jobs operate, see the reference page for the command or utility that the job uses. For information on managing VOB storage, see Chapter 11, *Administering VOB Storage*. For more information on managing view storage, see Chapter 20, *Administering View Storage*.

The default schedule also includes jobs to automate the synchronization of MultiSite replicas. These jobs are designed to run daily but are disabled by default, whether or not MultiSite is installed. For more information on these jobs and how to enable them for use with MultiSite, see the *Administrator's Guide* for Rational ClearCase MultiSite

28.3 Managing Tasks

A task has two components:

- A program (job) to be executed when the task runs
- A definition for the task in the scheduler's task database

ClearCase has a set of standard executable tasks and standard definitions for these tasks in the task database. You cannot create, change, or delete any standard ClearCase tasks or task definitions. You can, however, define new tasks in the task database. You can also customize two predefined ClearCase tasks, one of which is run daily and the other weekly in the default schedule. You can add your own procedures to these tasks and can change their schedules.

To view all task definitions in the task registry, use the following command:

cleartool schedule –get –tasks

Creating a Task

To create a new task:

1. Create an executable program suitable to be run in the scheduler's execution environment (see *Job Execution Environment* on page 443). You can place the program anywhere in the file system, but the recommended location is the directory *ccase-var-dir***scheduler\tasks**.
2. If you want the program to run daily, you can run it from the existing task **ccase_local_day.[sh | bat]**. If you want the program to run weekly, you can run it from the existing task **ccase_local_wk.[sh | bat]**. Both tasks are in the directory *ccase-var-dir***scheduler\tasks.** If you add your program to one of these customizable tasks, you need take no further action.
3. If you prefer to run your program as a new task, you must add the task to the scheduler's task registry, *ccase-var-dir***/scheduler/tasks/task_registry**. To add a task to this file, use a text editor.

   Tasks are defined using a job-definition syntax documented on the reference page for the **schedule** command. The essential components of a task definition are the following:

   - A unique numeric ID used by a scheduled job to refer to the task

- A unique name for the task
- The pathname to the executable program

WARNING: Place new task definitions at the end of the task registry file. Do not alter or delete any of the standard ClearCase tasks defined in that file.

4. If you have added a task to the scheduler's task registry, you must create a new job to run the task. See *Creating a Job* on page 447. You do not need to create a new job if you have added your program to an existing scheduled job such as **ccase_local_day.[sh | bat].**

Editing a Task

You may need to edit an existing task definition in the scheduler's task registry. For example, if you move the task's executable program to another directory, you must change the pathname in the task definition in the task registry.

WARNING: Edit only tasks that have been added at your site. Do not alter or delete any of the standard ClearCase tasks defined in the task registry.

To change a task definition, use a text editor to edit the task registry file, *ccase-var-dir***\scheduler\tasks\task_registry**. When you edit a task, you must use the task-definition syntax documented on the reference page for the **schedule** command.

CAUTION: The scheduler uses a task definition's numeric ID to refer to the task when it runs a scheduled job that uses that task. If you change a task's numeric ID, you must change all references to the task in all scheduled jobs. See *Editing Job Properties* on page 450.

Deleting a Task

Before you delete a task definition, you must remove all references to the task in all scheduled jobs. See *Editing Job Properties* on page 450. To delete a task definition, use a text editor to edit the task registry file *ccase-var-dir***\scheduler\tasks\task_registry**.

WARNING: Delete only tasks that have been added at your site. Do not alter or delete any of the standard ClearCase tasks defined in the task registry.

28.4 Managing Jobs

You can create, delete, or edit jobs run by the ClearCase scheduler. You can also run a scheduled job immediately. To manage a scheduled job on any Windows or UNIX host, use the ClearCase Administration Console. The Host snap-in on the console has a Scheduled Jobs node from which you can manage jobs on any Windows or UNIX host accessible to the console. If the schedule ACL supports write access (see *Managing the Scheduler Access Control List* on page 452), you can also use the **cleartool schedule** command on the host where the job scheduler is running.

To create, edit, delete, or run a scheduled job, you must have **Change** or **Full** access in the scheduler ACL. To view scheduled jobs, you must have **Read** access in the scheduler ACL. See *Managing the Scheduler Access Control List* on page 452.

Creating a Job

When you create a job, you supply the following information:

- A name and an optional description for the job.
- The task that the job runs. The task must already be defined in the task registry. For more information see *Managing Tasks* on page 445.
- Any arguments that the scheduler passes to the task when the task runs. For a standard ClearCase task that operates on VOBs or views, you can specify that the task operates on particular VOBs or views, or on all VOBs or views on the local host.
- The schedule on which the job runs. See *Specifying a Job's Schedule* on page 448.
- Job-related events that trigger e-mail notifications and recipients for the notifications. See *Specifying Job Notifications* on page 449.
- Whether the scheduler deletes the job after it runs.

To create a new job using the ClearCase Administration Console:

1. In ClearCase Administration Console, navigate to the Scheduled Jobs node for the host on which you want the new job to run.
2. Click **Action** > **New** > **Job**. This command opens a dialog box in which you supply the information needed to define a new job.

To create a new job using the command line, use the following command:

cleartool schedule –edit –schedule

This command opens in a text editor a file that contains definitions for all currently scheduled jobs. To create a new job, add a definition using the job-definition syntax documented on the reference page for the **schedule** command. You cannot specify any read-only job properties, such as **LastCompletionInfo**. The job runs in the environment described in *Job Execution Environment* on page 443.

Specifying a Job's Schedule

You can arrange for a job to run under two kinds of schedules:

- **Sequential**. The job runs immediately after another job finishes.
- **Periodic**. The job runs on specified days at specified times.

To specify a sequential job, you designate a scheduled job after which the current job is to run. To specify a periodic job, you designate the times when the job is to run. A periodic job can run at four kinds of intervals:

- **Run once**. Specify the date and time at which the job runs once only. A job runs only one time when you specify identical start and end dates. You can also use the Scheduled Jobs node on the ClearCase Administration Console to force immediate one-time execution of any scheduled job.
- **Run daily or every *n* days**. Specify the frequency of the job and the time of day the job starts.
- **Run weekly or every *n* weeks**. Specify the frequency of the job, the days of the week it runs, and the time of day the job starts.
- **Run monthly or every *n* months**. Specify the frequency of the job, the day of the month it runs, and the time of day the job starts.

For daily, weekly, and monthly schedules, you can also specify starting and ending dates for the job, and you can set the job to repeat at intervals during the day.

To specify the schedule for a job, use the ClearCase Administration Console:

1. Navigate to the Scheduled Jobs node of the host on which you want to specify a job's schedule.

2. To specify the schedule for a new job, click **Action** > **New** > **Job**. This command opens a dialog box in which you supply the information needed to define a new job. After you specify the task, click the **Schedule** tab to specify the schedule.

3. To specify the schedule for an existing job, select a job in the detail pane and click **Action** > **Properties**. This command opens a dialog box. Click the **Schedule** tab to specify the schedule.

Or run the following command:

cleartool schedule –edit –schedule

This command opens in a text editor a file that contains the definitions for all currently scheduled jobs. To specify the schedule for a new or existing job, edit the job's **Schedule** property using the job-definition syntax documented on the reference page for the **schedule** command.

Specifying Job Notifications

The scheduler can send e-mail notifications to recipients you specify. You can also determine particular events that trigger notifications, such as the start of a job or the end of a job that fails.

NOTE: Job notifications require the scheduler to contact an SMTP mail server. On Windows, you must specify the name of this server on the **Options** tab of the ClearCase program in Control Panel on each host where the scheduler runs. On UNIX, the scheduler uses the **/bin/mail** program to send notifications.

To specify the notification information for a job, use the ClearCase Administration Console:

1. Navigate to the Scheduled Jobs node for the host on which you want to specify a job's notification information.

2. To specify the notification information for a new job, click **Action** > **New** > **Job**. In the dialog box, supply the information needed to define a new job. After you specify the task, click the **Settings** tab to specify notification events and recipients.

3. To specify the notification information for an existing job, select a job in the detail pane and click **Action** > **Properties**. In the dialog box, click the **Settings** tab to specify notification events and recipients.

Or use the following command:

cleartool schedule –edit –schedule

This command opens in a text editor a file that contains definitions for all currently scheduled jobs. To specify the notification information for a new or existing job, edit the job's **NotifyInfo** property using the job-definition syntax documented on the reference page for the **schedule** command.

Viewing Job Properties

To view properties of a scheduled job, use the ClearCase Administration Console:

1. Navigate to the Scheduled Jobs node for the host on which you want to view job properties.
2. Select a job in the detail pane and click **Action** > **Properties**. In the dialog box, you can view properties of the job.
3. To view messages and information such as time and status from the last execution of the job, select the job in the detail pane and click **Action** > **Show Completion Details**.

Or use the following commands:

cleartool schedule –get –schedule

To view the definition of a particular job, use the following command:

cleartool schedule –get –job *job-id-or-name*

To view messages and information such as time and status from the last execution of the job, use the following command:

cleartool schedule –status *job-id-or-name*

These commands display properties of jobs using the job-definition syntax documented on the reference page for the **schedule** command.

Editing Job Properties

To edit an existing job, use the ClearCase Administration Console:

1. Navigate to the Scheduled Jobs node for the host on which you want to edit a job.
2. Select a job in the detail pane and click **Action** > **Properties**. This command opens a dialog box in which you can edit properties of the job. You cannot edit any read-only job properties.

Or use the following command:

cleartool schedule –edit –schedule

This command opens in a text editor a file that contains definitions for all currently scheduled jobs. Edit the properties of the job using the job-definition syntax documented on the reference page for the **schedule** command. You cannot edit any read-only job properties, such as **LastCompletionInfo**.

If you have a text file of job definitions that uses the scheduler's job-definition syntax, you can replace the entire schedule with the job definitions in your file by running the following command, where *defn_file_pname* represents your file of job definitions:

cleartool schedule –set –schedule *defn_file_pname*

Running a Job Immediately

To run a scheduled job immediately, use the ClearCase Administration Console:

1. Navigate to the Scheduled Jobs node for the host on which you want to run a job.
2. Select the job in the detail pane and click **Action** > **Run Now**.

Or use the following command:

cleartool schedule –run *job-id-or-name*

The job runs in the scheduler's execution environment. See *Job Execution Environment* on page 443.

Deleting a Job

To delete a scheduled job, use the ClearCase Administration Console:

1. Navigate to the Scheduled Jobs node for the host on which you want to delete a job.

2. Select a job in the detail pane and click **Action** > **Delete Job**.

Or use the following command:

cleartool schedule –delete *job-id-or-name*

28.5 Managing the Scheduler Access Control List

The scheduler maintains a single access control list that determines who is allowed access to the scheduler and to the ACL itself.

The ACL consists of a list of entries. Each entry assigns an *access type* to an *identity*. Four types of identity exist: **Everyone**, **Domain**, **Group**, and **User**. A domain is a Windows domain for hosts running Windows and an NIS domain for hosts running UNIX. Each group and user is qualified by a domain name. In a Windows domain, a group must be a global group, and a user must be a domain account.

NOTE: UNIX hosts that are not part of an NIS domain can use the string **<unknown>** in place of the domain name in an ACL entry.

Each identity has one of three access types. Table 9 shows the access types and their implications for access to the schedule and access to the ACL itself.

Table 9 Access Types in Scheduler ACL Entries

Access Type	Access to Schedule	Access to ACL
Read	Read only	Read only
Change	Read and write; can start jobs	Read only
Full	Read and write; can start jobs	Read and write

Each identity can have only one access type. However, access rights are inherited from **Everyone** to **Domain** to **Group** to **User** in such a way that each user has the least restrictive of all these access rights that apply to that user. For example, if a user's ACL entry specifies **Read** access but the ACL entry for the user's group specifies **Change** access, the user has **Change** access.

By default, everyone has **Read** access. On a local Windows host (the host where the scheduler is running), a member of the ClearCase administrators group always has **Full** access. On a local UNIX host, the **root** user always has **Full** access. On a remote host, access rights of a member of the ClearCase administrators group or the **root** user are determined by the ACL. Thus, to change the default ACL, you must be logged on to the host where the scheduler is running, and you must be the privileged user.

To view or edit the scheduler's ACL, use the ClearCase Administration Console:

1. Navigate to the Scheduled Jobs node for the host on which you want to view or edit the scheduler's ACL.
2. Click **Action** > **All Tasks** > **Edit Permissions**. This command opens a dialog box in which you can view or edit the scheduler's ACL.

Or use the following command to view the ACL:

cleartool schedule –get –acl

Use the following command to edit the ACL:

cleartool schedule –edit –acl

This command opens in a text editor a file containing a representation of the current ACL. You can edit the ACL using the ACL-definition syntax documented on the reference page for the **schedule** command.

If you have a text file containing ACL entries using the scheduler's ACL-definition syntax, you can use the following command to replace the entire ACL with the ACL entries in your file:

cleartool schedule –set –acl *defn_file_pname*

Administering Web Servers

29 Configuring a Web Server for the ClearCase Web Interface

This chapter explains how to configure a ClearCase Web server and to enable use of the ClearCase Web interface.

29.1 Configuration Planning

Configuring a Web server to run the ClearCase Web interface includes both ClearCase administration and Web administration tasks. In many cases, especially when setting up the interface for Internet access, the two types of tasks are not handled by the same person. As an aid to planning the configuration, this chapter includes lines for recording information that may need to be shared between the ClearCase administrator and the Web administrator. We recommend that you record information on the lines provided and share it as appropriate.

Web Administration Considerations

This section discusses decisions that a Web administrator must make before beginning configuration. It assumes that the Web administrator has experience setting up corporate Web servers and is familiar with such things as security issues.

- Running the ClearCase Web interface requires that ClearCase be installed on a system running a Web server. Supported Web servers are Apache, Microsoft Internet Information Server (IIS), and iPlanet. If a ClearCase view server is run on the same computer (not required but preferable), the server needs enough free disk space to load ClearCase plus

approximately 0.5 to 1.0 MB for each user who will use the Web interface through the server. Because a large site may have many systems operating as multiple Web servers, first choose a server on which to install ClearCase.

Server Name: _____

Server Type (UNIX or Windows) _____

The Server Name can be either a system name (for example, within an intranet) or a domain name (for an Internet server).

Approximate disk space required _____

- In a number of places, the installation requires a pathname beginning with the base URL for the interface. The base URL (referred to as *ccbase-url* in the instructions) can be any arbitrary string, for example, **ccaseweb** or **ccweb**. Select a base URL name.

  ClearCase Base URL: _____

  The full URL for the Web interface:

  http://*server-name***/***ccbase-url***/bin/ccweb** (UNIX computers)
  http://*server-name***/***ccbase-url***/bin/ccweb.exe** (Windows computers)

- If the Web server on the system to be configured is an iPlanet server, the configuration requires the name of the iPlanet administration server. The URL for the iPlanet administration server is identified during installation of the iPlanet server.

  iPlanet Administration Server _____

- If there are security concerns, you may want to provide a secure port through which to access ClearCase. The ClearCase Web interface can run through either a secure port using the Secure Socket Layer (SSL) or through a standard HTTP port. If the server is on a secure port, the URL begins with **https** rather than **http**.

ClearCase Considerations

This section discusses issues for consideration by the site's ClearCase administrator.

- In addition to the ClearCase base URL, configuration requires the location of the ClearCase installation directory. This is typically **C:\Program Files\Rational\ClearCase** on Windows

computers and **/usr/atria** on UNIX computers. This location is denoted by *ccase-home-dir* in the configuration instructions.

ClearCase installation directory:_____

- ClearCase requires only a snapshot view client configuration (no MVFS is needed) on the Web server. For best performance, allow view servers to run on the Web server. If you choose to run the view server on another host, the view must use a storage location registered in the ClearCase registry.

- The Web interface creates snapshot view directories for client users on the server only if view servers are allowed to run on the Web server.

  Although the snapshot view directories on the ClearCase server are typically empty (no files loaded), they are used for temporary storage of files that are checked out or that are to be created as elements. Therefore, they must be on a disk volume that has enough space for the number of users to be supported. Depending on how many files a typical user will have checked out at once, or how many new elements are to be created at once, allow for at least 0.5 MB to 1 MB of disk space for each user.

  By default, the Web interface creates those directories under what is known as the "host data" area for ClearCase. On UNIX systems, this is typically **/var/adm/atria**. On Windows systems, it is the **var** subdirectory under the ClearCase installation directory. A **ccweb** subdirectory is created in the host-data directory at ClearCase installation time, and all snapshot view directories are stored under that **ccweb** directory. (If ClearCase is installed in a pathname that contains spaces, such as **C:\Program Files**, the **ccweb** directory is created in the root of the drive on which ClearCase is installed.)

  However, if the default directory is not appropriate, you can select a different area by modifying the **ccweb.conf** file in *ccase-home-dir***/config/ccweb**. Add the line

  `-view_storage` *pathname*

  to **ccweb.conf**, where *pathname* is the directory in which you want snapshot view directories used by the Web interface to be created. This pathname must be local to the Web server host.

  NOTE: Even though the Web interface may create a separate **ccweb** directory for view storage, it continues to keep administrative information in a **ccweb** subdirectory under the ClearCase installation directory (for example, **C:\Program Files\Rational\ClearCase\var\ccweb**).

- You may want to limit the size of files that can be uploaded to the Web server, to reduce the likelihood of denial of service attacks. If an extremely large file is uploaded and the Web server disk is filled, operation of the server computer may be disrupted, (depending on which disk it is).

To limit the size of uploaded files, modify the following line in the **ccweb.conf** file:

`-upload_limit` *size*

where *size* is the approximate desired size limit in bytes. An attempt to upload a file that is too large results in an error message in the **Client Upload** output window.

- We recommend that you specify the primary group for all users who access ClearCase using this Web server by modifying the following line in the **ccweb.conf** file:

  `-primary_group` *group-name*

  where *group-name* is the name of the ClearCase users group. See *Setting the ClearCase Primary Group* on page 52 for more information on this topic.

- You can configure the session timeout interval, which controls how long a user login remains valid. The default value is 14400 seconds (four hours). You can change this default by modifying the line

  `-session_timeout` *seconds*

  in the **ccweb.conf** file, where *seconds* is an integer number of seconds between 600 (10 minutes) and 2147483647 (about 68 days). Values lower than 600 will be interpreted as 600.

- You can designate a directory where the ClearCase Web interface will store temporary files by adding a line of the form

  `-tmpdir` *directory-name*

  to the **ccweb.conf** file, where *directory-name* is a directory on the Web server host. If this line is not present in the **ccweb.conf** file, the ClearCase Web interface uses the value of the TMP or TEMP environment variables, if they exist. The ClearCase Web interface must be able to create and delete files in this directory regardless of the files' ownership or permissions.

- If users from multiple domains will access ClearCase using this Web server, you must enable domain mapping as described in *Using Proxy Groups and Domain Mapping in Windows NT Domains* on page 55. If you enable domain mapping, you must also specify the primary group of each user of the ClearCase Web interface by setting the **primary_group** in **ccweb.conf**.

  NOTE: When the Web server runs on a Windows computer, ClearCase Web interface users must be given permission to **Log On Locally** to the Web server host. Windows NT Server and Windows 2000 Server do not grant this permission by default. (Microsoft Internet Information Server can be configured in a way that does not require users to have this

permission. See *Microsoft Internet Information Server (IIS)* on page 462 for more information on this topic.)

Browser Considerations

Because Windows 2000 and Windows XP require special privileges to download components through Internet Explorer, users accessing the ClearCase Web interface on one of these platforms must be members of the Power Users or local Administrators groups to download the Web interface applets. After the applets have been downloaded (the first time the Web interface is used), these privileges are no longer required, although new releases of ClearCase and ClearCase patches may change the applets, which will require them to be downloaded again.

29.2 Configuring the Web Server

Each of the supported Web servers has a different configuration mechanism.

Note that a Windows Web server must run as a service and must be configured to log on as the **System** account. This is the default for the Microsoft and iPlanet Web servers; the instructions below for configuring an Apache Web server include this setup. If you start a Windows Web server as a console application, rather than as a service, it is not likely to have the rights required to perform logons for client users.

Apache

Configure the Apache server by editing the **httpd.conf** text file in the **conf** subdirectory of the Apache installation area. Add the following two lines to the file, substituting appropriate values for *ccase-home-dir* and *ccbase-url*.

```
ScriptAlias /ccbase-url/bin/ "ccase-home-dir/web/bin/"
Alias /ccbase-url/ "ccase-home-dir/web/"
```

Note that:

- On Windows as well as UNIX, all pathname component separators must be slashes (/); Apache on Windows does not recognize backslashes (\).

➤ The **ScriptAlias** directive must precede the **Alias** directive.

For example, on a Windows system where *ccase-home-dir* is **C:\Program Files\Rational\ClearCase** and *ccbase-url* is **ccase**, add these lines to **httpd.conf**:

```
ScriptAlias /ccase/bin/ "C:/Program Files/Rational/ClearCase/web/bin/"
Alias /ccase/ "C:/Program Files/Rational/ClearCase/web/"
```

For a ClearCase host running UNIX where *ccase-home-dir* is **/usr/atria** and *ccbase-url* is **ccaseweb**, add these two lines to **httpd.conf**:

```
ScriptAlias /ccaseweb/bin/ "/usr/atria/web/bin/"
Alias /ccaseweb/ "/usr/atria/web/"
```

For a ClearCase host running Windows, configure the Apache Web server as a Windows service. To do so, execute the **Install Apache as Service** entry in the Apache folder which was added to the **Start** menu during installation. (Newer versions of the Apache Web server provide an install-time option to install the Web server as a service.)

Restart the Apache server if it is running. (Note that only Apache servers require restarting.)

Microsoft Internet Information Server (IIS)

Configure IIS by running the Internet Service Manager; you must be logged on using the same account that you use to perform standard Web administrative operations. There is both a Microsoft Management Console version and an HTML version of the interface. These instructions apply to the MMC version. The tasks are the same in the HTML version, but the navigation is somewhat different.

NOTE: Configuration options are slightly different for IIS4 (supported on Windows NT) and IIS5 (supported on Windows 2000 and Windows XP).

Configuration Steps for IIS4

To configure the ClearCase Web Interface in IIS4:

1. Start the Internet Service Manager.
2. From the list presented, select the Web site in which you want to place the ClearCase interface.

3. Click the **Action** button in the toolbar, and then click **New** > **Virtual Directory**. The New Virtual Directory Wizard starts.

4. In the New Virtual Directory Wizard, enter the value of *ccbase-url* (for example, **ccase**), and click **Next**.

5. Enter the pathname of the *ccase-home-dir***web** directory (for example, **C:\Program Files\Rational\ClearCase\web**). To find the directory, click **Browse**; then click **Next**.

6. Make sure that the **Allow Read Access** and **Allow Execute Access** check boxes are selected, and that **Allow Write Access** and **Allow Directory Browsing** are cleared. (It doesn't matter whether **Allow Script Access** is selected.) Click **Finish**.

7. The new virtual directory appears as a folder under the chosen Web site. Right-click the folder and select **Properties** from the shortcut menu. On the **Virtual Directory** page, under **Content Control**, make sure that the **Directory browsing allowed** and **Index this directory** check boxes are cleared.

8. Click the **Directory Security** tab, and then click **Edit**. In the **Authentication Methods** dialog box, clear **Allow Anonymous Access** and select **Basic Authentication**.

   Basic authentication requires client users to supply a user name and password to access the Web site. Windows **Challenge/Response** authentication allows Internet Explorer clients, if they are running on Windows and logged on to a domain, to access the Web site as the client user without having to specify a user name and password. Access to other network resources from the Web server is not allowed. **Basic** authentication must always be enabled, so it can be used when needed. To simplify access for Internet Explorer users who are logged into a domain, you can also enable Windows **Challenge/Response** authentication when either of the following conditions is true:

   - All VOBs accessed through the Web interface reside on the Web server.
   - All VOBs accessed through the Web reside on UNIX servers, and CCFS access is enabled.

   NFS access to UNIX VOBs is not supported, because there is no way to establish the credentials of the Web client user with the NFS server. CCFS must be used to access UNIX VOBs through a Windows Web server.

   NOTE: ClearCase Web interface users do not need permission to **Log On Locally** to the Web server host if Windows **Challenge/Response** authentication is used.

9. Click OK to close the **Authentication Methods** dialog box. Then click **OK** to close the **Properties** sheet.

IIS4 is now configured for ClearCase Web access.

Configuration Steps for IIS5

To configure the ClearCase Web Interface in IIS5:

1. Start the Internet Service Manager.
2. From the list presented, select the Web site in which you want to place the ClearCase interface.
3. Click the **Action** button in the toolbar, and then click **New** > **Virtual Directory**. The New Virtual Directory Creation Wizard starts.
4. In the New Virtual Directory Creation Wizard, enter the value of *ccbase-url* (for example, **ccase**), and click **Next**.
5. Enter the pathname of the *ccase-home-dir***web** directory (for example, **C:\Program Files\Rational\ClearCase\web**). To find the directory, click **Browse**; then click **Next**.
6. Make sure that the **Read** and **Execute** check boxes are selected and the **Write** and **Browse** check boxes are cleared. (It doesn't matter whether **Run Scripts** is selected.) Click **Next** to get to the confirmation page, then click **Finish**.
7. The new virtual directory appears as a folder under the chosen Web site. Right-click the folder and select **Properties** from the shortcut menu. On the **Virtual Directory** page, make sure that the **Directory browsing** and **Index this resource** check boxes are cleared.
8. Click the **Directory Security** tab, and then click the **Edit** button in the **Anonymous access and authentication control** group. In the **Authentication Methods** dialog box, clear **Allow Anonymous Access** and select **Basic Authentication**.

   Basic authentication requires client users to supply a user name and password to access the Web site. **Integrated Windows authentication** allows Internet Explorer clients, if they are running on Windows and logged on to a domain, to access the Web site as the client user without having to specify a user name and password. Access to other network resources from the Web server is not allowed. **Basic** authentication must be enabled, so it can be used when needed. To simplify access for Internet Explorer users who are logged in to a domain, you can also enable **Integrated Windows authentication** when either of the following conditions is true:

   - All VOBs accessed through the Web interface reside on the Web server.

➢ All VOBs accessed through the Web reside on UNIX servers, and CCFS access is enabled.

NFS access to UNIX VOBs is not supported, because there is no way to establish the credentials of the Web client user with the NFS server. CCFS must be used to access UNIX VOBs through a Windows Web server.

NOTE: ClearCase Web interface users do not need permission to **Log On Locally** to the Web server host if **Integrated Windows authentication** is used. ClearCase does not support use of the Kerberos-based version of **Integrated Windows authentication**

9. Click **OK** to close the **Authentication Methods** dialog box. Then click **OK** to close the **Properties** sheet.

IIS5 is now configured for ClearCase Web access.

iPlanet Enterprise Server

Configure the iPlanet Web server by connecting to the iPlanet administration server. The procedure is the same for both Windows and UNIX. Connect to the URL for the administration server with a browser.

To configure the ClearCase Web Interface in iPlanet:

1. Select the server to configure from the drop-down list of servers, and then click the **Manage** button.
2. On the next page, click the **Class Manager** link in the upper right.
3. Click the **Programs** tab.
4. Make sure the **CGI Directory** option is selected.
5. In the **CGI Directory** form, enter the value of *ccbase-url*/**bin** as the URL prefix, and enter *ccase-home-dir*/**web/bin** as the CGI directory. For example, if *ccbase-url* is **ccase**, and *ccase-home-dir* is **/usr/atria**, enter **ccase/bin** as the URL prefix and enter **/usr/atria/web/bin** as the CGI directory.
6. Click **OK**, and then click **OK** in the confirmation dialog box.
7. In the row of tabs at the top of the page, click **Content Management**.
8. Click **Additional Document Directories** at the left of the page.

9. Enter the value of *ccbase-url* in the URL prefix box, and enter *ccase-home-dir*/**web** in the **Map To Directory** box.

10. Click **OK**, and then click **OK** in the confirmation dialog box.

11. Click the **Apply** link at the upper right of the page, and then click the **Apply Changes** button the next page.

12. Click the **OK** button in the confirmation dialog box.

The iPlanet server is now configured for ClearCase Web access.

Configuring Integrations with Microsoft Web Authoring Tools

30

This chapter explains how to configure an IIS Web server and enable use of the ClearCase integrations with Microsoft Web authoring tools.

30.1 Overview of the Integration

On Windows platforms, Rational ClearCase includes integrations with these Microsoft products:

- FrontPage 98
- FrontPage 2000
- Visual InterDev 6.0
- Office 2000 Web Folders functionality for Word, Excel, PowerPoint
- Internet Explorer 5.0 Web Folders

These integrations provide ClearCase configuration management capability for Web content and Web applications created using these tools. There are two installations, one on the server and one on the client.

The client is a Windows computer that runs a supported Web authoring application. Clients open Webs on the server using a URL and perform checkouts and checkins to a shared view that resides on the server. There can be multiple servers in your ClearCase region. Each server is

associated with a single Web content VOB using the default IIS alias. Multiple servers can be configured to share the same Web content VOB.

Server Setup Overview

A summary of the server installation is as follows. Detailed instructions for each step are in *Server Set-Up Details* on page 383.

1. Install IIS 4.0 (from Windows NT 4.0 Option Pack) or IIS 5.0 (from Windows 2000). IIS 5.0 is installed by default on Windows 2000 Server. If IIS is already installed on Windows NT 4.0, verify that the version of IIS is 4.0. If the IIS version is 2.0 or 3.0, upgrade to 4.0 by installing Windows NT 4.0 Option Pack. To determine the IIS version number, check the value of registry key **HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\W3SVC\Parameters\MajorVersion**.

2. Install FrontPage Server Extensions (FPSE) version 3.0.2 (from Windows NT 4.0 Option Pack) or version 4.0.2 (from Office 2000 CD3, Office Server Extensions, or Windows 2000). The FPSE are installed by default when Option Pack on Windows NT 4.0 Server and Windows 2000 Server are installed. If FPSE were installed along with IIS, you do not need to reinstall them. If version 3 was installed by a previous Option Pack install, you can upgrade to Office Server Extensions.

3. Install ClearCase (client or server, server recommended, MVFS not required). This sets the value of the Windows registry key **HKEY_LOCAL_MACHINE\Software\Atria\ClearCase\CurrentVersion\ProductHome** to the directory in which you install the product.

4. Run the Web Authoring Integration Configuration Wizard and follow the instructions. To start the wizard, click **Start** > **Programs** > **Rational ClearCase Administration** > **Integrations** > **Web Authoring Integration Configuration.**

   Online help is available. Specify server mode always. Specify local mode only if you have or plan to install FrontPage 2000 on the Web server.

Client Setup Overview

A summary of the client installation follows. Refer to the detailed instructions for each step in *Client Setup Procedure*.

1. Install one or more supported authoring tools:

- FrontPage 98
- FrontPage 2000
- Visual InterDev 6.0
- Internet Explorer 5.0 (for Web Folder functionality in Windows Explorer)
- Office 2000 (for Save to Web Folder functionality in Word, Excel, PowerPoint)

2. Create and add Webs to source control using FrontPage 98, FrontPage 2000, or Visual InterDev 6.0.
3. Verify that the new Web content is added to source control.
4. Enable Author/Administrator privilege for users who need to deliver content using FrontPage 98, FrontPage 2000, or Visual InterDev 6.0.
5. Optionally, enable local mode support for FrontPage 2000 clients.

30.2 Server Setup Procedure

The supported server platforms and required software versions for the Web server are listed in Table 10.

Table 10 Supported Platforms for Web Servers

Operating System Platform	Web Server Software	FrontPage Server Extensions / Office Server Extensions
Windows NT 4.0	IIS 4.0	3.0.2.1105 (ships on FrontPage 98 CD)
Windows NT 4.0	IIS 4.0	3.0.2.1706 (ships on Windows NT 4.0 Option Pack CD)
Windows NT 4.0 or Windows 2000	IIS 4.0 or IIS 5.0	4.0.2.2717 (ships with Office 2000)
Windows 2000	IIS 5.0	4.0.2.3xxx (ships with Windows 2000)

Step 1: Install IIS

We recommend that IIS be the only Web server on the host and that the default port (80) be used. Check for other Web server software before proceeding to install IIS.

Note that if IIS version 2.0 or version 3.0 is installed, you must uninstall it before you install IIS version 4.0 from the Windows NT 4.0 Option Pack.

If you are using a Windows 2000 server and have taken all the defaults for the Windows 2000 server installation, IIS 5.0 and FrontPage 2000 Server Extensions are installed on your server. If you have not performed a default Windows 2000 server installation, use the Windows 2000 Control Panel to add the required components.

If you are using Windows NT 4.0 server, you need to install IIS 4.0 and either FrontPage Server Extensions or Office Server Extensions.

When installing IIS 4.0 from the Windows NT 4.0 Option Pack on Windows NT 4.0 or IIS 5.0 from the Windows 2000 Control Panel, the following components are required for the FrontPage/InterDev integrations. All other components are optional.

- Internet Information Server (when you select this component, you will also have to select a number of other components, like Windows NT Option Pack common files, on which this component depends)
- Internet Service Manager
- FrontPage Server Extensions (if you plan to install OSE later, installing FPSE at this time is optional)
- Windows Scripting Host

When you install IIS, a screen similar to Figure 37 appears. The default Web alias directory determines the VOB-tag of the Web content VOB that will be created in Step 4. (See *Step 4: Run the Web Authoring Integration Configuration Wizard* on page 472.) You need to choose the VOB-tag you want this Web server to access. By default, this is **\wwwroot** as shown in Figure 36. If this VOB-tag is already registered in this machine's ClearCase registry or if you want another name (for example, **wwwroot_<host>**, or a descriptive name, **\sales_Webs**) you must change the default now. The remainder of this pathname becomes a snapshot view root when the Web Authoring Integration Configuration Wizard is run, as shown in Figure 37.

Figure 37 Setting Up the Root Web in the IIS Installation

After IIS is installed, you may need to run Internet Service Manager to add IIS operators and enable Basic Authentication. If you use a local VOB and view on the Web server that you are setting up, you do not need to enable Basic Authentication.

If Office 2000 was installed on the Windows NT 4.0 server before IIS 4.0 was installed, the FPSE will not be installed on the Web server even though you chose to install FPSE from the Windows NT 4.0 Option Pack. In this case, we recommend that you install OSE after the Windows NT 4.0 Option Pack to upgrade to version 4.0 server extensions.

Step 2: Install FPSE or OSE

If FPSE were installed in *Step 1: Install IIS*, it is not necessary to reinstall. If version 3 FPSE were installed by a previous Option Pack install, you can upgrade to OSE, but it is not necessary.

If FPSE were not installed in *Step 1: Install IIS*, install FPSE version 3.0 (from NT Option Pack) or version 4.0 (from Office 2000 CD3, Office Server Extensions (OSE), or Windows 2000). The FPSE are installed when you install Windows NT 4.0 Option Pack on Windows NT 4.0 Server and Windows 2000 Server.

Step 3: Install ClearCase

Install ClearCase with the following installation configuration:

- Local servers only (**view_server**, **VOB_server**, and **albd_server**)
- No MVFS

The Web Authoring Integration Configuration Wizard installed with ClearCase requires configured storage locations to create a VOB. We recommend that you create the default storage locations on the server as a part of ClearCase installation. The storage locations configured by the ClearCase installation are in the form \\<*hostname*>**ccstg_**<*disk*>.

If you have selected the **Server** option for the ClearCase installation, **SvrStor.exe** runs on reboot after installing ClearCase to enable you to create storage locations. Alternatively, if you have selected the **Client** option for the ClearCase installation, you can create storage locations by running the **SvrStor.exe,** located in *ccase-home-dir***etc**. You can also use **cleartool mkstgloc** command with the **–view** or **–vob** options.

Step 4: Run the Web Authoring Integration Configuration Wizard

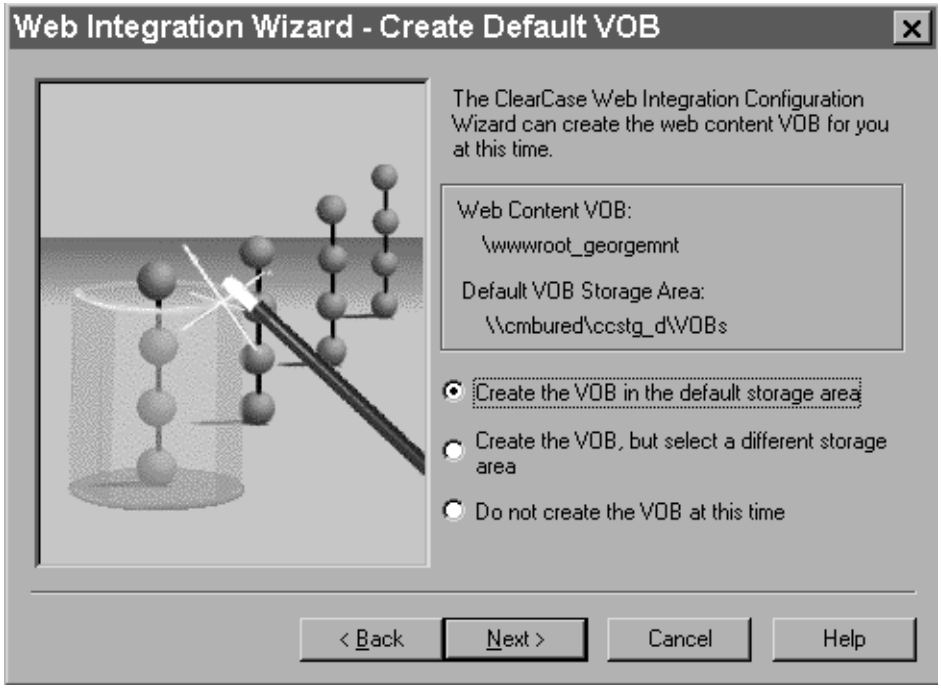
Run the Web Authoring Integration Configuration Wizard and follow the instructions. To start the wizard, click **Start** > **Programs** > **Rational ClearCase Administration** > **Integrations** > **Web Authoring Integration Configuration.**

Online help is available for each wizard screen. When running the wizard, always specify **Server Mode Configuration.** Specify **Local Mode Configuration only** if you plan to install FrontPage 2000 client on the Web server.

If you have previously installed SourceSafe on your Web server, the wizard displays a **Replace SourceSafe** screen. To use the integration, you must click **Yes**. Doing so does not disable any part of SourceSafe except for the SourceSafe COM API.

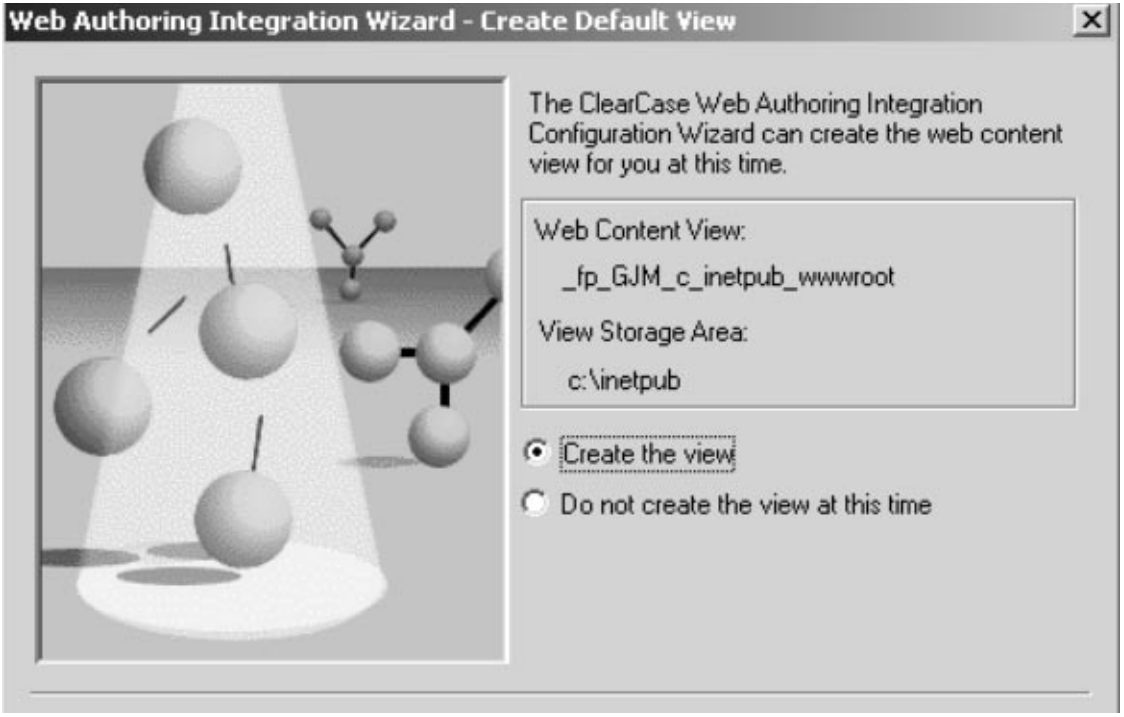
After the Web Authoring Integration Configuration Wizard checks the versions of IIS and server extensions on the Web server, you are prompted to create a content area VOB. You can accept the default VOB storage location, as in Figure 38, or use the wizard to select another VOB storage location.

Figure 38 Setting Up the VOB Storage for the Integration



The wizard then prompts you to create a content area view, as in Figure 39.

Figure 39 Setting Up the View Storage for the Integration



If you have not prepared storage locations for creation of the content VOB, you must create them and then rerun the wizard. We recommend that you put the VOB on the Web server, which improves performance and avoids the use of basic authentication.

If you decide to use an existing VOB (on UNIX or Windows NT) as the Web content VOB, it must be created and registered with the expected VOB-tag as described in *Step 1: Install IIS*. If this VOB is created before the wizard is run, the wizard shows the existing VOB-tag and skips the VOB creation step.

Any VOB accessed through the integration has the same trigger restrictions that ClearCase Web client access imposes, that is, interactive triggers fail.

The integration can only use views that are created either by the wizard or in FrontPage 2000 (with **ClearCase** > **Create Snapshot View**). The integration uses snapshot views that have a different hijacked-file detection mechanism than do standard snapshot views. This is necessary because FrontPage and InterDev rewrite files frequently. Attempts to use snapshot views created in any other way will fail. The integration does not support UCM-enabled snapshot views.

The Web Authoring Integration Configuration Wizard maintains a log file at *ccase-home-dir***var****log****webintegration_log**. You can review this log in the event of unexpected behavior or errors.

30.3 Client Setup Procedure

This section explains how to set up a ClearCase Web client on Windows.

Step 1: Install the Client Application

Install one or more of the supported client applications on your client computers:

- FrontPage 98
- FrontPage 2000
- Visual InterDev 6.0
- Internet Explorer 5.0
- Office 2000

Step 2: Add Web to Source Control

Using FrontPage 98, FrontPage 2000, or Visual InterDev 6.0, you can add a new Web to source control on the IIS server.

When you add a new Web to source control, the integration expects the Web to be a top-level Web, for example, **http://***<cc Web server>***/***<Web to be placed under source control>*.

From FrontPage 98

1. Create a new Web. Click **File** > **New** > **FrontPage Web** and complete the New FrontPage Web Wizard.

2. Add the new Web to source control by clicking **Tools** > **Web Settings**. In the **FrontPage Web Settings** dialog box, click the **Configuration** tab and complete the **Source Control Project** box, using the name of your new Web in Step #1.

   The Web name in the **Source Control Project** box must start with **$/**. For example, if you created a Web at **http://ccWebs/sales_collateral**, the **Source Control Project** name must be **$/sales_collateral**. The Web name may be different from the actual Web directory. You must use the Web directory as the **Source Control Project** name.

From FrontPage 2000

1. Install ClearCase on your client computer.
2. Run the Web Authoring Integration Configuration Wizard. Click **Start** > **Programs** > **Rational ClearCase Administration** > **Integrations** > **Web Authoring Integration Configuration**.

   From the Web Authoring Integration Configuration Wizard, select **Local Mode Configuration**.
3. In FrontPage 2000, create a new Web. Click **File** > **New** > **Web** and complete the **New** dialog box.
4. Click **ClearCase** > **Add Web to source control** to add the new Web to source control.

From Visual InterDev 6.0

To use Visual InterDev 6.0 with the ClearCase integration, you do not need to install ClearCase on the client computer. If ClearCase is installed on the client, the online help for the Visual InterDev integration is enabled.

1. Click **File** > **New Project** to create a new Web project.
2. Select the project from the Visual InterDev Project Explorer and click **Project** > **Source Control** > **Add to Source Control** to open the **Initial Solution Add** dialog box.
3. To open the **Enable Source Control** dialog box, click **Selection**.
4. In the **Source control project name** box, delete the **_Web** suffix from the default text. For example, if the Web project is named **stock_trading** the default text is **$/stock_trading_Web** and the correct project name is **$/stock_trading**.
5. Click **OK**. The project is now added to source control on the IIS server.

Step 3: Verify That New Web Content Is Added to Source Control

After you add a new Web to source control in FrontPage 98, FrontPage 2000, or Visual InterDev 6.0, look for the special source control icons that indicate successful completion. In FrontPage, these icons are green dots (Figure 40); in Visual InterDev, they are locks (Figure 41).

Figure 40 FrontPage Source Control Icons

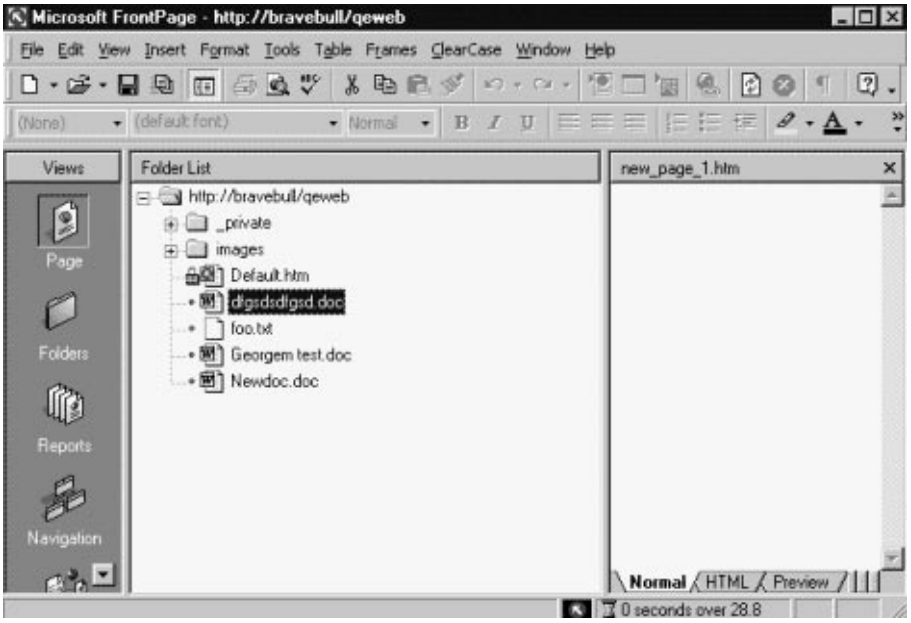
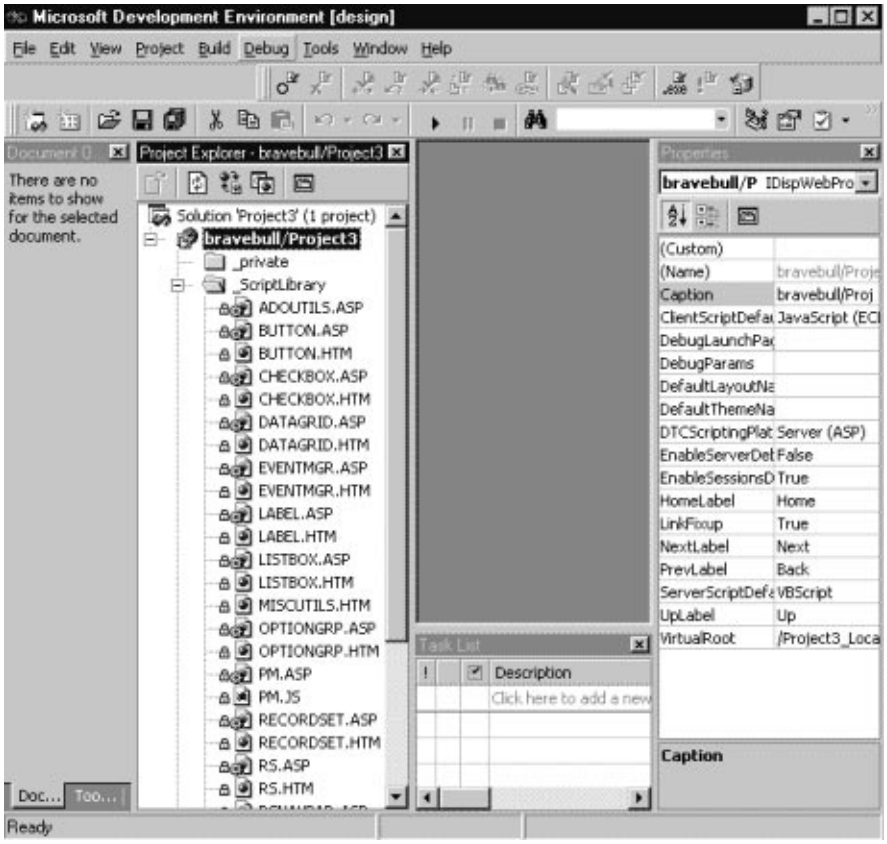


Figure 41 Visual InterDev Source Control Icons



If no source control icons appear in FrontPage or Visual InterDev, or if there are errors or other unexpected results during these procedures, the integration DLL maintains a log file at *ccase-home-dir***var\log\ssapi_log** that you can inspect to diagnose the error.

If you have existing content in flat files or on another Web server, you can also use the import features of FrontPage and Visual InterDev to pull additional content into your new Web and place it under source control.

Step 4: Setting User Permissions

FPSE maintain access control for Web authoring and administrative actions. To edit Web content, a user or group must have Author permission for the Web. Add all users and/or groups that need access to your Web content.

FrontPage 98

1. Click **File** > **Open FrontPage Web** to access the new Web.
2. Click **Tools** > **Permissions**. In the **Permissions** dialog box, click the **Users** tab or **Groups** tab to add user or group permissions.

FrontPage 2000

1. Click **File** > **Open Web** to access the new Web.
2. Click **Tools** > **Security** > **Permissions**. In the **Permissions** dialog box, click the **Users** tab or **Groups** tab to add user or group permissions.

Visual InterDev 6.0

1. Click **File** > **Open Project** to access the new Web.
2. Click **Project** > **Web Project** > **Web Permissions**. In the **Permissions** dialog box, click the **Users** tab or **Groups** tab to add user or group permissions.

In addition, ensure that you add any appropriate domain groups to the content VOB's group list. Values of **CLEARCASE_PRIMARY_GROUP** on client machines are not translated on the server end, so you need to add all groups at this time.

Every time an integration user opens a source control enabled Web, that user takes a ClearCase license.

Step 5: Local Mode Client Setup for FrontPage 2000

The integration supports two modes: server mode and local mode. Server mode operation is available on all the supported authoring tools. In server mode, the authoring tool runs locally, and all ClearCase operations run remotely on the ClearCase Web server. Webs are opened by accessing a URL. You do not need to install ClearCase on the client system, but doing so provides

the user with online help, as well as a limited ClearCase menu in FrontPage 2000 and a ClearCase toolbar in Visual InterDev.

Server mode operation provides access to a limited set of ClearCase features. When running in server mode, the interface to ClearCase resembles the interface between FrontPage or Visual InterDev and Microsoft Visual SourceSafe. All users share a single snapshot view on the Web server.

Local mode operation is supported only for FrontPage 2000; ClearCase must be installed on the same computer that is running FrontPage 2000. Local mode operation provides extra functionality, including a ClearCase menu that is available on the FrontPage 2000 GUI. Webs are opened by accessing a pathname (a disk-based Web) for a Web located in the user's own snapshot view. Multiple views and full access to ClearCase GUIs are available using local mode. Checkouts performed in local mode are unreserved by default.

To configure local mode for FrontPage 2000:

1. Install FrontPage 2000.
2. Install ClearCase (minimum client, view servers recommended).
3. Run Web Authoring Integration Configuration Wizard. Click **Start** > **Programs** > **Rational ClearCase Administration** > **Integrations** > **Web Authoring Integration Configuration**.

   From the Web Authoring Integration Configuration Wizard, select **Local Mode Configuration**.
4. In FrontPage 2000, click **ClearCase** > **Create Snapshot View** and complete the View Creation Wizard.

If you access Webs with FrontPage borders, you must reapply them in a local-mode view. We recommend not using FrontPage themes unless only server-mode access is used. Theme binding information is not stored under source control; reapplication of themes is time consuming, and many extra versions of essentially identical files are checked in.

Use of local mode requires any server-mode users to update the shared view periodically. If there are no local-mode users (or other write activity to the Web content VOB), updating the shared view is not necessary. You can mix and match local and server mode access in your installation.

30.4 Web Folders Support in Office 2000 and Microsoft Internet Explorer 5

The server mode integration option also enables you to configure your IIS Web server for the ClearCase integration with Office 2000 and Internet Explorer 5.0 Web Folders.

If you are using any of the Office 2000 applications or Internet Explorer 5.0, you can log on to an IIS Web server using the Web Folders feature and access the shared view of Web content as a Web address.

The ClearCase integration for Web Folders supports two cases:

- If the file is under source control, saving the file copies it to a Web Folder. ClearCase then checks in the file.
- If the file is not under source control, saving the file copies it to a Web Folder. ClearCase then adds the file to source control and checks it in.

30.5 Updating the Shared View on the Web Server

From time to time, users may want to update the shared Web content view. There is a script on the Web server that performs this function (*ccase-home-dir***etc****iisfix.bat**). Users can access this function from their client systems by opening the URL **http://**<*Web server name*>**/ccase_tools** and clicking **Update Shared View**. You may want to run this script on the IIS server periodically by using the Windows NT Task Scheduling service and specifying an appropriate user as the account to run the task. Using the Windows NT **at** command or the ClearCase Scheduler for this purpose is not supported.

30.6 Considerations for Migrating and Converting Data to the Integration

You can also use the integration with data from an existing Web. You may need to do so to migrate data from an existing VOB, or to convert data under source control from another source control vendor.

- Migration

The integration expects Webs under source control to be rooted in a subdirectory of the Web content VOB root. If you are relocating Webs from existing VOBs using **cleartool relocate** into the Web content VOB, relocate them to a VOB root subdirectory.

- Conversion

  The Web at **\source\qe_group\Webs\qe_Web** is currently in Visual SourceSafe. To convert it to ClearCase, run **clearexport_ssafe** on the VSS library where these files reside. Then use **clearimport**, specifying **\wwwroot\qe_Web** as the target VOB directory (assuming that the default Web content VOB-tag is **\wwwroot**).

In either scenario, it is necessary to run a script (*ccase-home-dir***\etc\iisfix.bat**) to install the FPSE and register the IIS alias and Source Control operations necessary to make such Webs visible and under source control in FrontPage and InterDev. After this has been done, the source control icons appear when the Web is opened in FrontPage and Visual InterDev.

NOTE: Use of VOB symbolic links in integration Webs is not supported.

30.7 Accessing Help Information for the Integration

When ClearCase is installed on client systems, online help for the integration is available. A ClearCase toolbar with a Help icon is available in Visual InterDev and a ClearCase menu, including a **Help** command, is available in FrontPage 2000. However, this online help is not available to users who have not installed ClearCase on their local systems. That is, if the elements are under ClearCase control, but ClearCase is not running on the local system, the only help available is the online help provided by the authoring tools. This online help on source control topics is for Visual SourceSafe.

Using Dynamic Views to Develop and Deliver Web Content

31

This chapter presents a model for using dynamic views to manage Web content. It also explains how to configure Netscape or Apache Web servers to support this model.

31.1 Overview of Using Dynamic Views on a Web Server

The difficulty in keeping Web content current and accurate increases as change cycles become shorter and more frequent. Using dynamic views as the basis for managing Web sites, you can update Web content without risk of the redundancy and delay common to copy-based update models. The model presented here uses three dynamic views to support the work flow for Web site development: one to create prototypes, one to test changes, and one to deliver completed work. This configuration allows your Web team to test changes thoroughly in the most current Web context without affecting the performance or availability of the external site.

Using dynamic views to develop and deliver Web content offers several advantages:

- You can keep Web content under ClearCase version control, and Rational ClearCase supports a seamless interface with HTML editing tools.
- You can isolate testing, changing, and staging of Web content from the external Web site.
- You can restrict the group of people who can make changes to Web content.
- You can identify baseline states for the Web content. For example, after work that supports a new product release is complete, you can capture the state of the data by labeling the version of all elements included in this new baseline. If the Web site must return to a

previous version of the content, it is easy to roll back by using ClearCase views configured to select an earlier baseline.

- If some Web developers are not working at the same site as the external Web server, you can use ClearCase MultiSite to distribute and manage development.

31.2 Example Scenario

The Web team consists of a content development team in Massachusetts and a publishing team in California. The Web server for the external Web site is in California.

The Web team follows this publishing cycle:

1. Developers change the source files.
2. Development team leaders approve the changes.
3. Approved changes are tested in Massachusetts.
4. Changes are sent to California.
5. The publishing team runs a final test on the new content.
6. New content is published.

The team leaders at both sites established these policies:

- All source files must be tested for correctness of links, style, and colors, and the presence of ALT tags for images before developers can submit them for approval.
- Only the team leaders can approve changes for publishing.

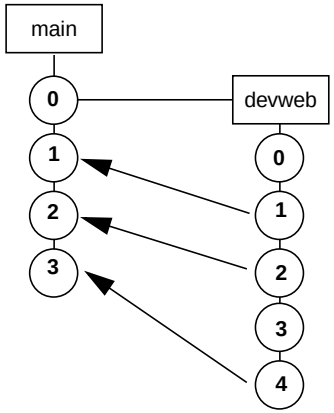
The following sections describe how each team uses ClearCase to control the publishing cycle and enforce policies.

VOB and Branch Configuration

All source files (.HTML, .PDF, .GIF, and .DOC) are stored in ClearCase VOBs. The Web team uses branches to separate ongoing development work from the work approved for publication. The

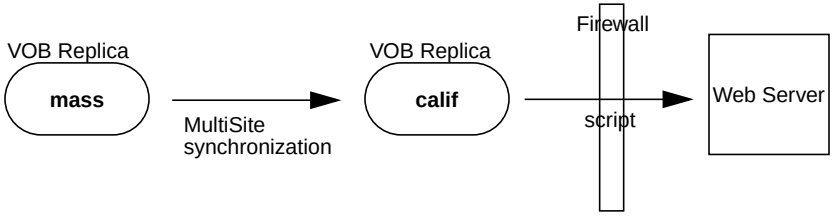
development team uses the **devweb** branch. Approved changes are merged to the **main** branch, and the Web site is published from the latest versions on the **main** branch. Figure 42 shows a version tree, including merges, for an element.

Figure 42 Development and Publishing Branches



Because the development team works at a different site, the VOB that stores Web content is replicated. The developers work in the **mass** VOB replica, and the publishing team publishes files from the **calif** replica. Because no development is done in California, synchronization of the replicas is unidirectional (changes are sent from **mass** to **calif**). The Web server is located outside the firewall, so the publishing team uses custom scripts to copy the content from the VOB to the external Web server.

Figure 43 VOB and Web Server Configuration



If development were also done in California, each site would have a site-specific branch (for example, **devweb_ma** and **devweb_ca**), and changes would be merged to the **main** branch at one site. Synchronization of the replica would occur in both directions, and depending on the speed of development, synchronization might be as frequent as four times an hour.

View Configuration for Tasks

By displaying the Web content in different views, the webmaster can use versioning and branching to control when and where content changes. Three dynamic views support the publishing cycle.

Developing New Content

The **web_devel** view is used to design site enhancements. Developers prototype and test new content designs in this view. New development is done on a new branch, to isolate changes from the other views. This is the config spec for this view:

```
element * CHECKEDOUT
element * /main/devweb/LATEST
element * /main/LATEST –mkbranch devweb
```

When developers are satisfied with new work, they check in their changes to the **devweb** branch. If a file does not meet the publication submission standards (see *Testing Source Files Before Checkin* on page 487), the checkin fails, and the developer must fix the problems and attempt the checkin again.

Merging and Testing Approved Changes

Development team leaders use the **web_merge** view to merge changes from the **devweb** branch to the **main** branch. Before checking in the merged changes, the team leaders test them. This is the config spec for the **web_merge** view:

```
element * CHECKEDOUT
element * /main/LATEST
```

The team leaders use this command to find changes that need to be merged:

cleartool findmerge . –all –fversion \main\devweb\LATEST –query –merge

Viewing and Testing Content

The **web_public** view is used for internal intranet access and provides a read-only view of the latest version of the content. The config spec for this view contains one rule:

```
element * /main/LATEST -nocheckout
```

New baselines for the Web site are tested extensively in this view. Thus, problems are identified and fixed before updated files are transferred to the external staging area.

Accessing Content from a Web Browser

To access files from a Web browser, the Web team uses different server port numbers to load each dynamic view through different URLs. For example, after the server process is started at ports 80, 5990, and 6990, each view is accessible through these URLs:

View	URL
web_public	**http://mass**
web_merge	**http://mass:5990**
web_devel	**http://mass:6990**

For information on configuring multiple dynamic views on an Apache or Netscape Web servers, refer to *Configuring the Web Server* on page 489.

Implementing Policies

The following sections describe how the Web team uses ClearCase to enforce policies.

Testing Source Files Before Checkin

When a developer tries to check in a file on the **devweb** branch, a trigger fires and runs a script that performs the following tasks:

- It writes an entry to a report log to track the state of checkins and checkouts at the Massachusetts site. The Massachusetts Web administrator uses the report log to audit all development work.
- It runs a link-check script to check any hypertext or image references in the file. Relative paths are used in URL addresses so that all hyperlinks work regardless of which view is being accessed.
- It checks for ALT tags for all images and consistent page background colors.
- It checks for stylistic consistency, including font face and font size.

If the script finds any problems, the checkin fails and the developer receives an e-mail message that lists the problems. If the script does not find any problems, the checkin succeeds.

Restricting the Users Who Can Approve Changes

Only the team leaders are allowed to check in changes on the **main** branch. To enforce this policy, the **main** branch type is locked for all users except the team leaders. For example:

cleartool lock –nusers emma,greg,maia brtype:main@\web

This lock prevents all users except **emma**, **greg**, and **maia** from checking out versions from the **main** branch of any element in the VOB.

Labeling Approved Sources

The team uses date-based labels to indicate which files have been published on the external Web site. The publishing team applies the label before copying the latest files on the **main** branch to the Web server.

cleartool mklbtype –c "June 1, 2000 update" WEB_UPDATE_2000_06_01@\web

cleartool mklabel –recurse –c "June 1, 2000 update" WEB_UPDATE_2000_06_01 \web

Synchronizing the Massachusetts and California VOB Replicas

The team uses the MultiSite synchronization scripts to synchronize the replicas:

1. In Massachusetts, the **sync_export_list** script runs every night to send changes to the California replica. The team uses the ClearCase scheduler run the script nightly.
2. When a synchronization update packet is received at the California replica, the **sync_receive** receipt handler runs to import the packet. The **sync_receive** script is listed as the receipt handler in the **shipping.conf** file on UNIX or **MultiSite Control Panel** on Windows.

For more information about synchronization, see the *Administrator's Guide* for Rational ClearCase MultiSite.

Copying Files to the Web Server

Because the Web server is outside the firewall, the publishing team uses custom scripts to copy files from the VOB replica to the Web server. The script uses a view that selects the latest versions on the **main** branch.

Rolling Back to Previously Published Versions

If any problems occur with published material, the publishing team can use a ClearCase view to select a previous baseline and copy those files to the Web server. For example, the team uses a view with the following config spec to roll back to the files published on May 15, 2000:

```
element * WEB_UPDATE_2000_05_15
```

31.3 Configuring the Web Server

Table 11 lists the supported platforms for Web servers.

Table 11 Supported Web Server Platforms

Web Server Software	Supported Operating System
Apache	Windows NT 4.0 Windows 2000 Windows 98 Windows Me Sun HP AIX IRIX LINUX
Netscape Enterprise Server	Windows NT 4.0 (SP5) Windows 2000 Sun HP Linux

When configuring a Web server using a Windows platform, ensure that the dynamic views are started and the required VOBs are mounted at boot time. The process that starts the views and mounts the VOBs should be completed before the Web server process starts. Refer to the *Windows NT 4.0 Resource Kit* for information on using the **srvany.exe** function to start views and mount VOBs at boot time.

The steps for making the contents of a dynamic view accessible through a URL are different for each Web server.

NOTE: When you configure ClearCase on your Web server, do not locate the ClearCase license or registry server processes on the Web server because this introduces a single point of failure into your network architecture.

Configuring the Apache Web Server

Using the configuration file, you can load each dynamic view as a different instance of the Apache Web server process using different server port numbers.

To Configure an Apache Web Server on Windows

1. Install ClearCase Release 4.0 or later on the Apache Web server. Install ClearCase as a server only if VOBs will be local to the Apache host; you will also need to enable MVFS to use dynamic views.

2. Create the dynamic views to support the different stages of content development.

3. Edit *<server-root>***conf****httpd.conf** on the Windows Web server to add a new virtual host for each dynamic view by specifying a different port number for each view using the **Listen** directive.

```
Listen 9990
NameVirtualHost 172.21.170.146:9990
<VirtualHost 172.21.170.146:9990>
ServerAdmin admin@rational.com
DocumentRoot "//view/web_public/vobs/web"
DirectoryIndex index.html
ServerName plankroad.atria.com
ErrorLog logs/error_status.log
TransferLog logs/access_status.log
</VirtualHost>
```

The **DocumentRoot** directive specifies the dynamic view using the following syntax:

//view/*<view-tag>***/***<VOB location>*

Additionally, you can define the default document file name with the **DirectoryIndex** directive to enable all users to access a common file when requesting the URL of the Web site root directory.

To Configure an Apache Web Server on UNIX

1. Install ClearCase Release 4.0 or later on the Apache Web server. Install ClearCase as a server only if VOBs will be local to Apache machine; you will also need to enable MVFS to use dynamic views.
2. Create the dynamic views to support the different stages of content development.
3. Create and edit **/etc/init.d/httpd** on the UNIX Web server to add a new server instance for each dynamic view by specifying a different port number for each view using the **Command** directive where **N** would be 1, 2, 3 up to the number of server instances required.

```
COMMANDN="-c “\Port 7990\”\
-c \“User http\”\
-c \“Group http\”\
-c \”ErrorLog /xweb/apache_m/logs/error_log\”\
-c \”Options Indexes\”\
-c \”CustomLog /xweb/apache_m/logs/access_log common\”\
-c \”PidFile /xweb/apache_m/logs/httpd.pid\”\
-c \”ScoreBoardFile /xweb/apache_m/logs/httpd.scoreboard\”
```

4. For each of the command blocks you have created in Step 3, you must include a command to start the Web server. Within the **/etc/init.d/httpd** script, add the following **cleartool** command:

cleartool setview –exec *“<path-to-Web-server-executable> $COMMANDN” <dynamic-view-name>*

5. Create a symbolic link for **/etc/init.d/httpd** from the appropriate **/etc/rc.n** directory (where **n=1,2,3** and so on). For example, suppose that ClearCase is started up in **/etc/rc2.d/ S77atria**, then you can create a symbolic link to **httpd** with the following command:

   ln -s /etc/init.d/httpd S99httpd

Configuring the Netscape Enterprise Web Server

Using the Netscape Enterprise Server Administration tools, you can load each dynamic view as a new server instance, using a different port address, of the Netscape Enterprise Server.

To configure a Netscape Enterprise Web server on Windows or UNIX:

1. Install ClearCase Release 4.0 or later on the Netscape Enterprise Web server host. Install ClearCase as a server only if VOBs will be local to Netscape machine; you will also need to enable MVFS to use dynamic views.
2. Create the dynamic views as necessary to support the different stages of content development.
3. On the Netscape Server General Administration page, click **Create New Netscape Enterprise Server**.
4. Create a new virtual Web service by editing the Netscape Server Installation screen and assigning a unique server port number.

   - If you are creating a new virtual Web service on Windows, specify the dynamic view in the **Document Root** box using the following syntax:

     //view/*<view-tag>***/***<VOB location>*

   - If you are creating a new virtual Web service on UNIX, specify the dynamic view in the **Document Root** box using the following syntax:

     /view/*<view-tag>***/***<VOB location>*

5. Click the **Content Management** tab and then click **Document Preferences**. Type the name of the default document in the **Index Filenames** box.

Tuning for Performance

Improving VOB Host Performance 32

This chapter presents techniques for improving the performance of Rational ClearCase on VOB hosts.

Your organization's VOBs constitute a central data repository. Good VOB host performance ensures that this centralized resource does not become a bottleneck.

The work of a VOB host involves both read and write access to the VOB database as well as periods of significant computation. VOB access patterns can greatly influence the number of concurrent users that a VOB host can support at a given level of performance. For example, many more users can read from a VOB directory at a level of good performance than can write to the same directory. For information about the characteristics of a good a VOB host, see Chapter 9, *VOB Server Configuration Guidelines*.

32.1 Minimize Process Overhead

The most effective measures for ensuring good performance from VOB hosts are also the easiest to implement:

- **Keep non-ClearCase processes off the VOB host.** Don't use the VOB host as a server host for another application (for example, a DBMS or Web Server) or for a critical network resources such as an NIS server on UNIX or a Primary Domain Controller on Windows.
- **Keep ClearCase client processes off the VOB host.** Do not use the VOB server host for other ClearCase tasks such as building or other CM activities (diff/merge, **cleartool find**, and so on). The VOB server host should not also be used as a developer's desktop system.

- **Keep view_server processes off the VOB host.** This recommendation may be harder to implement; many organizations create shared views on the same hosts as VOBs. If possible, minimize this double use of VOB hosts.

  EXCEPTION: For reliable non-ClearCase access (avoiding multihop network access paths), place the VOB and the view through which it is exported on the same host. For more information, see *Setting Up an Export View for Non-ClearCase Access* on page 344.

32.2 Maximize Disk Performance

Follow these recommendations to obtain the best I/O performance on VOB hosts:

- Use disks with fast seek times and high rotational speeds.
- Where practical, dedicate a disk spindle for each VOB.
- For very busy VOBs, dedicate two disk spindles per VOB if the VOB server host provides such a feature: one for the database and source directories, and one for the cleartext and DO pools.
- Use stripe technology (RAID 0) for improved performance.
- Use mirroring (RAID 1) if high availability is desired.
- Avoid RAID 5, unless your benchmarks show equal performance to RAID (0+1).

Consult your system documentation for details about how to use disk striping and mirroring

32.3 Add Memory for Disk Caching on Windows

Windows systems have a dynamic disk buffer cache. As much main memory as possible is used to cache blocks of data files that have been updated by user processes. Periodically, the disk buffer cache is flushed to disk. The cache size increases when you add more memory to the host.

This feature speeds up disk I/O significantly; making full use of it is an important factor in good VOB host performance. An inadequate disk buffer cache causes thrashing of VOB database files. The result is a significant performance degradation. These are the symptoms:

- Extended periods required for **scrubber** and **vob_scrubber** execution
- Very slow **omake** or **clearmake** builds
- ClearCase clients experience RPC time-out errors

There is additional information about the relationship of main memory to VOB size in *VOB Server Configuration Guidelines* on page 140.

32.4 Tune Block Buffer Caches on UNIX

Most of the UNIX operating systems that ClearCase supports have a dynamic block buffer cache. As much main memory as possible is used to cache blocks of data files that have been updated by user processes. Periodically, the block buffer cache is flushed to disk.

We recommend that the size of a VOB host's block buffer cache average roughly 50% of the total size of all VOB database directories (*vob-stg-dir*/**db**) on the host. On most UNIX operating systems, the cache size increases when you add more main memory to the host. For information on architecture-dependent block buffer cache operation, see the *Platform-Specific Guide* in online help.

If there is a substantial amount of non-ClearCase activity or ClearCase client activity on the host, it will need even more main memory to assure good VOB database performance.

Block Buffer Cache Statistics

The standard UNIX SystemV **sar(1M)** utility reports block buffer cache activity. For example, this command reports activity over a 5-minute period, with a cumulative sample taken every 60 seconds:

sar –b 60 5

```
12:14:22 bread/s lread/s  %rcache bwrit/s lwrit/s  %wcache pread/s pwrit/s
12:15:22       0       1      100       1       1        0       0       0
12:16:23       1       1      -60       2       2        0       0       0
12:17:24       0       4      100       4      17       77       0       0
12:18:25       0       6      100       3     145       98       0       0
12:19:25      17      91       81      28     335       92       0       0

12:19:25 bread/s lread/s  %rcache bwrit/s lwrit/s  %wcache pread/s pwrit/s
Average        4      21       83       8     100       92       0       0
```

If your block buffer caches are sized correctly, cache reads are in the 90% to 95% range and cache writes are 75% or above.

Some UNIX variants provide special tools for monitoring buffer cache performance. See the *Platform-Specific Guide* in online help.

Flushing the Block Buffer Cache

Interactive performance suffers considerably when the block buffer cache is flushed to disk. Most UNIX systems provide no user-level control over the frequency of flushing; HP-UX does, through the **syncer(1M)** utility. The larger the block buffer cache, the less frequently it should be flushed.

32.5 Modify Lock Manager Startup Options

Every VOB server host must run a single lock manager process, which controls database access for every VOB on the system. The lock manager runs with a default set of startup options that are intended to deliver good performance under a wide range of loads. However, you may want to experiment with changing certain lock manager startup options on VOB server hosts that support many VOBs or many users.

Lock Manager Implementations

There are two implementations of the lock manager: one reads and writes data using a socket, the other, which is available on certain UNIX platforms, uses shared memory, which results in lower latency for each request. In many cases, the shared memory implementation can provide better performance on hosts that must support many VOBs and/or many concurrent users. You can tell which type of lock manager is on a system by examining its startup message in **lockmgr_log** file. The conventional lock manager prints the following lines:

```
db_VISTA Version 3.20
Database Lock Manager for UNIX BSD
```

The shared memory lock manager prints the following lines:

```
db_VISTA Version 3.20
Database Lock Manager for UNIX System V shared memory
```

Lock Manager Startup Options

On UNIX platforms, lock manager startup options are defined in the startup script *ccase-home-dir*/**etc/atria_start.** To change these values, open the startup script in a text editor and edit the command that starts **lockmgr**:

```
${ATRIA}/etc/lockmgr ...
```

On Windows platforms, lock manager startup options are defined internally. To change these defaults, create the following Windows registry key as a REG_SZ value:

HKEY_LOCAL_MACHINE\SOFTWARE\Atria\ClearCase\CurrentVersion

`LockMgrCmdLine: REG_SZ : –a almd –f` *num* `–u` *num* `–q` *num*

NOTE: If you change any lock manager startup option on UNIX or Windows, you must stop and re-start ClearCase on the host before the change will take effect.

SPECIFYING THE LOCKMGR SOCKET. *Default:* **almd**

–a almd
: Specifies the name of the socket or shared memory file created by the **lockmgr**. Do not change this name.

SPECIFYING THE NUMBER OF FILES. *Default on Windows:* 128. *Default on* UNIX: 256.

–f *num*
: Specifies the number of database files that can be open concurrently. Each VOB database consists of seven database files. The default startup values allow the lock manager to handle a maximum of 36 VOBs on a UNIX host and 18 on a Windows host. If there are more VOBs on the host, the lock manager will not be able to service requests for all of the VOBs concurrently. User response times will degrade, and the **db_server** or **vobrpc_server** log files will include messages of the form:

  ```
  Error: Too many open databases on host (try increasing the -f argument
  on lockmgr command line).
  ```

  When this happens, you should either move some of the VOBs to another host, or increase the value of the **-f** option to 7**V* where *V* represents the number of VOBs on the host.

SPECIFYING THE NUMBER OF USERS. *Default on Windows:* 128. *Default on* UNIX: 256

–u *num*
: Specifies the number of **db_server** or **vobrpc_server** processes that can concurrently request locks. Each active view requires one **vobrpc_server** process for each VOB that the view accesses. In addition, various operations that change VOB metadata cause a

db_server process to access the VOB through the lock manager. Poor user response time and messages of the form

```
db_VISTA database -922: lockmgr is busy
```

in the **lockmgr_log** file may indicate that the value of the **-u** option should be raised.

On hosts that do not support the shared-memory lock manager, the **-u** option cannot be set higher than 1018. On hosts that support the shared-memory lock manager, the **-u** option is bounded only by available virtual memory.

You can compute an approximate worst case value for **-u** using the formula:

$V*(N/4 + 5)$

where V is the number of VOBs on the host, and N is the number of users who access those VOBs. For a more realistic value—one that will not cause the lock manager to consume unnecessary virtual memory on the VOB server host—monitor the total number of **vob_server** and **vobrpc_server** processes running on the VOB server host for an extended period of typical use (perhaps a week or two), then multiply the peak value by a factor that will accommodate growth (two, or perhaps a little more).

SPECIFYING THE SIZE OF THE REQUEST QUEUE. *Default on Windows:* 128. *Default on* UNIX: 1024.

–q *num*

Specifies the number of lock requests for locks to be queued. The lock manager delays queuing lock requests in excess of this value. Poor user response time and messages of the form

```
db_VISTA database -922: lockmgr is busy
```

in the **db_server_log** or **vobrpc_server_log** files (and, often, concurrently in a **view_log** file) may indicate that the value of the **-q** option should be raised. As a rule, this value should be no greater that five times the value of the **-u** option.

Improving Client Host Performance 33

This chapter presents techniques for improving ClearCase performance on the client host. The primary administrative responsibilities related to client host performance include the following:

- Establishing standards for client host configurations (memory, processing power, network interface characteristics, and local storage).
- Understanding and establishing sitewide defaults for MVFS cache sizes.
- Understanding view caches and how to adjust them.

33.1 Client Host Configuration Guidelines

ClearCase client software makes demands on host memory, CPU, and disk subsystems that are comparable to the demands made by similar workstation applications. Any computer configured to support such applications will deliver good performance on the majority of ClearCase client tasks.

Because Rational ClearCase is a distributed application, it also requires good performance from the client host's network interface and the network to which it is connected. Poor network performance will have a negative impact on the performance of even a well-configured ClearCase client host.

Additional memory may be appropriate for some client hosts. For example, a client host that is expected to do additional work, such as hosting distributed builds or shared views, will need additional memory and perhaps a larger, higher-performance disk subsystem. And any client

that must run other workstation applications while it is also running ClearCase may need to have its resources adjusted to adequately support simultaneous use of both.

33.2 Examining and Adjusting MVFS Cache Size

Client hosts that use dynamic views may be able to benefit from MVFS cache tuning. Use the **getcache** command to print information about your MVFS cache. For example:

cleartool getcache –mvfs

```
Mnodes: (active/max)    1791/8192 (21.863%)
Mnode freelist:         1701/1800 (94.500%)
Cltxt freelist:         737/1800 (40.944%)

DNC:    Files:          848/1600 (53.000%)
       Directories:    185/400 (46.250%)
       ENOENT:         827/1600 (51.688%)

RPC handles:            4/10 (40.000%)
```

NOTE: The statistics presented above are in the form *current-number-on-list/list-capacity* and (*percentage-of-list-capacity*).

```
Attribute cache miss summary (for tuning suggestions, see the
documentation for administering ClearCase):
Attribute cache total misses:              49609        (100.00%)
Close-to-open (view pvt) misses:           18964        ( 38.23%)
Generation (parallel build) misses:         1179        (  2.38%)
Cache timeout misses:                        234        (  0.47%)
Cache fill (new file) misses:                  0        (  0.00%)
Event time (vob/view mod) misses:          29232        ( 58.92%)
```

You may want to change ClearCase MVFS cache sizes to improve performance, if your host performs builds that involve a large (greater than 400) number of files.

Remember, the size of physical memory is the key factor, but caching changes may help.

To resize the MVFS caches, do one of the following:

- Use **cleartool setcache –mvfs** to test different MVFS cache sizes. This method allows you to evaluate results before making a permanent change. See *Real-Time Updating of MVFS Cache Sizes* on page 506 for details.

- On a UNIX host, set the **mvfs_largeinit** option. This affects a number of other default sizing values and is the preferred method for making a long-lived change. For details, see *Adjusting the MVFS Memory Initialization Factor on page 507*.

- On a Windows host, increase the scaling factor on the **MVFS Performance** tab in the ClearCase program in Control Panel. This raises a number of default sizing values and is the preferred method for a long-lived change. See the online help for the **MVFS Performance** tab as well as *Adjusting the MVFS Memory Initialization Factor on page 507* for more details.

- Override selected values for some or all of the specific caching components. (See *Setting Individual Caching Parameters on UNIX* on page 508.) This method provides somewhat finer control, but the suggested values are generally close to those used by **mvfs_largeinit**. On Windows computers, this value is represented in the ClearCase Control Panel as the **scaling factor** on the **MVFS Performance** tab.

NOTE: On some UNIX computers, you must recompile the kernel after changing **mvfs_largeinit**. For details, see the *Platform-Specific Guide* in online help.

Increasing **mvfs_largeinit** adds about 500 KB to the size of kernel (200 KB nonpageable, 300 KB pageable) memory for each increment of the **mvfs_largeinit** value or scaling factor. Enlarging the MVFS caches reduces the amount of memory available to applications but provides better performance when the working set of objects in a build or command exceeds the default cache allocations. Increase the value gradually and check the cache utilization with **cleartool getcache –mvfs**. If you change your MVFS configuration, also consider reconfiguring each view that is used to access ClearCase data on that host, increasing its **view_server** cache size. See *Reconfiguring a View* on page 515.

Table 12 describes each tunable caching parameter with recommendations for setting its size. Also shown is the relationship among the fields in the **getcache** output, the **setcache** options, and the names of the caching parameters.

Table 12 MVFS Cache Information (Part 1 of 2)

getcache Output Field Name	Description	Make Adjustments with:	
		setcache Option	Caching Parameter (UNIX) Control Panel Value (Windows)
`Mnodes`	An *mnode* is a data structure used in the MVFS to keep track of a file or directory. The number of mnodes grows dynamically.	(N/A)	**mvfs_mnmax** on UNIX, (N/A on Windows)
`Mnode freelist`	Maximum number of mnodes to keep on the VOB free list Mnodes on the VOB free list were used (open or had statistics fetched from them) recently but are currently idle. By keeping more mnodes on a free list, the time needed to reopen the associated file is reduced.	**–vobfree**	**mvfs_vobfreemax (UNIX)** **Control Panel value (Windows)**
(N/A)	Minimum number of mnodes to keep on the VOB free list. When the number of mnodes on the VOB free list reaches the value specified by **mvfs_vobfreemax**, the number will be reduced to the value specified by **mvfs_vobfreemin**	(N/A)	**mvfs_vobfreemin (UNIX)** **Control Panel value (Windows)**
`Cltxt freelist`	Mnodes on the free list may also contain pointers to underlying storage pool file objects. The cleartext free list is the collection of these file objects. Keeping these object pointers cached in the mnode speeds the reopening of an MVFS-resident file, but consumes additional memory resources on the client machine. (On a Windows computer, these resources include open file descriptors, for example, on a LAN Manager connection if the storage is on a remote computer.)	**–cvpfree**	**mvfs_cvpfreemax** Mnodes to keep for cleartext free list (Do not change this value except to fix error #2009 in the event log: `server could not expand a table because it reached the maximum size`.)

Table 12 MVFS Cache Information (Part 2 of 2)

getcache Output Field Name	Description	Make Adjustments with:	
		setcache Option	Caching Parameter (UNIX) Control Panel Value (Windows)
`DNC Files`	These caches perform name translations to files, directories, or nonexistent names. If a file name is looked up but not in the cache, the MVFS must perform a remote procedure call (RPC) to the **view_server** to translate the name to a file or directory (or receive an error that the name is not found). When a name is found in the cache, the MVFS saves time by avoiding the RPC. The capacity of each of these categories can be adjusted independently.	**–regdnc**	**mvfs_dncregmax** Maximum number of entries for files
`DNC Directories`		**–dirdnc**	**mvfs_dncdirmax** Maximum number of entries for directories
`DNC ENOENT`		**–noentdnc**	**mvfs_dncnoentmax** Maximum number of entries for non-existent names
`RPC handles`	One RPC handle is used for each RPC in progress from the MVFS to a **view_server**. If the cache is 100% full and you perform large builds with many simultaneously active processes, you may want to increase this cache size to reduce the time taken to perform an RPC. After an RPC handle is added to this cache, it stays on the list until ClearCase is stopped on that host. If no RPC handles are available in the cache, a new one is created on demand. If the cache is not full, the new RPC handle is returned to the cache when the RPC completes. Otherwise, it is destroyed when the RPC completes.	**–rpchandles**	**mvfs_client_cache_size** RPC handles

Real-Time Updating of MVFS Cache Sizes

To perform real-time updating of the MVFS cache sizes, use **cleartool setcache –mvfs**, which modifies cache sizes without requiring you to shut down and restart your computer. Real-time updating is useful for testing different configurations until you find the one that is best for you.

- On UNIX computers, these changes are not persistent until you edit the values for each significant caching component as described in *Setting Individual Caching Parameters on UNIX* on page 508.
- On Windows computers, these changes are not persistent until you update the values on the **MVFS Performance** tab of the ClearCase Control Panel, and then shut down and restart your computer.

The entries in the sample output show the corresponding **setcache** options that can be used to make adjustments to these caches.

cleartool getcache –mvfs

```
Mnodes: (active/max)    1791/8192 (21.863%)          (grows automatically)
Mnode freelist:         1701/1800 (94.500%)          (adjust with –vobfree option)
Cltxt freelist:         737/1800 (40.944%)           (adjust with –cvpfree option)

DNC:    Files:          848/1600 (53.000%)           (adjust with –regdnc option)
       Directories:    185/400 (46.250%)             (adjust with –dirdnc option)
       ENOENT:         827/1600 (51.688%)           (adjust with –noentdnc option)

RPC handles:            4/10 (40.000%)               (adjust with –rpchandles option)
.
.
.
```

You probably also need to use the **mvfsstat** and **mvfstime** commands to determine the effectiveness of your cache before manipulating its size. A full cache is not necessarily ineffective if its hit rate is high enough. We recommend maintaining a hit rate of 85% or better.

NOTE: **setcache** can sometimes fail with a "Device busy" error. Such errors are usually transient and indicate that some other process is also trying to use the MVFS.

Adjusting the MVFS Memory Initialization Factor

You can specify how much memory the MVFS uses for various caches by changing the MVFS scaling factor.

The MVFS scaling factor is set automatically, as shown in Table 13, based on the amount of physical memory installed in the host computer.

Table 13 How Memory Size Affects the MVFS Scaling Factor

Memory Size	**<24MB**	**24MB-256MB**	**256MB-1GB**	**>1GB**
MVFS Scaling Factor	0	1	2	*size*/512MB +1

If you wish, you can manually override the automatic setting.

- On UNIX platforms, the scaling factor is the value of **mvfs_largeinit**. The way in which **mvfs_largeinit** is set is platform specific. The *Platform-Specific Guide*, in online help, has more information about platform-specific values for **mvfs_largeinit**. For greater control over your cache sizes, you can set the individual caching parameters as described in *Setting Individual Caching Parameters on UNIX* on page 508.
- On Windows platforms, the scaling factor is set to 1 by default. To change the scaling factor, start the ClearCase Control Panel. On the **MVFS Performance** tab, set the scaling factor value in the **Scaling factor to initialize MVFS with more memory for better performance** box. Click **OK**. Changes take effect after you shut down and restart your computer. For finer control over the individual cache sizes, you can change some of the individual values. See *Setting Individual Cache Sizes on Windows* on page 509.

Changing the value of **mvfs_largeinit** or the Scaling Factor scales all of the MVFS cache sizes proportionally as shown in Table 14.

Table 14 How the MVFS Scaling Factor or mvfs_largeinit Affects Individual MVFS Cache Sizes

MVFS Cache Name	**scaling factor or mvfs_largeinit = 0**	**scaling factor or mvfs_largeinit = 1**	**scaling factor or mvfs_largeinit = 2**	**scaling factor or mvfs_largeinit > 0**
DNC File Cache	800 bytes	1600 bytes	2400 bytes	800(*N*+1) bytes
DNC Directory Cache	200 bytes	400 bytes	600 bytes	200(*N*+1) bytes

Table 14 How the MVFS Scaling Factor or mvfs_largeinit Affects Individual MVFS Cache Sizes

MVFS Cache Name	scaling factor or mvfs_largeinit = 0	scaling factor or mvfs_largeinit = 1	scaling factor or mvfs_largeinit = 2	scaling factor or mvfs_largeinit > 0
DNC ENOENT Cache	800	1600	2400	800(*N*+1)
Cleartext File Cache (UNIX)	900	1800	2700	900(*N*+1)
Cleartext File Cache(Windows)	900	1800	1800	1800
RPC Handle Cache	5	10	15	5(*N*+1)
Mnode Freelist Cache	900	1800	2700	900(*N*+1)
Mnode Cache	4096	8192	1288	4096(N+1),N<4; 2048(N+7),N>4

Setting Individual Caching Parameters on UNIX

Platform-specific instructions for changing caching parameters on all supported UNIX systems are provided in the *Platform-Specific Guide* in online help.

The following list identifies all significant caching components and provides the default values as loaded at system startup. You can bypass this level of detail by choosing the **mvfs_largeinit** option as described in *Adjusting the MVFS Memory Initialization Factor on page 507*.

- Cache for the systemwide maximum number of mnodes is set with the **mvfs_mnmax** parameter at up to 4,096 MVFS objects. The cache grows dynamically if more is required.
- The maximum number of unused mnodes to cache (at 400 bytes/object) is set with the **mvfs_vobfreemax** parameter, which has a default value of 900.
- The minimum number of unused mnodes to keep on the VOB free list set with the **mvfs_vobfreemin** parameter. This parameter has a default value of 0, which causes **mvfs_vobfreemin** to be set at 90% of **mvfs_vobfreemax**.

- The maximum number of unused cleartext files to cache differs by system. The value is set by **mvfs_cvpfreemax**. The *Platform-Specific Guide* provides detailed information.
- Caches for MVFS directory name objects are set with these parameters:
  - The number of regular file names to cache (at 100 bytes/entry) is set by **mvfs_dncregmax**.
  - The number of directory names to cache (at 100 bytes/entry) is set by **mvfs_dncdirmax**.
  - The number of names that produce name-not-found returns (at 100 bytes/entry) is set by **mvfs_dncnoentmax**.

  The default value for each of these parameters is 0, which causes the size of the cache to be determined by the value of **mvfs_largeinit**.

For the individual cache sizes associated with particular values of **mvfs_largeinit**, see *Adjusting the MVFS Memory Initialization Factor on page 507*.

Setting Individual Cache Sizes on Windows

Use the ClearCase Control Panel to modify individual cache sizes. On the **MVFS Performance** tab, select the **Override** check box for a particular value. Enter a new value for the parameter. When you have finished modifying fields, click **OK**.

Each mnode in the mnode freelist cache uses about 400 bytes. Each entry in the DNC files, directories, and ENOENT caches uses about 100 bytes.

After changing cache sizes, you must shut down and restart your computer to make your changes take effect.

Minimizing Attribute Cache Misses

The sections that follow this sample output describe each cache-miss category and the ways to reduce the miss count.

cleartool getcache –mvfs

```
.
.
.
Attribute cache miss summary (for tuning suggestions, see the
documentation for administering ClearCase):
Attribute cache total misses:              49609        (100.00%)
Close-to-open (view pvt) misses:           18964        ( 38.23%)
Generation (parallel build) misses:         1179        (  2.38%)
Cache timeout misses:                        234        (  0.47%)
Cache fill (new file) misses:                  0        (  0.00%)
Event time (vob/view mod) misses:          29232        ( 58.92%)
```

Attribute Cache Total Misses

Total misses is the sum of all the misses entries. This total is reduced by reducing the other categories of misses entries described below.

Close-to-Open Misses

Close-to-open misses occur when an open view-private file is reopened by another process. The MVFS rechecks with the **view_server** when a view-private file is reopened to refresh its cached attributes in case the file was modified by another MVFS client.

This behavior can be disabled on a per-computer (not a per-view) basis. If you are absolutely sure that no other client on the network is updating view-private files in any views you are using from an MVFS client, you may want to disable this behavior to reduce these cache misses.

Use **mvfscache** to change this setting.

Generation Misses

Generation misses occur during a parallel build. If you are doing parallel builds, you cannot avoid these misses.

Cache Timeout Misses

Cache timeout misses occur when a file's attributes have not been verified recently. The MVFS periodically rechecks a file's attributes to ensure that it does not cache stale copies of the attributes.

These misses cannot be completely eliminated. However, the time-out period for the attributes may be adjusted. The cache timeout varies, depending on how recently a file or directory was modified; the more recently the file was modified, the shorter the time-out period. The value for this initial time-out period is constrained to lie within the minimum and maximum attribute-cache lifetimes as specified at VOB **mount** time through the **acregmin**/**acregmax** (for regular files) and **acdirmin**/**acdirmax** (for directories) parameters. These are the default values:

- **acregmin**: 3 seconds
- **acregmax**: 60 seconds
- **acdirmin**: 30 seconds
- **acdirmax**: 60 seconds

If you consider changing these values, be aware that a longer timeout means that this client may not notice other clients' updates to the VOB or view for longer periods.

To change these values, specify a mount option for the VOB in one of the following ways:

- At mount time. For example:

  cleartool mount –options acregmin=30 *vob-tag*

  This is a privileged operation. You must be the privileged user to do this.

- In the registry (either at VOB creation with **mkvob** or later using **mktag**). For example:

  cleartool mktag –vob –tag *vob-tag* **–replace –options** *mount-options* . . .

NOTE: The time-out values specified in these mount options affect the view's metadata latency (the delay before changes to VOB metadata become visible in a dynamic view other than the one in which the changes were made). Longer time-out values improve performance at the expense of greater latency. Shorter time out values decrease latency, but also have an impact on view performance because the caches must be refreshed more frequently.

Cache Fill Misses

Cache fill misses occur when a file's attributes are not in the cache. If the percentage of these is high (above 20%), your cache may be too small for your working set. Consider increasing the number of mnodes on the free list by changing the **mvfs_vobfreemax** parameter as described in *Setting Individual Caching Parameters on UNIX* on page 508 and *Setting Individual Cache Sizes on Windows* on page 509.

Event Time Misses

Event time misses occur when a cached name-to-object translation requires revalidation of the attributes on the resulting object (for example, the name cache has "foo" mapped to a particular file object, but the attribute cache on that object needs to be refreshed because of a timeout or a parallel-build-induced generation miss).

These misses cannot be completely eliminated, but as with *Cache Timeout Misses* they can be reduced by adjusting minimum/maximum cache lifetimes.

33.3 View Caches

To speed its performance, the **view_server** process associated with a view maintains a cache. The default size of this cache is 500 KB (1 MB for some 64-bit UNIX platforms). You can configure a larger cache size to boost performance. A larger cache is particularly useful for views in which very large software systems are built by **omake** or **clearmake**.

The **view_server** maintains a number of caches, consisting mostly of data retrieved from the VOB, to respond faster to RPCs from client machines. These are the view caches:

- Object cache, which facilitates retrieval of VOB and view objects (for example, versions and branches)
- Directory cache, which facilitates file system directory read access
- Stat cache, which stores file attributes
- Name cache, which stores names (of existing files and names that do not exist in a directory) and accelerates name lookups

When a **view_server** process is started, it chooses its cache size from the first one of these that yields a value:

- A persistent value set when the view was created (**cleartool mkview –cachesize**) or modified with the **cleartool setcache –view –cachesize** command.
- Contents of the file **/var/adm/atria/config/view_cache_size** or *ccase-home-dir***var\config\view_cache_size** (decimal number; set with **setcache –view –host**)
- Site-wide cache default stored in the ClearCase registry (set with **setcache –view –site**)

- Default value: 512 KB on 32-bit platforms, 1 MB on 64-bit platforms

The view cache size represents the total number of bytes available for allocation among the individual view caches.

See the **setcache** reference page for information about setting the cache size for a view and for a site, and the **getcache** reference page for information about displaying cache information.

33.4 Obtaining View Cache Information

To examine a view's cache information, use **cleartool getcache -view**. The view server prints information about the view cache sizes and hit rates. You can use this information in several ways:

- To determine whether to increase the view cache
- To check the results after changing the view cache
- To analyze other view server processes

Example:

cleartool getcache –view jo_main

```
Lookup cache:    29% full,   1121 entries ( 56.8K),  15832 requests,  75% hits
Readdir cache:    4% full,     24 entries ( 36.5K),   4159 requests,  83% hits
Fstat cache:     31% full,    281 entries (105.1K),  55164 requests, 100% hits
Object cache:    26% full,   1281 entries (176.6K),  40626 requests,  72% hits
Total memory used for view caches: 375.0Kbytes
The current view server cache limits are:
Lookup cache:             201312 bytes
Readdir cache:            838860 bytes
Fstat cache:              352296 bytes
Object cache:             704592 bytes
Total cache size limit:  2097152 bytes
```

The view cache includes these types of subcaches:

- **Lookup**. Stores data used to accelerate the mapping of names to objects in the view.
- **Read Directory.** Stores data used to accelerate read-directory operations (for example, **ls** or **dir**) by the view.
- **File Stats.** Stores data on file attributes used by the view.

- **Object.** Stores data pertaining to objects used by the view.

To find the size of the total view cache, sum the sizes of these components.

NOTE: On UNIX computers, you can force a **view_server** process to write cumulative cache-performance (and other) statistics to its log file, **/var/adm/atria/log/view_log** then reset all the statistics accumulators to zero, by running the following command on the host where the **view_server** executes:

kill -**HUP** *view_server-process-ID*

Analyzing the Output

getcache -view provides this information:

- Cache type
- Percentage of the view cache being used
- Number of entries in cache
- Number of requests made
- Percentage of cache hit rates
- Amount of view cache memory being used

Here are some suggestions for analyzing this information:

- Check the percentage of view cache being used. This value is very important.
  - If the hit rate is 90% or less and the view cache is 100% full, the view cache may be too small. The combination of a hit rate greater than 90% and view cache that is 100% full indicates that the cache size is about right.
  - If you are at less than 50% on every portion, your cache is probably too large.
- Check this value more than once to be sure you are not seeing a transitory value, such as for a newly started or restarted view server.
- If you decide to increase the view cache size for a view, use the procedure described in *Reconfiguring a View*.

33.5 Reconfiguring a View

Use **setcache** to reconfigure a **view_server**'s cache to a new size. The ratio of memory allotted to each subcache is fixed. When specifying a cache size, keep the following guidelines in mind:

- The value cannot be smaller than 50 KB for 32-bit platforms or 100 KB for 64-bit platforms.
- Do not specify a value larger than the amount of physical memory on the server host that you want to dedicate to this view.
- Larger cache sizes generally improve view performance, though as cache sizes approach 4 MB, the performance improvement usually becomes less noticeable.
- Verify your changes by checking the hit rates and utilization percentages periodically to see whether they have improved.

To specify a new cache size for a single view, use the **setcache –view** command:

cleartool setcache –view –cachesize *nnn view-tag*

Note that you must be the privileged user or the view owner to use this command. See the **setcache** reference page for details.

Troubleshooting

34 Determining a Data Container's Location

This chapter demonstrates how to determine the actual storage locations of *MVFS files*—those accessed through VOB directories in dynamic views. Both standard operating system utilities and the ClearCase **mvfsstorage** utility are used. These tools can help diagnose problems in accessing ClearCase files.

34.1 Scenario

This chapter focuses on three files within VOB directory **\monet\src**, as seen through view **allison_vu**:

- Element **cmd.c** has element type **text_file**, and is currently checked out.
- Element **monet.icon** has element type *file*, and is not currently checked out.
- File **ralph_msg** is a view-private file, created by saving an electronic mail message to disk.

NOTE: On a UNIX computer, the VOB-tag would probably include a standard VOB mount point. For example, if this mount-point was **/vobs**, then the directory would be **/vobs/monet/src**.

34.2 Determining the ClearCase Status of Files

The **describe** command verifies that the three files are as described:

cleartool describe cmd.c monet.icon ralph_msg

```
version "cmd.c@@\main\CHECKEDOUT" from \main\6 (reserved)
  checked out 03-Feb-93.20:40:30 by (allison.mon@phobos)
  by view: allison_vu ("phobos:d:\users\people\arb\vw_store\arb.vws")
  element type: text_file

version "monet.icon@@\main\1"
  created 03-Feb-93.20:17:04 by (allison.mon@phobos)
  element type: file

View private file "ralph_msg"
  Modified: Wednesday 02/03/93 21:39:49
```

34.3 Determining the Full UNIX Pathnames of Files

The standard **ls**(1) and **pwd**(1) commands show the full pathnames of the files on UNIX:

ls –l ‘pwd‘/cmd.c

```
-rw-rw-r--   1 allison  mon     211 Feb  2 12:03 /proj/monet/src/cmd.c
```

ls –l ‘pwd‘/monet.icon

```
-r--r--r--   1 allison  mon     266 Feb  3 20:17 /proj/monet/src/monet.icon
```

ls –l ‘pwd‘/ralph_msg

```
-rw-rw-r--   1 allison  mon     852 Feb  3 20:40 /proj/monet/src/ralph_msg
```

34.4 Where Is the VOB?

The **describe** command shows you the path to the VOB root over the network and also relative to the host on which the VOB storage resides:

cleartool describe vob:\monet\src

```
versioned object base "\monet"
  created 01-Feb-93.17:35:03 by (vobadm.vobadm@sol)
  VOB storage host:pathname "sol:c:\vbstore\monet.vbs"
  VOB storage global pathname "\\sol_vbstore\monet.vbs"
  VOB ownership:
    owner vobadm
    group vobadm
```

You can also get this information from the **All VOBs** node of the ClearCase Administration Console, which lists all VOB-tags registered in the local host's region on the local host's registry server. The **Taskpad** and **Detail** views show the host and global path of the VOB storage directory along with other information about each VOB. From this listing you can navigate to the VOB storage node for the specific VOB in the ClearCase Administration Console, where you can manage VOB storage.

34.5 Where Is the View?

The **pwv** (print working view) and **lsview** (list view-tag) commands show the location of the view storage area:

cleartool pwv
```
Working directory view: allison_vu
Set view: allison_vu
```

cleartool lsview allison_vu
```
* allison_vu \\phobos_users\people\arb\vw_store\arb.vws
```

NOTE: On UNIX computers, you may need to use the **mount** command to identify the host on which the view storage area resides (to answer the question "Which host contains directory **/net/phobos**?").

The **All Views** node of the ClearCase Administration Console lists all view-tags registered in the local host's region on the local host's registry server. The **Taskpad** and **Detail** views show the host and global path of the view storage directory along with other information about each view. From this listing you can navigate to the view storage node for the specific view in the ClearCase Administration Console, where you can manage view storage.

34.6 Where Are the Individual Files?

The *data containers* for all MVFS files are logically stored within a VOB or view storage area, as shown in Table 15.

Table 15 Storage Locations of MVFS Files

Kind of File	Storage Location
Version (checked-in)	VOB *source storage pool* (**s** subdirectory of the VOB storage directory) and perhaps VOB *cleartext* storage pool (**c** subdirectory of the VOB storage directory)
Checked-out version	View-private data storage (**.s** subdirectory of the view storage directory)
Unshared or nonshareable derived object	View-private data storage (**.s** subdirectory of the view storage directory)
Shared derived object	VOB *derived object storage pool* (**d** subdirectory of the VOB storage directory)
View-private file	View-private data storage (**.s** subdirectory of the view storage directory)

The following sections show how the **mvfsstorage** utility indicates the exact storage location of an MVFS file.

NOTE: On UNIX computers, this utility is located in directory *ccase-home-dir***/etc**. If this directory is not in your search path (and it usually isn't), run **mvfsstorage** using its full pathname.

Locating a Checked-Out Version

mvfsstorage shows the location in view-private data storage of the checked-out version of *text_file* element **cmd.c**:

mvfsstorage cmd.c
```
\\phobos\vw_store\arb.vws\.s\00050\8000000B.00B0.cmd.c
```

Locating a Checked-In Version's Cleartext Container

For a checked-in version of an element that uses a single data container to store all its versions, **mvfsstorage** shows the location of the cleartext data container into which the type manager extracts the version:

mvfsstorage cmd.c@@\main\1
```
\\sol\vobstore\monet.vbs\c\cdft\28\32\8a1a9a50010e11cca2ca080069021822
```

mvfsstorage cmd.c@@\main\2
```
\\sol\vobstore\monet.vbs\c\cdft\3a\33\8e4a9a54010e11cca2ca080069021822
```

Locating a Checked-In Version's Source Container

For a checked-in version of an element that uses a separate data container for each version, **mvfsstorage** shows the location of the data container in the source pool:

mvfsstorage monet.icon
```
\\sol\vobstore\monet.vbs\s\sdft\26\4\474fa2f4021e11cca42f0800690605d8
```

Element types that store each version in a separate container do not use the cleartext pool. Instead, programs access the data container in the source pool.

Locating a View-Private File

Like a checked-out version, a view-private file is located in a view's private data storage:

mvfsstorage ralph_msg
```
\\sol\view_store\arb.vws\.s\00050\8000000C.00BD.ralph_msg
```

Issues with Nonlocal UNIX Storage

On UNIX computers, VOB storage pools can be located outside the VOB storage directory itself; likewise, a view's private storage area can be located outside the view storage directory.

If **mvfsstorage** indicates that a data container is in a nondefault VOB storage pool, use the **lspool** command to determine the location of the pool. The default pools are **sdft** (default source pool), **cdft** (default cleartext pool), and **ddft** (default derived object pool). For example:

*ccase-home-dir***/etc/mvfsstorage hello.h**
```
/vobstore/monet.vbs/c/clrtxt.1/36/f/6b6ed22b08da11cca0ef0800690605d8
```

cleartool lspool –l clrtxt.1
```
pool "clrtxt.1"
 08-Feb-93.10:25:46 by (vobadm.vobadm@starfield)
  "nonlocal cleartext storage for monet VOB"
  kind: cleartext pool
  pool storage remote host:path "sol:/netwide/public/ccase_pools/clrtxt.1"
  pool storage local pathname "/vobstore/monet.vbs/c/clrtxt.1"
  maximum size: 0  reclaim size: 0  age: 96
```

clrtxt.1 is a nondefault cleartext pool.

Use UNIX **ls** to determine whether a view's private storage area (subdirectory **.s**) is nonlocal:

ls –ld ~jones/view_store/temp.vws/.s
```
lrwxrwxr-x   1 jones    dvt        34 Feb 17 17:06
/usr/people/jones/view_store/temp.vws/.s -> /public/jones_temp
```

Links and Directories on UNIX

On UNIX computers, mvfsstorage deals with VOB and file-system link and directory objects as follows:

- For a link, **mvfsstorage** indicates the storage location of the object to which the link points. This applies to all links: view-private hard links and symbolic links, VOB hard links, and VOB symbolic links.
- A view-private directory does not have a data container; nor does a directory element. In both cases, **mvfsstorage** echoes the directory pathname.

35 Repairing VOB and View Storage Directory ACLs on Windows

We recommend that you use NTFS-formatted disks for holding VOB and view storage directories. NTFS file-system objects are protected by Security Descriptors, which contain ownership information and discretionary access control list (DACL). (DACL and ACL are often used to mean the same thing.) FAT file-system objects are not protected in this way. Although the **readonly** attribute is available in both NTFS and FAT, it is not enforced; that is, it can be removed easily.

On NTFS, the ClearCase storage directory's ownership (its owner and primary group ID) is determined from the storage directory root's Security Descriptor. Because FAT file systems do not support the Security Descriptor, ClearCase creates the **identity.sd** file to store it. A copy of the storage directory root's Security Descriptor is always stored in the **identity.sd** file, regardless of the file system type, and the **groups.sd** file holds the supplementary VOB group list.

35.1 ClearCase ACLs

Rational ClearCase establishes ACLs for VOB and view storage directories when VOBs and views are created. These ACLs have a particular form that ClearCase relies on. The following example shows the correct ACL for a VOB storage directory, **myvob.vbs**, created by user **ccase_adm**, who has primary group **user**, in domain **nt_west**:

cacls c:\vobstore\myvob.vbs

```
NT_WEST\user:(CI)R                                  (VOB's principal group)
Everyone:(CI)R
NT_WEST\ccase_adm:(CI)(special access:)             (VOB owner)
        STANDARD_RIGHTS_ALL
        DELETE
        READ_CONTROL
        WRITE_DAC
        WRITE_OWNER
        SYNCHRONIZE
        STANDARD_RIGHTS_REQUIRED
        FILE_GENERIC_READ
        FILE_GENERIC_WRITE
        FILE_GENERIC_EXECUTE
        FILE_READ_DATA
        FILE_WRITE_DATA
        FILE_APPEND_DATA
        FILE_READ_EA
        FILE_WRITE_EA
        FILE_EXECUTE
        FILE_READ_ATTRIBUTES
        FILE_WRITE_ATTRIBUTES

NT_WEST\clearcase:(CI)F                             (clearcase group)
NT_WEST\user:(OI)(IO)(special access:)              (VOB's principal group)
        GENERIC_READ
        GENERIC_EXECUTE

Everyone:(OI)(IO)(special access:)
        GENERIC_READ
        GENERIC_EXECUTE

NT_WEST\ccase_adm:(OI)(IO)(special access:)         (VOB owner)
        DELETE
        WRITE_DAC
        WRITE_OWNER
        GENERIC_READ
        GENERIC_WRITE
        GENERIC_EXECUTE
```

```
NT_WEST\clearcase:(OI)(IO)F
BUILTIN\Administrators:(OI)(special access:)
        DELETE
        READ_CONTROL
        WRITE_DAC
        SYNCHRONIZE
        FILE_GENERIC_READ
        FILE_GENERIC_WRITE
        FILE_GENERIC_EXECUTE
        FILE_READ_DATA
        FILE_WRITE_DATA
        FILE_APPEND_DATA
        FILE_READ_EA
        FILE_WRITE_EA
        FILE_EXECUTE
        FILE_READ_ATTRIBUTES
        FILE_WRITE_ATTRIBUTES
```

35.2 Causes of Protection Problems

This section describes typical scenarios that can lead to inappropriate storage protections and suggests how to avoid these situations.

Copying the Storage Directory

If you use **xcopy** or Windows Explorer to copy or restore the storage directory, Windows does not retain the Security Descriptor and its protection is incorrect. We recommend that you use one or more of the following procedures to copy the storage directory:

- Use **scopy** (Windows NT Resource Kit command)

  scopy *source destination* **/o /s**

  You must log on as a member of the Administrators or Backup Operators group. If you are copying across the network, your domain account must belong to one of these groups on both host machines.

- Use an offline backup tool

Use commercially available offline backup/restore tools for Windows, such as tape backup, which retain the Security Descriptors. You must log on as a member of the Administrators or Backup Operators group.

➤ Use **ccopy** (*ccase-home-dir***etc****utils****ccopy**)

ccopy *source destination*

You must log in as VOB owner.

NOTE: **ccopy** does not always preserve ownership when copying files. If this is a concern, use **scopy**.

For information about fixing protection problems caused by copying the directory, see *Fixing Protection Problems* on page 531.

Converting the File System from FAT to NTFS

If you create the storage directory in FAT and later convert that partition to NTFS, its protection will be incorrect. ClearCase reports a different VOB owner after the conversion. VOB and view servers do not start because the **identity.sd** file does not agree with the storage directory root's Security Descriptor. There is no way to avoid this behavior.

For information about fixing protection problems caused by converting from FAT to NTFS, see *Fixing Protection Problems* on page 531.

Editing Permissions

If you edit a file permission, for example, by using Windows Explorer or **cacls**, ClearCase users will begin experiencing access and protection problems.

WARNING: Never click **OK** in the **File Permissions** dialog box if the changes will affect VOB and/or view storage. Doing so changes DACL (the order of access control entries) even if you have not changed anything. To detect protection problems, run this command:

cleartool checkvob –protections –pool *vob-stg-pname*

For information about fixing protection problems caused by editing permissions, see *Fixing Protection Problems* on page 531. For more information about the options to the **checkvob** command, see the **checkvob** reference page.

35.3 Utilities for Fixing Protection Problems

ClearCase includes three utility programs for fixing protection problems on Windows:

- *ccase-home-dir***etc\utils\vob_sidwalk.exe** repairs permissions on VOB storage directories. It can also be used to change ownership on VOB objects. For details, see *Using vob_sidwalk to Change or Update VOB Users and Groups* on page 68.
- *ccase-home-dir***etc\utils\fix_prot.exe** repairs permissions on VOB or view storage directories
- *ccase-home-dir***etc\utils\lsacl.exe** displays NTFS DACLs for file-system objects

fix_prot

fix_prot [**-f**·**orce**] { **-root** [**-r**·**ecurse**] [**-recover** {**-chown** *user* | **-chgrp** *group* } | **-replace**·**_server_process_group** |
[**-r**·**ecurse**] [**-type** { **d** | **f** }] [**-chown** *user*] [**-chgrp** *group*] [**-chmod** *permissions*] } *pname* ...

Options

–f·**orce**
Do not prompt for confirmation.

–r·**ecurse**
Recursively fix protections.

–root
Specifies that *pname* is a VOB or view storage directory root.

–type
Specifies the type of file-system objects to fix. Use **d** for directories and **f** for files. If **-type** is not specified, **fix_prot** operates on both directories and files.

–chown
Specifies the new owner. Mandatory with **–root**.

–chgrp
Specifies the new primary group. Mandatory with **–root**.

–chmod
Specifies the new access rights: `owner`, `group`, `other` (world). Both symbolic and absolute codes are valid, such as `go-x` (symbolic) or `0644` (absolute).

-recover
(Windows only.) Restores correct file system ACLs in a view storage directory based on the information in the view's **identity.sd** and **groups.sd** files. Not valid on VOB storage (use **vob_sidwalk -recover_filesystem** instead).

-replace_**_server_process_group**
(Windows only.) Replaces ACL entries for the ClearCase administrators group. Use this option if you have changed the ClearCase administrators group name or have moved a view to a new domain that has a different SID for this group.

Examples

To create a UNIX **.identity** directory after moving a VOB from Windows to UNIX. The VOB has been moved to the storage directory **/vobstg/winvob.vbs**. The new owner is **vobadm** and the new group is **ccusers**. You must run this command as **root**.

*ccase-home-dir***/etc/utils/fix_prot -root -recurse -chown vobadm -chgrp ccusers /vobstg/winvob.vbs**

To repair ACLs damaged when a view storage directory was coped to **C:\ClearCaseStorage\integration.vws** using a copy utility that did not preserve Windows ACLs:

*ccase-home-dir***\etc\utils\fix_prot -root -recover C:\ClearCaseStorage\integration.vws**

To display the protection modes Clearcase associates with the directory **E:\vobstg\myvob**:

*ccase-home-dir***\etc\utils\fix_prot E:\vobstg\myvob**
```
drwxr-xr-x      MYDOMAIN\me      MYDOMAIN\mygroup     E:\vobstg\myvob
```

NOTE: **fix_prot** may return an error message that begins with the following text:

```
fix_prot: Error: unknown style protections on foo: The data is invalid.
```

If it does, you must rerun **fix_prot** and specify all of the **–chown**, **–chgrp**, and **–chmod** options with the absolute codes. For example:

*ccase-home-dir***etc\utils\fix_prot –chown** *owner* **–chgrp** *group* **–chmod 0666** *pname*

lsacl

lsacl [**–s** | **–l**] [**–n**] [**–f**] *path-name*

Options:

–s | **–l**
: Specifies short or long format; displays generic rights, by default.

–n
: Specifies that the numeric security ID (SID) is not to be translated into the user's name. Use this option if the domain controller is down or if the user's account has been removed.

–f
: Reads a security descriptor from a file; allows you to display the contents of the **identity.sd** and **groups.sd** files.

Note that you can also use **%SystemRoot%\system32\cacls** to display a DACL, but **cacls** cannot read a security descriptor from a file.

35.4 Fixing Protection Problems

The following sections describe how to fix the protection problems described in *Causes of Protection Problems* on page 527.

To fix most protection problems:

1. Log on as a member of the Administrators or Backup Operators group.
2. If the **groups.sd** file exists in the storage directory root, run this command:

*ccase-home-dir***etc\utils\lsacl –f** *stg-pname***groups.sd**

Note the supplementary group list. The following is sample output:

```
===== stg-pname\groups.sd
Owner: FOO\bob (User) (non-defaulted)              (Owner)
Group: FOO\usersnt (Group) (non-defaulted)         (Primary group)
ACL (revision 2):
0: allowed
SID: FOO\user (Group)                              (Supplementary group)
rights (00000000)

1: allowed
SID: FOO\tester (Group)                            (Supplementary group)
rights (00000000)

===== stg-pname\groups.sd
Owner: FOO\bob (User) (non-defaulted)              (Owner)
Group: FOO\usersnt (Group) (non-defaulted)         (Primary group)
ACL (revision 2):
Empty ACL: all access denied                       (No supplementary group)
```

3. Issue the following command:

   *ccase-home-dir***etc\utils\fix_prot –r –root –chown** *owner* **–chgrp** *group stg-pname*

   fix_prot –root removes the supplementary group list.

   If you are fixing view storage, you are finished. There should be no supplementary groups for the view storage directory.

4. If you are fixing VOB storage and your VOB had the supplementary group list, run this command:

   *ccase-home-dir***bin\cleartool protectvob –add_group** *group-name[,...] vob-stg-pname*

5. Remove the **cleartext** containers. To do so, log on as the VOB owner and run this command:

   *ccase-home-dir***bin\scrubber –e –k cltxt** *vob-stg-pname*

   This step is necessary because **cleartool checkvob** cannot fix the **cleartext** containers.

6. Fix the storage pool's protections. Log on as the VOB owner and run this command:

   *ccase-home-dir***bin\cleartool checkvob –force –fix –protections –pool** *vob-stg-pname*

36 Preventing Accidental Deletion of Data by crontab Entries

This chapter describes changes made during ClearCase installation to ensure that **crontab**(1) scripts do not accidentally delete ClearCase data. In addition, we describe situations in which you may need to take measures to prevent such accidents from occurring.

36.1 Preventing Recursive Traversal of the Root Directory

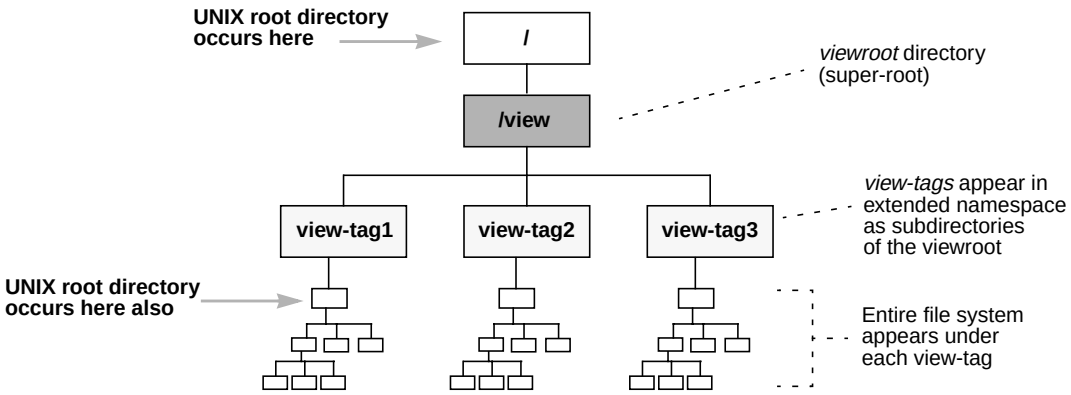
When the MVFS is active on a client host, a **/view** directory, the *viewroot*, is created. This directory functions as a mount point for the MVFS namespace (see Figure 44). The **/view** directory causes the root directory to contain itself recursively, which makes certain recursive pathnames valid. For example:

```
/view/alpha/view/beta/view/alpha/view/gamma/usr/src/lib
```

As a result, commands that traverse the entire directory tree, starting at the UNIX root directory (/), loop infinitely. In particular, many UNIX systems configure the **root** user to have a daily **crontab**(1) script that performs a cleanup on the file-system tree. If the script uses a find / command, it runs the risk of looping infinitely.

NOTE: This situation applies equally to commands and programs executed by any user, either interactively or through a script.

Figure 44 Directory as a Super-Root



crontab Modification During ClearCase Installation

The ClearCase installation script, **install_release**, analyzes the **crontab** file of the **root** user on a client host. It modifies entries in this file to prevent the recursive traversal problem (or displays a message warning that it cannot perform the modification).

After installation, verify the correctness of the **install_release** changes. In addition, modify the **crontab** entries of other users, according to the instructions in *Modifying a crontab Entry*.

Modifying a crontab Entry

Use the following procedure to analyze and, if necessary, modify all of a host's **crontab** entries.

1. **Analyze the crontab entries.** Determine which entries will encounter the recursion problem:

```
% su
Password: <enter root password>
# grep "find /"  /usr/spool/cron/crontabs/*
/usr/spool/cron/crontabs/root:15 3 * * * find / –name .nfs\*
     –mtime +7 –exec rm –f {} \; –o –fstype nfs –prune
```

In the example above, long lines are broken for readability. In actual **crontab** files, each entry must be contained on a single physical text line.

2. **Revise crontab entries.** You must modify each **crontab** file in which an offending entry was found. For example:

# **su –** *username*	*(switch user identity)*
# **crontab –l > /tmp/C**	*(create temporary file with that user's crontab entries)*
# **vi /tmp/C**	*(modify those entries)*
# **crontab < /tmp/C**	*(configure the modified entries)*

During the edit session, change the command containing **find /** by adding the host-appropriate options. Detailed information on platform-specific options is in the *Platform-Specific Guide* in online help. It is also a good idea to add comments to the **crontab** files warning others not to add entries that cause recursive traversal problems.

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