IBM System Storage SAN Volume Controller

CIM Agent Developer's Guide

Version 4.3.1

SC23-6665-00

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SC23-6665-00

Note:
Before using this information and the product it supports, read the information in **Notices**.

This edition applies to the IBM System Storage SAN Volume Controller, release 4.3.1, and to all subsequent releases and modifications until otherwise indicated in new editions. This edition replaces SC26-7904-03.

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About this guide

This publication introduces the Common Information Model (CIM) agent for the IBM® System Storage™ SAN Volume Controller.

This section describes:

- Content and intended audience of this book
- Typefaces that are used to show emphasis
- Information that is related to this book
- How to order IBM publications
- How to send in your feedback on this book
- Web sites that provide information about the SAN Volume Controller or related products or technologies

Who should use this guide?

This reference book is for application programmers who are developing with the Common Information Model.

This reference book is for CIM-based application programmers who want to perform the following tasks:

- Understand the CIM Agent for the SAN Volume Controller
- Discover and connect to the CIM Agent service
- Retrieve and extract the CIM Agent object classes, attributes, and methods
- Create new object instances for basic storage configuration, logical unit number (LUN) masking, and Copy Services on the SAN Volume Controller.

Summary of changes

This document contains terminology, maintenance, and editorial changes.

Technical changes or additions to the text and illustrations are indicated by a vertical line to the left of the change. This summary of changes describes new functions that have been added to this release.

Summary of changes for SC23-6665-00 SAN Volume Controller CIM Agent Developer's Guide

The summary of changes provides a list of new, modified, and changed information since the last version of the guide.

New information

This topic describes the changes to this guide since the previous edition of the *IBM System Storage SAN Volume Controller CIM Agent Developer's Reference*, SC26-7904-03. The name of this publication is now called *IBM System Storage SAN Volume Controller CIM Agent Developer's Guide*, SC23-6665-00. The following section summarizes the changes that have since been implemented from the previous version.

This version includes the following general new information:

- The CIM object manager (CIMOM) resides on both the SAN Volume Controller Console and the cluster. The SAN Volume Controller GUI continues to use the CIMOM that is on the SAN Volume Controller Console.
- You cannot use CIM agent to add nonautodeleting IBM FlashCopy® maps to an autodeleting FlashCopy consistency group. You can, however, use the CIM agent to convert a FlashCopy set to a clone copy set, and you can also use the CIM agent to convert a clone copy set to a FlashCopy set. To convert either the FlashCopy set or a clone copy set, use the ModifySychronizedSet method in the StorageConfigurationService class.

Changed information

This section lists the updates that were made in this document.

- The messages for CIM return codes and their corresponding SAN Volume Controller CLI error codes was removed from this guide. The actual error code reference comparisons remain. For information on their specific messages and action plans, refer to the *IBM System Storage SAN Volume Controller Command-Line Interface User's Guide*.
- Several FlashCopy consistency groups have the autodeleting option. The table that compares SAN Volume Controller concepts to Common Information Model concepts was updated to include new entries for these consistency groups.
- A listing of the SMI-S profiles that CIM agent for SAN Volume Controller supports was added.

Summary of changes for SC26-7904-03 SAN Volume Controller CIM Agent Developer's Reference

The summary of changes provides a list of new, modified, and changed information since the last version of the guide.

New information

This topic describes the changes to this guide since the previous edition, SC26-7904-02. The following section summarizes the changes that have since been implemented from the previous version.

This version includes the following general new information:

- The SAN Volume Controller CIM Agent version 4.3.0 is based on Open Pegasus version 2.7.0.
- This edition, SC26-7904-03, only applies if you are running SAN Volume Controller software version 4.3.0 or higher. If you are running software version 4.2.1, use the previous edition, SC26-7904-02. If you are running 4.2.0 or earlier, use the edition SC26-7904-01.
- Virtual disk (VDisk) mirroring feature additions.
- Space-efficient virtual disk feature additions.
- Implementation of Internet Protocol Version 6 (IPv6): IPv4 formats also continue to be recognized. Keys should never be constructed by client software but treated as opaque values.
- The SAN Volume Controller CIM agent command-line utility.

Changed information

This section lists the updates that were made in this document:

- A section was added about creating a synchronous copy relationship between volumes in different clusters.
- A topic was added about updating Secure Sockets Layer (SSL) certificates.
- A chapter was added about CIM agent maintenance and diagnostic tasks.
- Specific information about the CIM agent classes and methods was removed from this manual.

Emphasis

Different typefaces are used in this guide to show emphasis.

The following typefaces are used to show emphasis:

Boldface	Text in **boldface** represents menu items and command names.
Italics	Text in *italics* is used to emphasize a word. In command syntax, it is used for variables for which you supply actual values, such as a default directory or the name of a cluster.
`Monospace`	Text in `monospace` identifies the data or commands that you type, samples of command output, examples of program code or messages from the system, or names of command flags, parameters, arguments, and name-value pairs.

SAN Volume Controller library and related publications

A list of other publications that are related to this product are provided to you for your reference.

The tables in this section list and describe the following publications:

- The publications that make up the library for the IBM System Storage SAN Volume Controller
- Other IBM publications that relate to the SAN Volume Controller

SAN Volume Controller library

The following table lists and describes the publications that make up the SAN Volume Controller library. Unless otherwise noted, these publications are available in Adobe® portable document format (PDF) from the following Web site:

www.ibm.com/storage/support/2145

Title	Description	Order number
IBM System Storage SAN Volume Controller Planning Guide	This guide introduces the SAN Volume Controller and lists the features you can order. It also provides guidelines for planning the installation and configuration of the SAN Volume Controller.	GA32-0551

Title	Description	Order number
IBM System Storage SAN Volume Controller Model 2145-8A4 Hardware Installation Guide	This guide provides the instructions that the IBM service representative uses to install the hardware for SAN Volume Controller model 2145-8A4.	GC27-2219
IBM System Storage SAN Volume Controller Model 2145-8G4 Hardware Installation Guide	This guide provides the instructions that the IBM service representative uses to install the hardware for SAN Volume Controller model 2145-8G4.	GC27-2220
IBM System Storage SAN Volume Controller Software Installation and Configuration Guide	This guide provides guidelines for configuring your SAN Volume Controller. Instructions for backing up and restoring the cluster configuration, using and upgrading the SAN Volume Controller Console, using the CLI, upgrading the SAN Volume Controller software, and replacing or adding nodes to a cluster are included.	SC23-6628
IBM System Storage SAN Volume Controller CIM Agent Developer's Guide	This guide describes the concepts of the Common Information Model (CIM) environment. Steps about using the CIM agent object class instances to complete basic storage configuration tasks, establishing new Copy Services relationships, and performing CIM agent maintenance and diagnostic tasks are included.	SC23-6665
IBM System Storage SAN Volume Controller Command-Line Interface User's Guide	This guide describes the commands that you can use from the SAN Volume Controller command-line interface (CLI).	SC26-7903
IBM System Storage SAN Volume Controller Host Attachment Guide	This guide provides guidelines for attaching the SAN Volume Controller to your host system.	SC26-7905
IBM System Storage SAN Volume Controller Troubleshooting Guide	This guide describes the features of each SAN Volume Controller model, explains how to use the front panel, and provides maintenance analysis procedures to help you diagnose and solve problems with the SAN Volume Controller.	GC27-2227

Title	Description	Order number
IBM System Storage SAN Volume Controller Hardware Maintenance Guide	This guide provides the instructions that the IBM service representative uses to service the SAN Volume Controller hardware, including the removal and replacement of parts.	GC27-2226
IBM System Storage SAN Volume Controller Models 2145-8F2 and 2145-8F4 Hardware Installation Guide	This guide provides the instructions that the IBM service representative uses to install the hardware for SAN Volume Controller models 2145-8F2 and 2145-8F4.	GC27-2221
IBM System Storage SAN Volume Controller Model 2145-4F2 Hardware Installation Guide	This guide provides the instructions that the IBM service representative uses to install the hardware for SAN Volume Controller model 2145-4F2.	GC27-2222
IBM System Storage SAN Volume Controller Master Console Guide	This guide describes how to install, maintain, and service the master console.	GC27-2223
IBM Systems Safety Notices	This guide contains translated caution and danger statements. Each caution and danger statement in the SAN Volume Controller documentation has a number that you can use to locate the corresponding statement in your language in the *IBM Systems Safety Notices* document.	G229-9054

Other IBM publications

The following table lists and describes other IBM publications that contain additional information that is related to the SAN Volume Controller.

You can download IBM eServer™ IBM xSeries® and IBM System x™ publications from the following Web site:

www.ibm.com/jct01004c/systems/support/

Title	Description	Order number
IBM System Storage Productivity Center Introduction and Planning Guide	This guide introduces the IBM System Storage Productivity Center hardware and software.	SC23-8824
Read This First: Installing the IBM System Storage Productivity Center	This guide describes how to install the IBM System Storage Productivity Center hardware.	GI11-8938

Title	Description	Order number
IBM System Storage Productivity Center User's Guide	This guide describes how to configure the IBM System Storage Productivity Center software.	SC27-2336
IBM System Storage Multipath Subsystem Device Driver User's Guide	This guide describes the IBM System Storage Multipath Subsystem Device Driver for IBM System Storage products and how to use it with the SAN Volume Controller.	GC52-1309
IBM System Storage DS Storage Manager Version 10.30 Installation and Host Support Guide	This guide provides information about how to plan, install, configure, and work with IBM System Storage DS™ Storage Manager.	GC53-1135
IBM System Storage DS Storage Manager Version 10.30 Copy Services Guide	This guide provides information about setting up, installing, configuring, and working with the three IBM System Storage DS Storage Manager premium features that assist with copy services: FlashCopy®, VolumeCopy, and the Enhanced Remote Mirroring Option.	GC53-1136
IBM System Storage DS4000/DS5000 Fibre Channel and Serial ATA Intermix Premium Feature Installation Overview	This overview describes how to install the IBM System Storage DS4000/DS5000 Fibre Channel and Serial ATA Intermix Premium Feature.	GC53-1137
IBM System Storage DS5100 and DS5300 Installation, User's and Maintenance Guide	This guide describes how to install and configure the IBM System Storage DS5100 and DS5300.	GC53-1140
IBM System Storage EXP5000 Storage Expansion Enclosure Installation, User's, and Maintenance Guide	This guide describes how to install and configure the IBM System Storage EXP5000 Storage Expansion Enclosure.	GC53-1141
IBM System Storage DS Storage Manager Command-line Programming Guide	This guide describes the commands that you can use from the IBM System Storage DS Storage Manager command-line interface.	GC52-1275
IBM System Storage DS5000 Quick Start Guide: Quick Reference for the DS5100, DS5300 and EXP5000	This guide provides information about setting up and installing the DS5100, DS5300 and EXP5000.	GC53-1134
IBM TotalStorage DS4300 Fibre Channel Storage Subsystem Installation, User's, and Maintenance Guide	This guide describes how to install and configure the IBM TotalStorage® DS4300 Fibre-Channel Storage Subsystem.	GC26-7722

Title	Description	Order number
IBM eServer xSeries 306m (Types 8849 and 8491) Installation Guide	This guide describes how to install the IBM eServer xSeries 306m, which is the hardware delivered for some versions of the hardware master console.	MIGR-61615
IBM xSeries 306m (Types 8849 and 8491) User's Guide	This guide describes how to use the IBM eServer xSeries 306m, which is the hardware delivered for some versions of the hardware master console.	MIGR-61901
IBM xSeries 306m (Types 8849 and 8491) Problem Determination and Service Guide	This guide can help you troubleshoot and resolve problems with the IBM eServer xSeries 306m, which is the hardware delivered for some versions of the hardware master console.	MIGR-62594
IBM eServer xSeries 306 (Type 8836) Installation Guide	This guide describes how to install the IBM eServer xSeries 306, which is the hardware delivered for some versions of the hardware master console.	MIGR-55080
IBM eServer xSeries 306 (Type 8836) User's Guide	This guide describes how to use the IBM eServer xSeries 306, which is the hardware delivered for some versions of the hardware master console.	MIGR-55079
IBM eServer xSeries 306 (Types 1878, 8489 and 8836) Hardware Maintenance Manual and Troubleshooting Guide	This guide can help you troubleshoot problems and maintain the IBM eServer xSeries 306, which is the hardware delivered for some versions of the hardware master console.	MIGR-54820
IBM eServer xSeries 305 (Type 8673) Installation Guide	This guide describes how to install the IBM eServer xSeries 305, which is the hardware delivered for some versions of the hardware master console.	MIGR-44200
IBM eServer xSeries 305 (Type 8673) User's Guide	This guide describes how to use the IBM eServer xSeries 305, which is the hardware delivered for some versions of the hardware master console.	MIGR-44199

Title	Description	Order number
IBM eServer xSeries 305 (Type 8673) Hardware Maintenance Manual and Troubleshooting Guide	This guide can help you troubleshoot problems and maintain the IBM eServer xSeries 305, which is the hardware delivered for some versions of the hardware master console.	MIGR-44094
IBM TotalStorage 3534 Model F08 SAN Fibre Channel Switch User's Guide	This guide introduces the IBM TotalStorage SAN Switch 3534 Model F08.	GC26-7454
IBM System x3250 (Types 4364 and 4365) Installation Guide	This guide describes how to install the IBM System x3250, which is the hardware delivered for some versions of the hardware master console.	MIGR-5069761
IBM System x3250 (Types 4364 and 4365) User's Guide	This guide describes how to use the IBM System x3250, which is the hardware delivered for some versions of the hardware master console.	MIGR-66373
IBM System x3250 (Types 4364 and 4365) Problem Determination and Service Guide	This guide can help you troubleshoot and resolve problems with the IBM System x3250, which is the hardware delivered for some versions of the hardware master console.	MIGR-66374
IBM TotalStorage SAN Switch 2109 Model F16 User's Guide	This guide introduces the IBM TotalStorage SAN Switch 2109 Model F16.	GC26-7439
IBM TotalStorage SAN Switch 2109 Model F32 User's Guide	This guide introduces the IBM TotalStorage SAN Switch 2109 Model F32. It also describes the features of the switch and tells you where to find more information about those features.	GC26-7517

Some related publications are available from the following SAN Volume Controller support Web site:

www.ibm.com/storage/support/2145

Related Web sites

The following Web sites provide information about the SAN Volume Controller or related products or technologies:

Type of information	Web site
SAN Volume Controller support	www.ibm.com/storage/support/2145

Technical support for IBM storage products	www.ibm.com/storage/support/

How to order IBM publications

The IBM Publications Center is a worldwide central repository for IBM product publications and marketing material.

The IBM Publications Center offers customized search functions to help you find the publications that you need. Some publications are available for you to view or download at no charge. You can also order publications. The publications center displays prices in your local currency. You can access the IBM Publications Center through the following Web site:

www.ibm.com/shop/publications/order/

How to send your comments

Your feedback is important to help us provide the highest quality information. If you have any comments about this book or any other documentation, you can submit them in one of the following ways:

- E-mail

  Submit your comments electronically to the following e-mail address:

  starpubs@us.ibm.com

  Be sure to include the name and order number of the book and, if applicable, the specific location of the text you are commenting on, such as a page number or table number.
- Mail

  Fill out the Readers' Comments form (RCF) at the back of this book. If the RCF has been removed, you can address your comments to:

  International Business Machines Corporation
  RCF Processing Department
  Department 61C
  9032 South Rita Road
  Tucson, Arizona 85775-4401
  U.S.A.

Chapter 1. Introduction to CIM agent

The Common Information Model (CIM) provides an open approach to the design and implementation of storage systems, applications, databases, networks, and devices. The CIM agent is a set of standards that is developed by the Distributed Management Task Force (DMTF).

The following information introduces the Storage Management Initiative Specification (SMI-S), the CIM agent, the SAN Volume Controller, and the CIM agent for the SAN Volume Controller. Functional views of the CIM agent object models illustrate the architecture and specific functions of the CIM agent.

Storage Management Initiative Specification

The Storage Management Initiative Specification (SMI-S) is a design specification of the Storage Management Initiative (SMI) that is launched by the Storage Networking Industry Association (SNIA).

The SMI-S specifies a secure and reliable interface that allows storage management systems to identify, classify, monitor, and control physical and logical resources in a storage area network (SAN). The interface integrates the various devices to be managed in a SAN and the tools used to manage them.

SMI-S is based on a number of existing technologies or industry standards that include the following:

Common Information Model (CIM)
An object model for data storage and management that is developed by the Distributed Management Task Force (DMTF). CIM makes it possible to organize devices and components of devices in an object-oriented pattern.

Web-Based Enterprise Management (WBEM)
A tiered enterprise management architecture that is also developed by the DMTF. This architecture provides the management design framework that consists of devices, device providers, the object manager, and the messaging protocol for the communication between client applications and the object manager. In the case of the CIM, the object manager is the CIMOM and the messaging protocol is the CIM over HTTP technology. The CIM over HTTP approach specifies that the CIM data is encoded in XML and sent in specific messages between the client applications and the CIMOM over the TCP/IP network in a SAN.

Service Location Protocol (SLP)
A directory service that the client application uses to locate the CIMOM.

Intended to be an industry standard, SMI-S extends the generic capabilities of the CIM, the WBEM, and the SLP to implement storage networking interoperability. For example, the WBEM provides provisions for security, resource-locking management, event notification, and service discovery.

For more information about SMI-S conforming profiles that are supported by CIM agent for the SAN Volume Controller and writing standards-based implementations, see the following Web site:

www.snia.org/forums/smi/tech_programs/smis_home/

CIM agent

The Common Information Model (CIM) agent is a set of standards that is developed by the Distributed Management Task Force (DMTF).

The CIM provides an open approach to the design and implementation of storage systems, applications, databases, networks, and devices.

The CIM specifications provide the language and the methodology for describing management data. For example, CIM Schema 2.7 for Managing Storage Arrays specifies how to enable the management environment for data management in a common way. The CIM defines common object classes, associations, and methods. Member vendors can use those objects and extend them to specify how data can be processed and organized in a specific managed environment.

CIM agent concepts

This information describes the basic terminology and functions of the Common Information Model (CIM) agent object models.

You must familiarize yourself with these concepts. The CIM agent specifications use the following concepts and terminology to describe the object models:

Association
A class with two references that define a relationship between two referenced objects.

Class The definition of an object within a specific hierarchy. An object class can have properties and methods and serve as the target of an association.

Indication
An object representation of an event.

Instance
An individual object that is the member of a class. In object-oriented programming, an object that is created by instantiating a class.

Managed Object Format (MOF)
A language for defining Common Information Model (CIM) schemas.

Method
A way to implement a function on a class.

Namespace
The scope within which a CIM schema applies.

Object path
An object that consists of a namespace path and a model path. The namespace path provides access to the CIM implementation that the CIM agent manages, and the model path provides navigation within the implementation.

Property
An attribute that is used to characterize instances of a class.

Qualifier
A value that provides additional information about a class, association, indication, method, method parameter, instance, property, or reference.

Reference
A pointer to another instance that defines the role and scope of an object in an association.

Schema
A group of object classes defined for and applicable to a single namespace. Within the CIM agent, the supported schemas are the ones that are loaded through the Managed Object Format (MOF) compiler.

CIM agent components

With a Common Information Model (CIM) agent, application programmers can use common building blocks rather than proprietary software or device-specific programming interfaces to manage CIM-compliant devices. Standardization of the way that applications manage storage provides easier storage management.

Components

A CIM agent involves the following components:

agent code
An open-systems standard that interprets CIM requests and responses as they transfer between the client application and the device.

CIM object manager (CIMOM)
The common conceptual framework for data management that receives, validates, and authenticates the CIM requests from the client application. It then directs the requests to the appropriate component or device provider. The SAN Volume Controller software version 4.2.1 is based on the Open Pegasus version 2.5.1 CIMOM.

client application
A storage management program that initiates CIM requests to the CIM agent for the device.

device
The storage server that processes and hosts the client application requests.

device provider
A device-specific handler that serves as a plugin for the CIM. That is, the CIMOM uses the handler to interface with the device.

Service Location Protocol (SLP)
A directory service that the client application calls to locate the CIMOM.

CIM agent for the SAN Volume Controller

The Common Information Model (CIM) agent for the SAN Volume Controller serves as a configuration interface for the SAN Volume Controller.

The CIM agent consists of the following main components:

- CIM object manager (CIMOM)
- Service Location Protocol (SLP) agent
- SAN Volume Controller provider

The SAN Volume Controller Console is configured to locate the CIMOM though its IP address. When the CIMOM is started, it registers itself with the SLP directory service by supplying its IP address, port number, and service type information. With the location information secured, the SAN Volume Controller Console begins to

communicate directly with the CIMOM and the SAN Volume Controller provider. The CIMOM makes requests to the provider and the provider uses the functions that are provided by the SAN Volume Controller to fulfill these requests.

Examples of how CIM agent works

The Common Information Model (CIM) agent can be used to provide common building blocks to manage CIM-compliant devices.

Typical CIM agent configuration

Figure 1 shows how a typical CIM agent works.

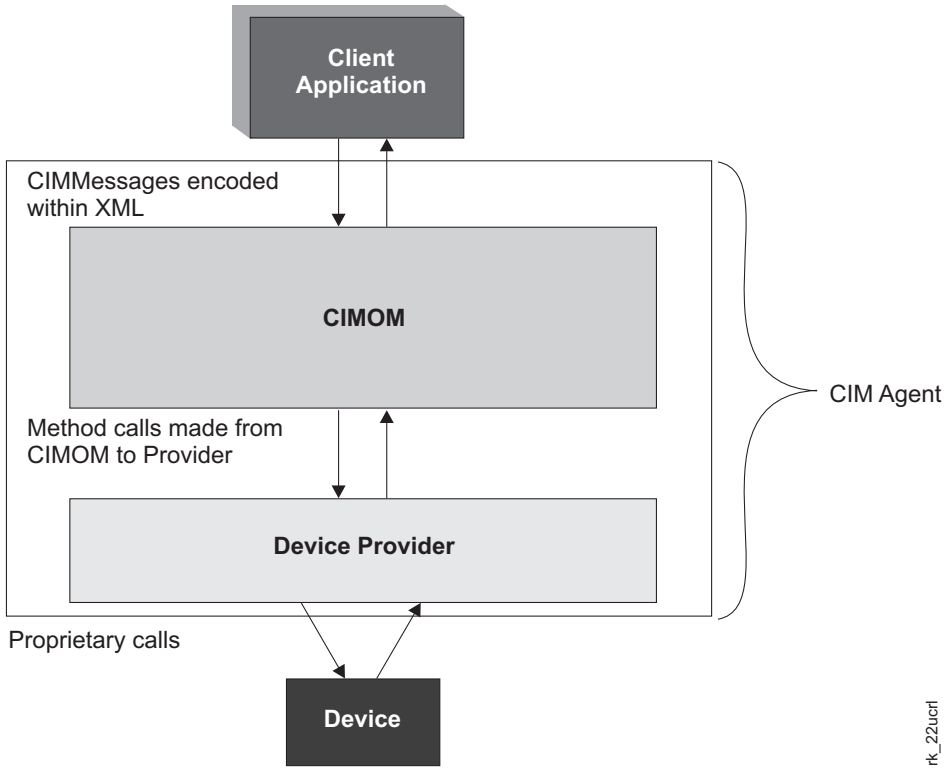

Figure 1. A typical CIM agent at work

A typical configuration for your CIM client is to use the CIMOM that is located at https://*cluster_ip* port 5989 with namespace=/root/ibm. (The standard secure port is 5989.)

The client application sends CIM requests to the CIMOM. As requests arrive, the CIMOM validates and authenticates each request. It then directs the requests to the appropriate functional component of the CIMOM or to a device provider. To satisfy client application requests, the provider makes calls to a device-unique programming interface on behalf of the CIMOM.

The management application can obtain an instance of the RemoteServiceAccessPoint from the CIMOM. This instance allows the management application to access the Web User Interface.

CIM agent configuration with Service Location Protocol

If you use Service Location Protocol (SLP) to discover the CIMOM, the client application locates the CIMOM by calling an SLP directory service. When the CIMOM is first invoked, it registers itself to the SLP Service agent and supplies its location, IP address, port number, and the type of service that it provides. A string that describes the CIM agent access point is registered.

The following output provides an example of the registered string:

```
service:wbem:https://<CIM Agent IP>:<port number>
```

The SLP provides the following attributes:

```
template-type=wbem
template-version=1.0
template-description=This template describes the attributes used for
advertising WBEM servers.
template-url-syntax=https://9.47.24.91:5989
service-location-tcp=https://9.47.24.91:5989
service-hi-name=IBM System Storage SAN Volume Controller CIMOM
service-hi-description=IBM SVC CIM Agent Version 4.2.1.xxx
service-id=IBMTSSVC:9.47.24.91
ProtocolVersion=1.2
CommunicationMechanism=cim-xml
FunctionalProfilesSupported=Basic Read, Basic Write, Instance Manipulation,
Association, Traversal, Query Execution, Qualifier Declaration, Indications
AuthenticationMechanismSupported=Basic
Namespace=/root/ibm
InteropSchemaNamespace=/root/ibm
MultipleOperationsSupported=false
RegisteredProfilesSupported=SNIA:Storage Virtualizer,SNIA:Storage Virtualizer:
Access Points,SNIA:Storage Virtualizer:Block Services,SNIA:Storage Virtualizer:
Cascading,SNIA:Storage Virtualizer:Copy Services,SNIA:Storage Virtualizer:
FC Initiator Ports,SNIA:Storage Virtualizer:FC Target Ports,SNIA:Storage
Virtualizer:Health,SNIA:Storage Virtualizer:Masking and Mapping,SNIA:Storage
Virtualizer:Multiple Computer System,SNIA:Storage Virtualizer:Physical Package,
SNIA:Storage Virtualizer:Software,SNIA:Server,SNIA:Server:Profile Registration,
SNIA:Server:Indication,SNIA:SMI-S
```

With this information, the client application starts to directly communicate with the CIMOM.

CIM agent configuration on the console and the cluster

SAN Volume Controller 4.3.1 has two CIMOMs. One CIMOM resides on the host where the SAN Volume Controller Console is running. The host that runs the SAN Volume Controller Console can be either the IBM System Storage Productivity Center (SSPC) or master console. The other CIMOM resides on the SAN Volume Controller cluster. The SAN Volume Controller Console uses the CIMOM that is on the same host. Other IBM storage management tools use the CIMOM that is on the cluster.

Figure 2 on page 6 shows how this dual CIMOM configuration is defined.

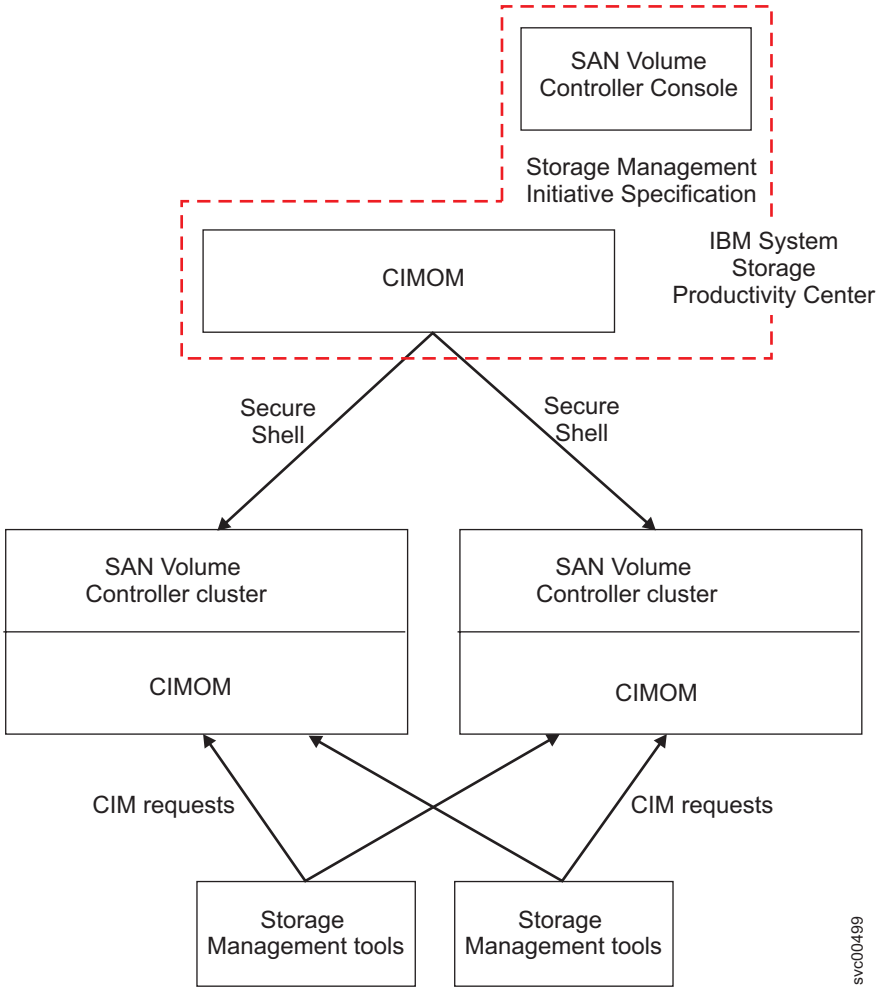

Figure 2. CIMOM on the console and cluster

SAN Volume Controller CIMOM programming

CIM object manager (CIMOM) programming provides the opportunity to handle multiple connections from multiple sources while maintaining security. CIM clients connect to the CIMOM with a user name and password and then invoke methods to run commands.

The creation of a CIM client requires a suitable framework such as the Java™ WBEM Service project, the SBLIM CIM Client for Java, and the Aperi open source project. There are also implementations in other languages, including C++ and Python. For more information, see the following Web sites:

Java WBEM Service project
wbemservices.sourceforge.net/

SBLIM CIM Client for Java
www.sblim.wiki.sourceforge.net/CimClient

Aperi www.eclipse.org/aperi/faq/

Figure 3 shows a simple Java program that connects to a SAN Volume Controller CIMOM.

```
import java.util.*;

import javax.wbem.cim.*;
import javax.wbem.client.*;

public class ITSOClient {
  public static void main(String[] args)
  {
    String username = args[0];
    String password = args[1];
    String masterConsoleIP = args[2];
    String masterConsoleSecurePort = args[3];
    UserPrincipal user = new UserPrincipal(username);
    PasswordCredential pwd = new PasswordCredential(password);
    CIMNameSpace ns = new CIMNameSpace("https://"+
         masterConsoleIP+":"+
         masterConsoleSecurePort+"/root/ibm");

    CIMClient client = null;
    try
    {
      System.out.println("Connecting to CIMOM");
      client = new CIMClient(ns,user,pwd);
   }
   catch (CIMException e)
   {
     // Handle the CIM Exception
     e.printStackTrace();
    }
}
```

Figure 3. Java program for connecting to a SAN Volume Controller CIMOM

To view the CIM agent style pages that are shipped with the SAN Volume Controller Console, select the documentation information from the following Web site:

www.ibm.com/storage/support/2145

How SAN Volume Controller concepts map to CIM concepts

To administer the SAN Volume Controller through the CIM object manager (CIMOM), it is important to understand the relationship between SAN Volume Controller and Common Information Model (CIM) concepts.

Table 1 shows how these concepts relate to one another.

Table 1. Relating SAN Volume Controller concepts to CIM concepts

SAN Volume Controller concept	CIM	
	CIM name	**CIM concept**
Cluster	IBMTSSVC_Cluster	Class
ClusterName	ElementName	Property
Cluster ID	Name	Property
VDisk	IBMTSSVC_StorageVolume	Class
VDisk ID	DeviceID	Property

Table 1. Relating SAN Volume Controller concepts to CIM concepts (continued)

SAN Volume Controller concept	CIM	
	CIM name	**CIM concept**
FlashCopy Consistency Group (regular)	IBMTSSVC_FlashCopyStorageSynchronizedSet	Class
FlashCopy Consistency Group (autodelete)	IBMTSSVC_CloneCopyStorageSynchronizedSet	Class
FlashCopy Mapping	IBMTSSVC_LocalStorageSynchronized	Association
FlashCopy Mapping Status	SyncState	Property
mkfcmap	AttachReplica	Method
preparefcmap	ModifySynchronization	Method
startfcmap	ModifySynchronization	Method
Remote Copy Consistency Group (Global Mirror)	IBMTSSVC_AsyncCopyStorageSynchronizedSet	Class
Remote Copy Consistency Group (Metro Mirror)	IBMTSSVC_SyncCopyStorageSynchronizedSet	Class
Remote Copy relationship	IBMTSSVC_RemoteStorageSynchronized	Association
Remote Copy relationship state	NativeState	Property
mkrcrelationship	AttachReplica	Method
startrcrelationship	ModifySynchronization	Method
mdisk	IBMTSSVC_BackendVolume	Class
mdiskgrp	IBMTSSVC_ConcreteStoragePool	Class
mkvdisk	CreateOrModifyElementFromStoragePool	Method
mkmdiskgrp	CreateOrModifyStoragePool	Method
rmvdisk	ReturnToStoragePool	Method
rmmdiskgrp	DeleteStoragePool	Method
Host (with regard to ports)	IBMTSSVC_StorageHardwareID	Class
Host (with regard to VDisk mapping)	IBMTSSVC_ProtocolController	Class
mkvdiskhostmap	ExposePaths	Method
rmvdiskhostmap	HidePaths	Method
mkhost	CreateStorageHardwareID	Method
rmhost	DeleteStorageHardwareID	Method

Functional diagrams of the Common Information Model agent

The functional diagrams of the Common Information Model (CIM) agent object model show specific functions that the CIM agent provides, including storage configuration service, Copy Services, LUN masking, and security. The diagrams also illustrate the architecture of the CIM Agent for the SAN Volume Controller.

Physical package

The physical package of the Common Information Model (CIM) Agent for the SAN Volume Controller consists of two classes and two association classes.

Figure 4 shows the basic classes (building blocks) for the model.

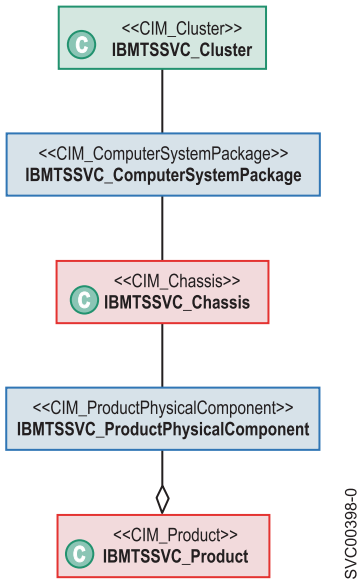

Figure 4. High-level overview of the physical package of the CIM Agent for the SAN Volume Controller.

Server profile

The server profile of the Common Information Model (CIM) Agent for the SAN Volume Controller consists of several basic classes.

Figure 5 on page 10 shows the basic classes (building blocks) for the model.

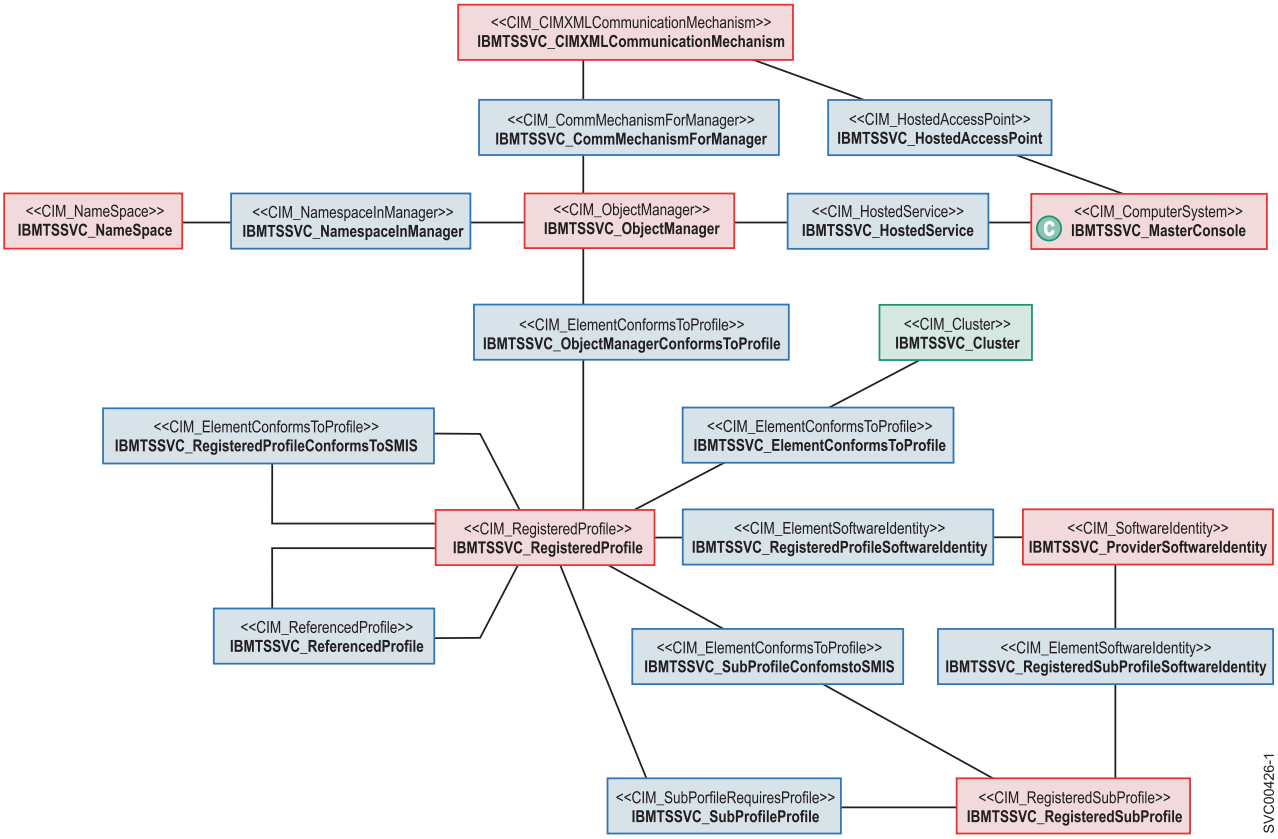

Figure 5. High-level overview of the server profile of the CIM Agent for the SAN Volume Controller.

Access point subprofile

The access point subprofile of the Common Information Model (CIM) Agent for the SAN Volume Controller consists of several basic classes.

Figure 6 shows the basic classes (building blocks) for the model.

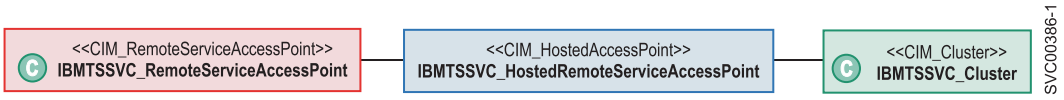

Figure 6. High-level overview of the access point subprofile of the CIM Agent for the SAN Volume Controller.

Cluster subprofile

There are several classes and associations that provide the function of a clustering service.

Figure 7 on page 11 shows the classes and associations that provide the function of a clustering service.

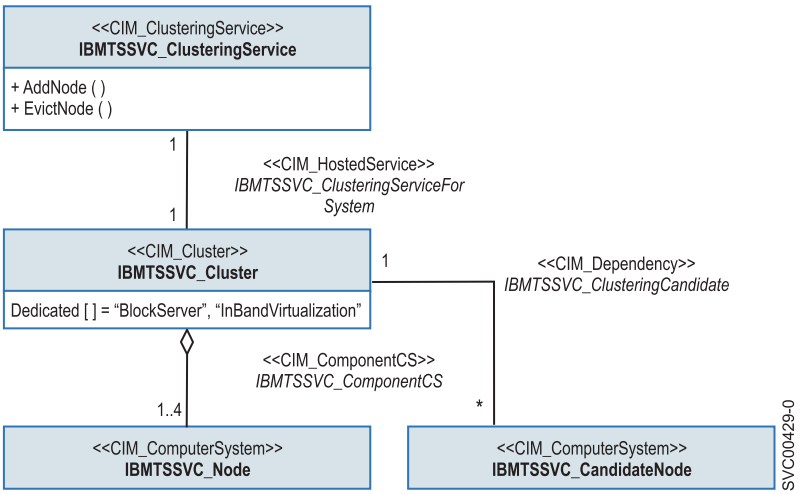

Figure 7. Class diagram of Clustering instance

Copy Services

The IBMTSSVC_StorageConfigurationService class provides the methods to create copy relationships.

Figure 8 on page 12 shows the object classes that provide FlashCopy, Metro Mirror, and Global Mirror Copy Services.

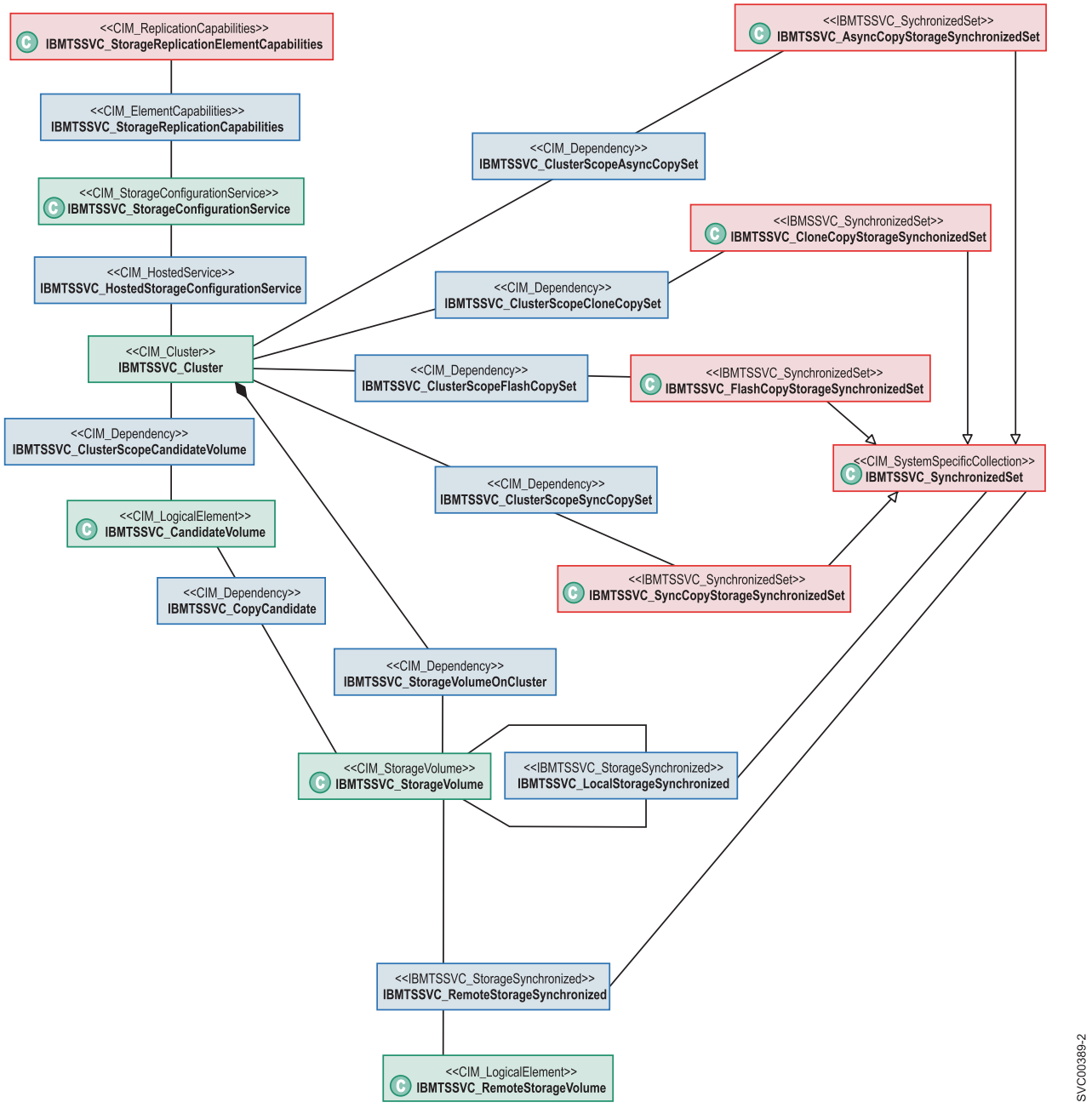

Figure 8. Class diagram of Copy Services instances

Masking and mapping profile

The masking and mapping profile provides an interface to create, modify, delete, and mask hosts.

Figure 9 on page 13 shows the classes and associations for the masking and mapping profile.

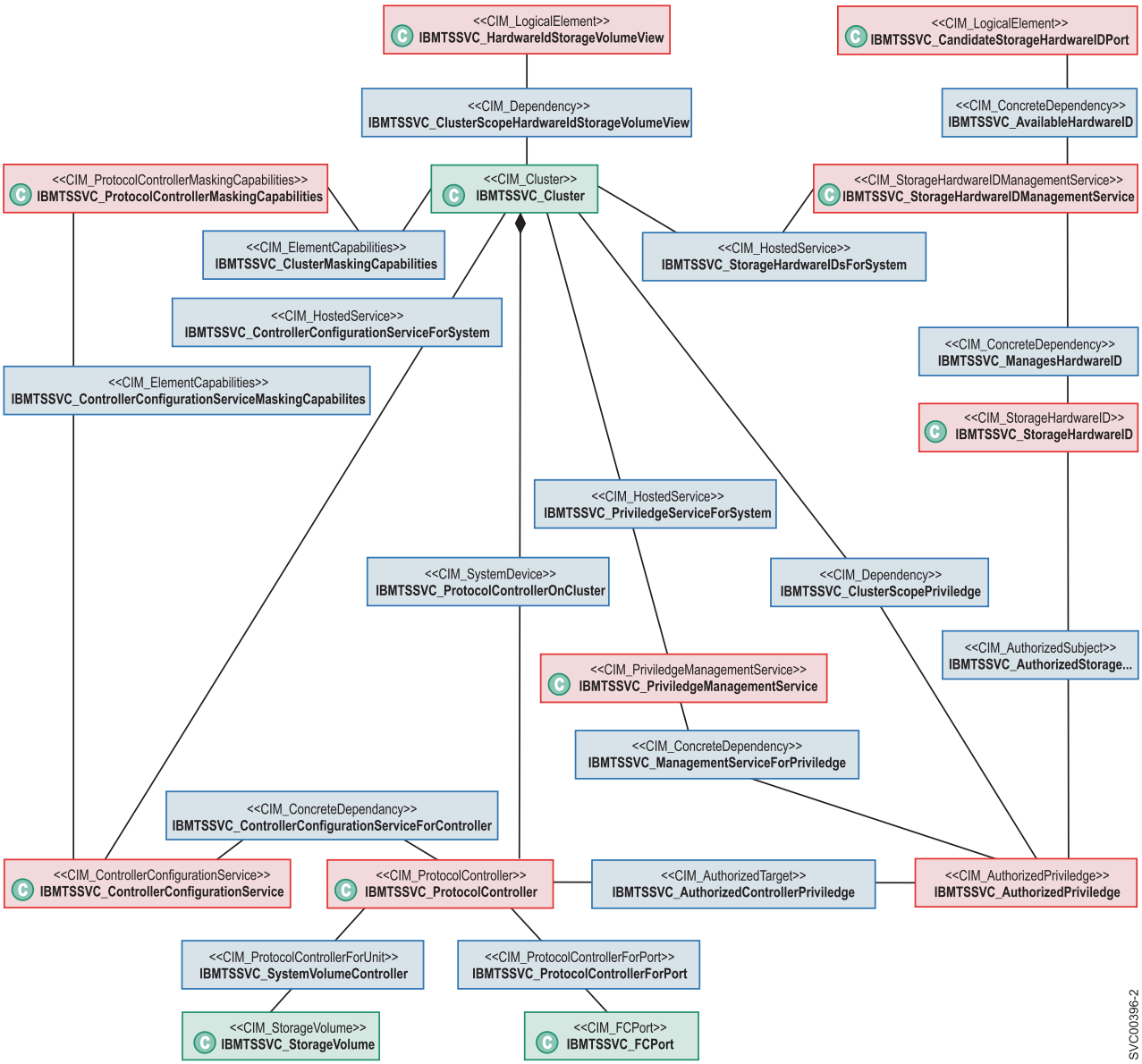

Figure 9. Class diagram of masking and mapping instances

Device configuration profile

The device configuration profile and utilities allow you to configure SAN Volume Controller clusters that are under management. You can use the CIM interface or the command-line tools to add or delete the SAN Volume Controller clusters that are managed by this instance of the CIM Agent.

Figure 10 on page 14 shows the classes and associations for the device configuration profile.

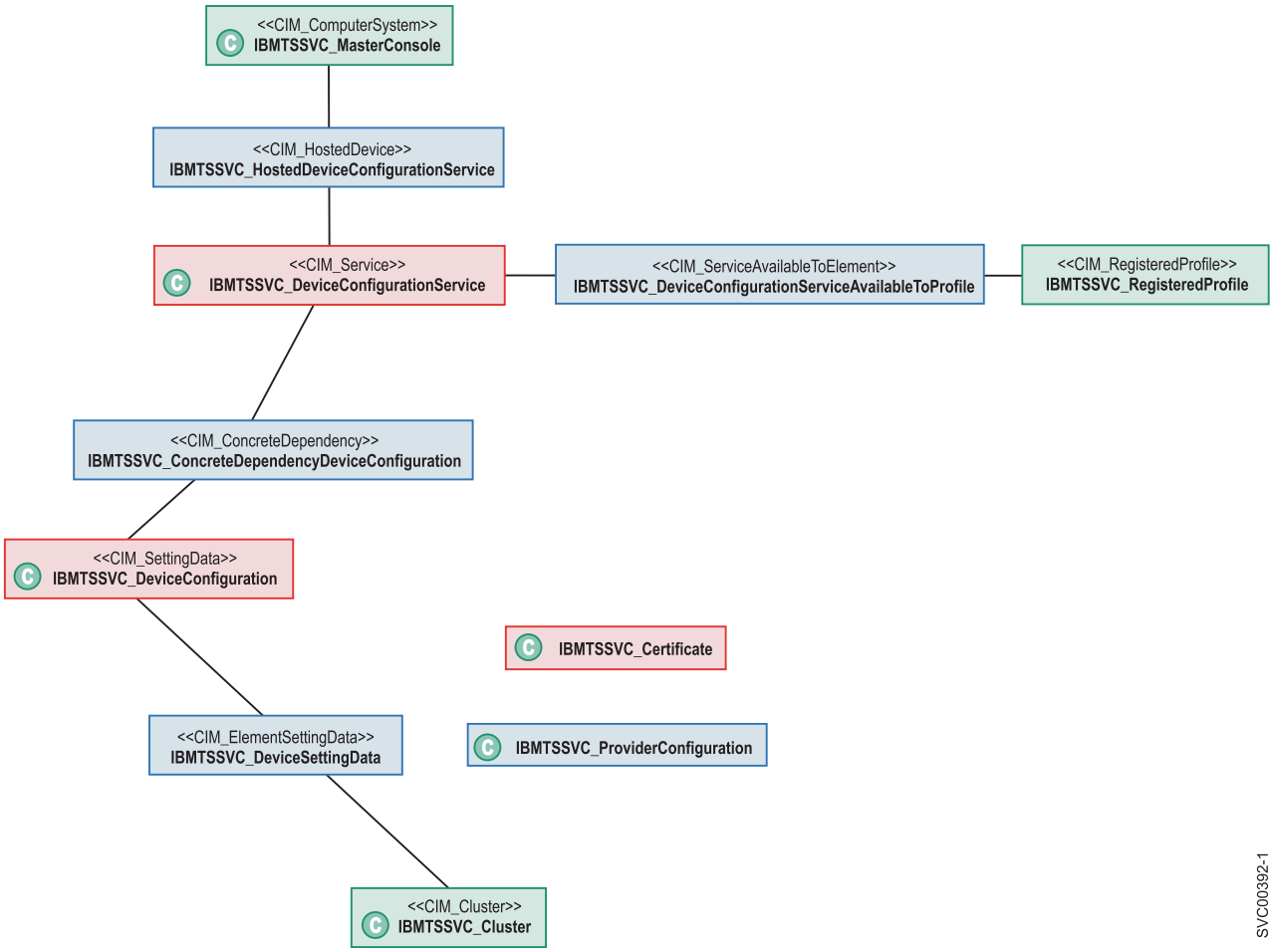

Figure 10. Class diagram of device configuration instances

Multiple computer system profile

The multiple computer system profile utilizes multiple systems to present a virtual computer system.

Figure 11 on page 15 shows the classes and associations for the multiple computer system profile.

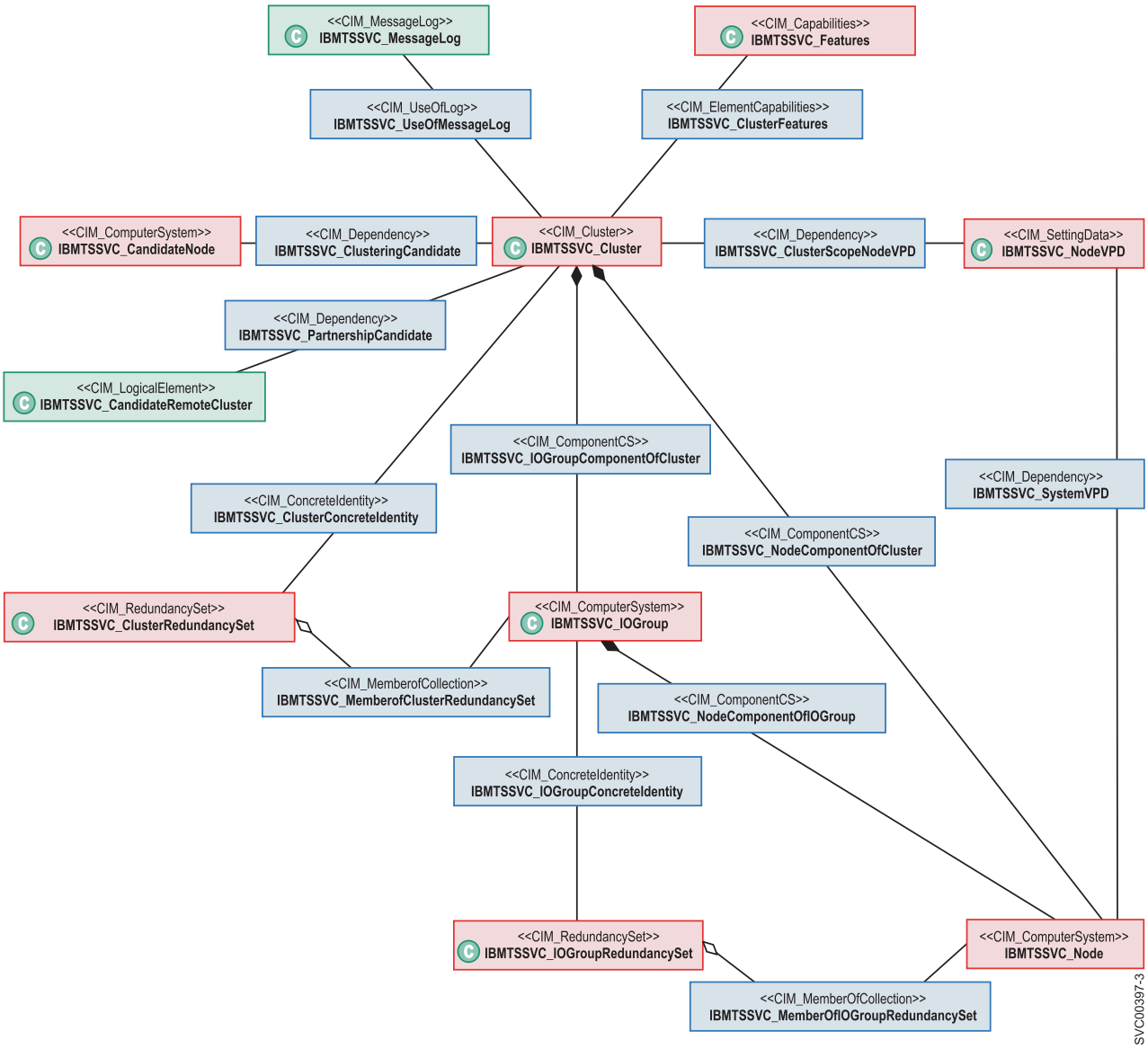

Figure 11. Class diagram of multiple computer system instances

Job control profile

The job control profile contains classes that allow you to monitor asynchronous commands that format, migrate, or run copy operations on a device.

Figure 12 on page 16 shows the classes and associations for the job control profile.

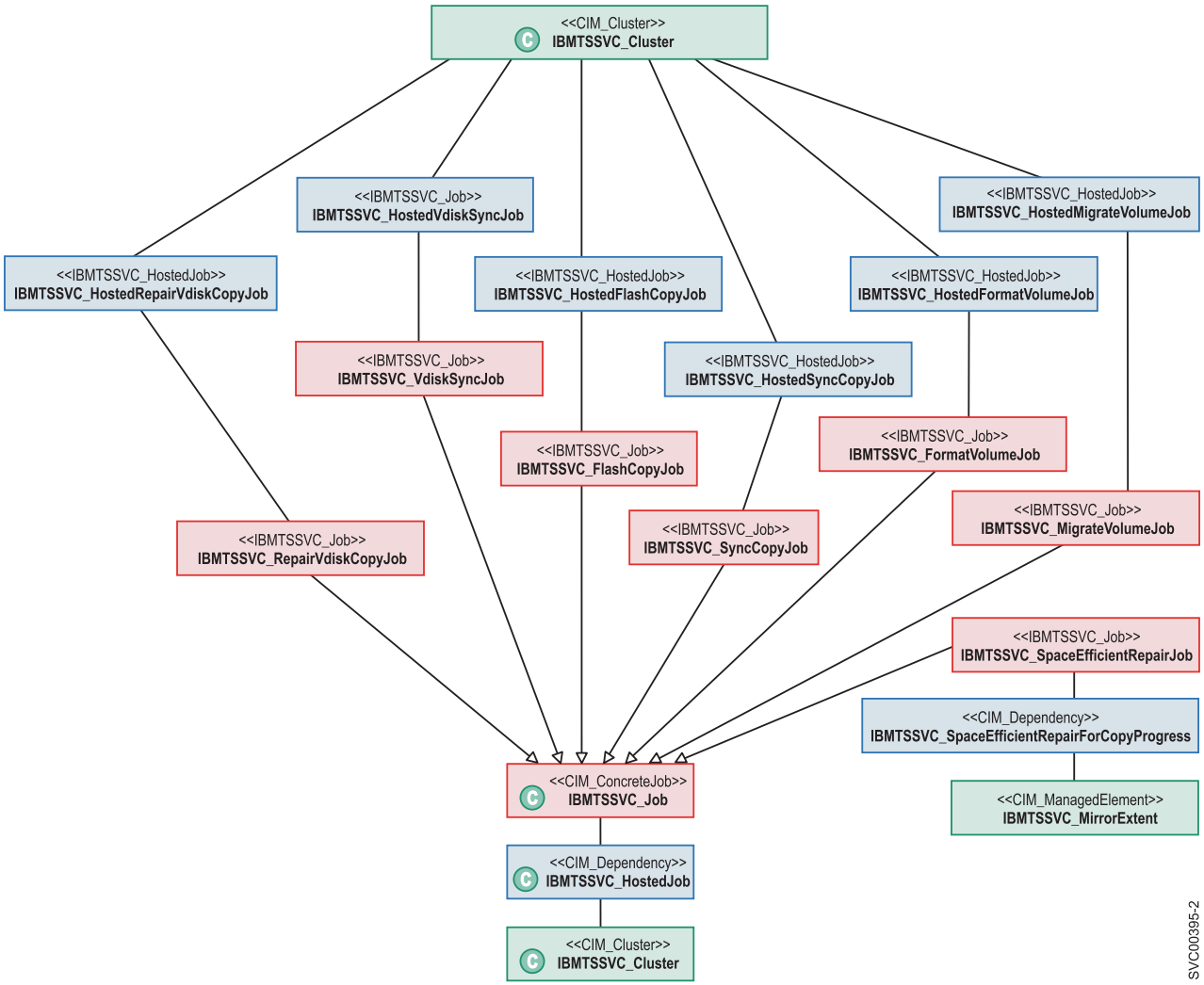

Figure 12. Class diagram of job control instances

Software profile

The software profile allows the CIM Agent to model the software for the SAN Volume Controller cluster and for the CIM Agent.

Figure 13 on page 17 shows the classes and associations for the software profile.

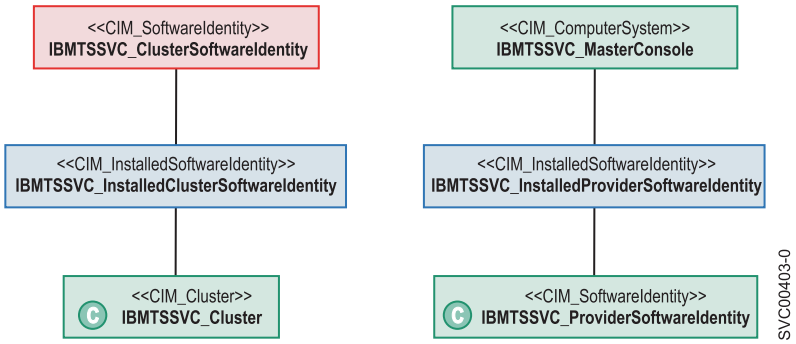

Figure 13. Class diagram of software instances

FC port profile

The FC port profile models the fibre-channel connection relationship between the SAN Volume Controller and the backend storage that the SAN Volume Controller virtualizes.

Figure 14 on page 18 shows the classes and associations for the FC port profile.

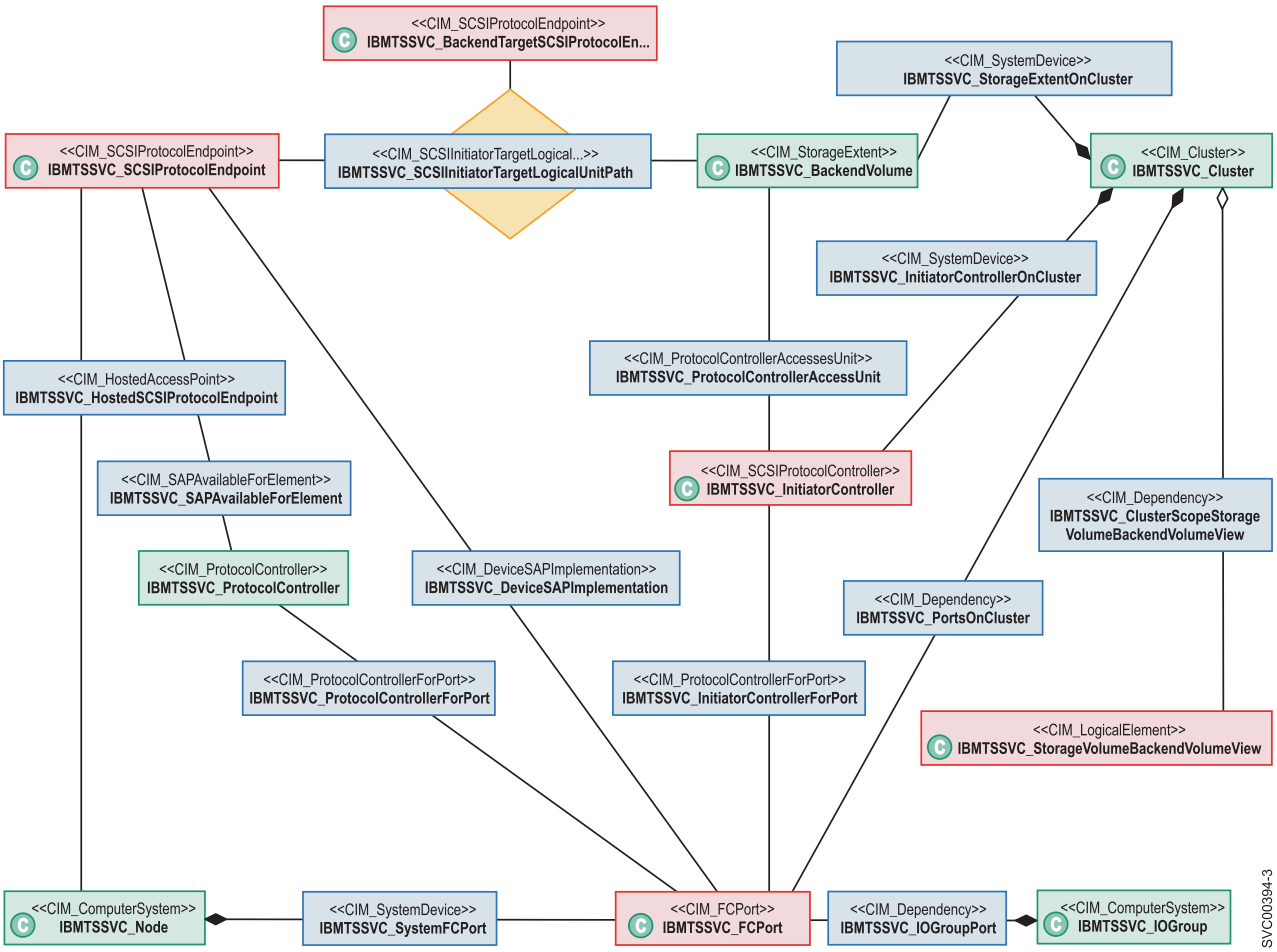

Figure 14. Class diagram of FC port instances

Block services profile

You can use several object classes to manipulate storage pools.

The block services profile allocates back-end storage volumes into storage pools and then creates storage volumes.

Figure 15 on page 19 provides a high-level overview of the object classes that you can use for pool manipulation of the CIM Agent for the SAN Volume Controller.

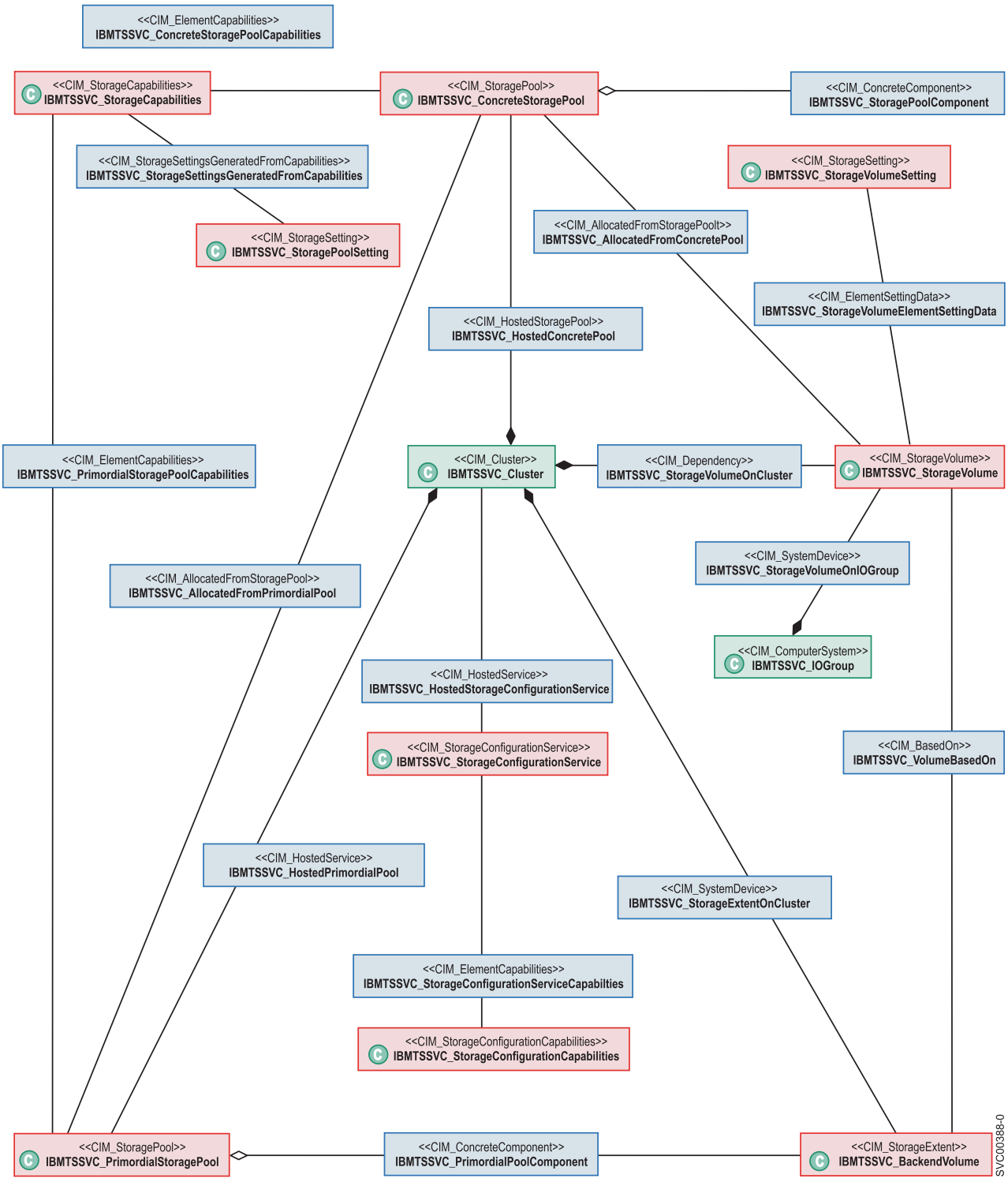

Figure 15. High-level overview of block services of the CIM Agent for the SAN Volume Controller.

Storage volume mirroring

You can create two mirrored copies of a storage volume to increase data availability. The volume remains online and available as long as one copy is available.

Figure 16 shows the classes and associations that are involved in mirroring storage volumes.

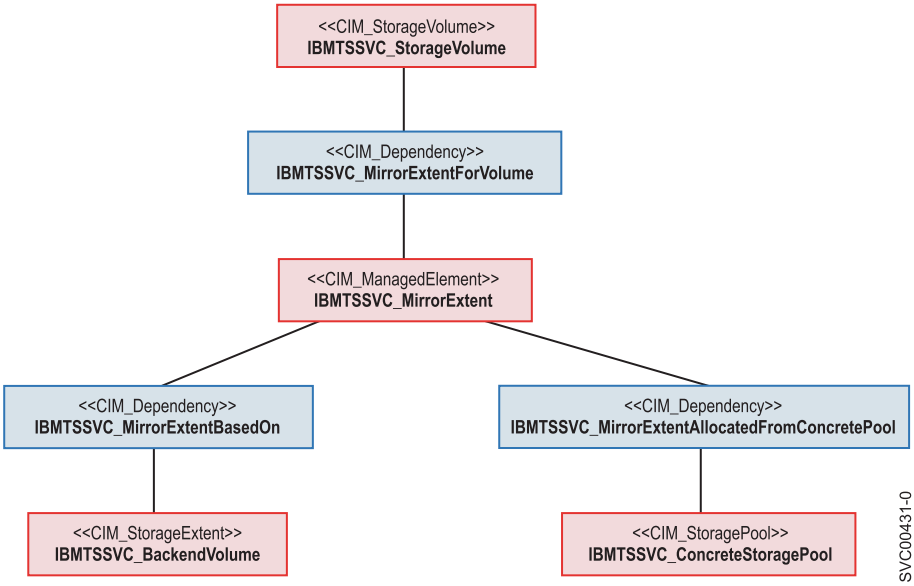

Figure 16. Classes and associations in mirroring storage volumes

Chapter 2. Performing storage configuration tasks

Storage configuration is the mapping of the back-end storage to the storage pools and the allocation of volumes from those pools. After you complete the initial setup of the SAN Volume Controller, you use the Common Information Model (CIM) Agent object class instances to complete basic storage configuration tasks.

In the Common Information Model (CIM) Agent for the SAN Volume Controller, storage configuration involves three layers of objects: back-end, middle and front-end. The objects in the *back-end* layer contain the back-end controllers and volumes, those in the *middle* layer contain the storage pools, and those in the *front-end* layer contain the storage volumes that are exposed to the hosts.

The IBMTSSVC_StorageConfigurationService class provides the CreateOrModifyStoragePool() and CreateOrModifyElementFromStoragePool() methods for performing basic storage configuration.

You can use the CreateOrModifyStoragePool() method to create an IBMTSSVC_StoragePool and add or remove an IBMTSSVC_BackendVolume. You can use the CreateOrModifyElementFromStoragePool() method to allocate, expand, or shrink an IBMTSSVC_StorageVolume from an IBMTSSVC_ConcreteStoragePool.

If you have SAN Volume Controller release 4.3.1 installed, the CIM object manager (CIMOM) is already configured and resides on the cluster.

If you have release 4.3.0 or earlier installed, you must complete the initial setup of the SAN Volume Controller before you complete the storage configuration tasks. Completing the initial setup requires creating and adding clusters to the CIMOM configuration file of the CIM agent. As a result, the CIM agent discovers all the back-end volumes that are required for the storage configuration. Next, you add a device to the CIMOM and input the IP address of the IBMTSSVC_Cluster (DeviceConfigurationService addDevice Method).

To complete basic storage configuration, perform the following tasks:

1. Add a node to the cluster.
2. Create a storage pool.
3. Modify the storage pool.
4. Create a storage volume.
5. Modify a storage volume.

Adding a candidate node to a cluster

You can add an IBMTSSVC_CandidateNode to an existing IBMTSSVC_Cluster.

To add an IBMTSSVC_CandidateNode to an existing IBMTSSVC_Cluster, follow these steps:

1. Obtain the reference (CIMObjectPath) of the IBMTSSVC_Cluster to which you want to add an IBMTSSVC_CandidateNode.
2. Obtain the Reference for the IBMTSSVC_CandidateNode instance.
3. Locate the IBMTSSVC_ClusteringService instance that is associated with the IBMTSSVC_Cluster by traversing the IBMTSSVC_ClusteringServiceForSystem association.

4. Invoke the IBMTSSVC_ClusteringService.AddNode() method. The AddNode method has the parameter CandidateNode Ref, and the IOGroup Ref to which you want to add the Node. Every node must be in an IOGroup and each IOGroup can only contain two nodes.

Creating a new storage pool

The IBMTSSVC_StorageConfigurationService class provides the methods for creating a new IBMTSSVC_StoragePool.

To create a new IBMTSSVC_StoragePool instance, follow these steps:

1. Obtain the reference (CIMObjectPath) of an IBMTSSVC_StorageConfigurationService instance that is associated with the IBMTSSVC_Cluster in which you will create the new storage pool by traversing the IBMTSSVC_HostedStorageConfigurationService association.
2. Invoke the IBMTSSVC_StorageConfigurationService.CreateOrModifyStoragePool method while you specify the Extent[] parameter with a list of IBMTSSVC_BackendVolume instances.

   The Extent[] parameter is a string array that contains the representation of the CIMObjectPath to an IBMTSSVC_BackendVolume.

   You can also just specify the size, and the CIM agent performs a best-fit heuristic to match it. You can specify the Name of the pool by using the ElementName Parameter and the Block Size by using the BlockSize parameter.

Modifying a storage pool

You can modify an IBMTSSVC_ConcreteStoragePool instance by changing the pool name and adding or removing an IBMTSSVC_BackendVolume instance from the pool.

To modify an IBMTSSVC_ConcreteStoragePool instance, follow these steps:

1. Select the IBMTSSVC_ConcreteStoragePool instance that you want to modify from an IBMTSSVC_Cluster.
2. Identify the IBMTSSVC_StorageSettingPool instance that contains the parameter settings of the IBMTSSVC_ConcreteStoragePool Setting instance. You can do this by calling the IBMTSSVC_StorageCapabilities.CreateSetting() method or by enumerating the IBMTSSVC_StoragePoolSetting that is associated through IBMTSSVC_StorageSettingsGeneratedFromCapabilities to the IBMTSSVC_StorageCapabilities that is associated to the IBMTSSVC_ConcreteStoragePool that is being modified.
3. Invoke the IBMTSSVC_ConcreteStoragePool .ModifyInstance() method to change the name of the selected IBMTSSVC_ConcreteStoragePool instance.
4. If necessary, you can further modify the IBMTSSVC_ConcreteStoragePool by adding or removing an IBMTSSVC_BackendVolume instance to the pool.

Creating a new storage volume

In the Common Information Model (CIM) Agent for the SAN Volume Controller, the IBMTSSVC_StorageConfigurationService class provides all the methods that are required for creating, modifying, and deleting an IBMTSSVC_StorageVolume instance.

To create a new IBMTSSVC_StorageVolume instance, follow these steps:

1. Obtain the reference (CIMObjectPath) of the IBMTSSVC_StorageConfigurationService instance that is associated with the IBMTSSVC_Cluster to which you will assign the new volume.
2. Invoke the IBMTSSVC_StorageConfigurationService. CreateOrModifyElementFromStoragePool() method to create the new IBMTSSVC_StorageVolume with the following parameter specifications:
   - The Virtualization Type is set using the VirtualizationType parameter (0,1,2 for striped, sequential or image).
   - A Format flag can be used to specify that the volume is formatted on creation or expansion.
   - You can specify the BackendVolumes to place the extents for the volume using the BackendVolume REF parameter.
   - The PreferredNode parameter is used to set the preferred node for the volume.
   - The UnitDeviceID parameter can be used to set the Volume's Unit Device ID on clusters that run software level 4.1.0 or higher.
   - The ElementName parameter can be used to set the Volumes Name at creation.
   - The Autoexpand parameter

   a. Set ElementType to 2.
   b. Set Size to the desired volume size in bytes.
   c. Obtain the reference (CIMObjectPath) of the IBMTSSVC_ConcreteStoragePool instance from which you will allocate an IBMTSSVC_StorageVolume.
   d. Set InPool to the reference (obtained in the previous step) of the pool from which the volume will be allocated.

The following additional parameters are examples of those that are available as part of the Virtual Disk (VDisk) Mirroring feature or Space-Efficient Virtual Disk feature.

Autoexpand
Used to attempt to maintain a fixed amount of unused real capacity on the virtual disk (VDisk), which is called the *contingency capacity*. The capacity is initially set to the *real capacity*, which is assigned when the VDisk is created. If you modify the real capacity, the contingency capacity is reset to be the difference between the *used capacity* and the *real capacity*.

Copies
Indicates the number of mirrored copies to create. Specify either 1 or 2.

Grainsize
Sets the grain size of a space-efficient VDisk. This is valid only if RealSize is set. Valid options include 32, 64, 128, or 256.

Import
Used to request the SAN Volume Controller to import a space-efficient storage volume from the storage pool.

IsSpaceEfficient
Flag that is used to indicate that the created VDisks are space-efficient VDisks. This does not apply to a modify operation.

RealSizeBytes and RealSizePercent
Indicates the real size of a space-efficient copy. These parameters cannot be used together.

WarningSizeBytes
Indicates the set point of used capacity at which point a warning is triggered. This parameter cannot be used with WarningSizePercent.

WarningSizePercent
Indicates the ratio of used capacity versus the VDisk virtual capacity that triggers a warning. This parameter cannot be used with the WarningSizeBytes parameter.

Chapter 3. Establishing Copy Services relationships

You can use the Common Information Model agent object class instances to establish new Copy Services relationships.

Copy Services

FlashCopy, Global Mirror, and Metro Mirror are Copy Services that are provided by the SAN Volume Controller.

These Copy Services are available to all supported hosts that are connected to the SAN Volume Controller.

The FlashCopy service enables you to make an instant, point-in-time copy of a source IBMTSSVC_StorageVolume instance to a target IBMTSSVC_StorageVolume instance.

The synchronous copy service (Metro Mirror) provides a consistent copy of the source IBMTSSVC_StorageVolume on the target IBMTSSVC_StorageVolume. Data is written to the target volume synchronously after it is written to the source volume, both of which can belong to the same IBMTSSVC_Cluster instance or different IBMTSSVC_Cluster instances.

The asynchronous copy service (Global Mirror) provides a copy of the source IBMTSSVC_StorageVolume on the target IBMTSSVC_StorageVolume. Data is written to the target volume asynchronously after it is written to the source volume, both of which can belong to the same IBMTSSVC_Cluster instance or different IBMTSSVC_Cluster instances.

Creating a new FlashCopy relationship between storage volumes

The IBMTSSVC_StorageConfigurationService class provides the methods for establishing a FlashCopy relationship between two IBMTSSVC_StorageVolume instances that are the same size and belong to the same IBMTSSVC_Cluster instance.

To create a FlashCopy relationship between two IBMTSSVC_StorageVolume instances, perform the following steps:

1. Select an IBMTSSVC_StorageVolume instance as the source volume for the desired FlashCopy relationship.
2. Select a valid IBMTSSVC_StorageVolume as a target.

   Make sure that the source IBMTSSVC_StorageVolume and target IBMTSSVC_StorageVolume instances belong to the same IBMTSSVC_Cluster instance.
3. Retrieve the IBMTSSVC_StorageConfigurationService instance that is associated with the IBMTSSVC_Cluster instance to which the selected IBMTSSVC_StorageVolume instances belong.
4. Invoke the IBMTSSVC_StorageConfigurationService.AttachReplica() method with the following parameter specifications:
   a. Set SourceElement to the reference (CIMObjectPath) of the source IBMTSSVC_StorageVolume.
   b. Set TargetElement to the reference (CIMObjectPath) of the target IBMTSSVC_StorageVolume.

c. Optionally set ElementName to the name of the synchronization.
d. Optionally set BackgroundCopyRate to the desired priority of the background copy rate (0 - 100).
e. Optionally specify Set to add the newly created FlashCopySynchronization to the set. If you specify a null value, the newly created FlashCopySynchronization will not be a member of a synchronized set.
f. Optionally set CopyType to 5. This sets AutoDelete to true, which automatically deletes the FlashCopy mapping after the background copy is complete.
g. If you do not want to automatically delete FlashCopy mappings, Set CopyType to 4.

The source IBMTSSVC_StorageVolume and target IBMTSSVC_StorageVolume instances are now connected through the IBMTSSVC_LocalStorageSynchronized association.

Creating a FlashCopy relationship for a synchronized set

The IBMTSSVC_StorageConfigurationService class provides the methods for establishing a FlashCopy relationship between two IBMTSSVC_StorageVolume instances and then adding it to an IBMTSSVC_FlashCopySynchronizedSet instance.

Perform the following steps to create a FlashCopy relationship between two IBMTSSVC_StorageVolume instances and add it to an IBMTSSVC_FlashCopySynchronizedSet instance:

1. Select an IBMTSSVC_StorageVolume instance as the source volume for the desired FlashCopy relationship.
2. Select a valid IBMTSSVC_StorageVolume as a target. Valid volumes can be determined using IBMTSSVC_CandidateVolume.

   Make sure that the source IBMTSSVC_StorageVolume and target IBMTSSVC_StorageVolume instances belong to the same IBMTSSVC_Cluster instance.
3. Retrieve the IBMTSSVC_StorageConfigurationService instance that is associated with the IBMTSSVC_Cluster instance to which the selected IBMTSSVC_StorageVolume instances belong.
4. Invoke the IBMTSSVC_StorageConfigurationService.AttachReplica() method with the following parameter specifications:
   a. Set SourceElement to the reference (CIMObjectPath) of the source IBMTSSVC_StorageVolume.
   b. Set TargetElement to the reference (CIMObjectPath) of the target IBMTSSVC_StorageVolume.
   c. Optionally set ElementName to the name of the synchronization.
   d. Optionally set BackgroundCopyRate to the desired priority of the background copy rate in percent (0 - 100%).
   e. Optionally specify Set to add the newly created FlashCopySynchronization to the set. If you specify a null value, the newly created FlashCopySynchronization will not be a member of a synchronized set.
   f. Optionally set CopyType to 5. This sets AutoDelete to true, which automatically deletes the FlashCopy mapping after the background copy is complete.

g. If you do not want to automatically delete FlashCopy mappings, Set CopyType to 4.

5. Create an IBMTSSVC_FlashCopySynchronizedSet instance by invoking the IBMTSSVC_StorageConfigurationService.CreateSynchronizedSet() method with the following parameter specifications:
   a. Set CopyType to 4 (flash).
   b. Optionally set ElementName to the name of the newly created IBMTSSVC_FlashCopySynchronizedSet instance.
6. Add the IBMTSSVC_FlashCopyStorageSynchronized instance to the IBMTSSVC_FlashCopySynchronizedSet instance by invoking the IBMTSSVC_StorageConfigurationService.ModifySynchronizedSet() method with the Operation parameter set to 0 (add). If the FlashCopy Added to the Set is CopyType 5, the Set becomes CopyType 5, and any other FlashCopy mappings that are added to the Set must have CopyType 5 or the add fails. Similarly, if a Set contains a FlashCopy of CopyType 4, all other FlashCopy mappings in the set must be of CopyType 4 or the Modify fails.

   The synchronization must belong to the same cluster as the hosting service.

Creating a synchronous copy relationship between volumes in the same cluster

The IBMTSSVC_StorageConfigurationService class provides the methods for creating a synchronous copy relationship between a source IBMTSSVC_StorageVolume and a target IBMTSSVC_StorageVolume.

Perform the following steps to create the synchronous copy relationship:

1. Select an IBMTSSVC_StorageVolume instance as the source volume for the desired synchronous copy relationship.
2. Select an IBMTSSVC_StorageVolume instance as the target volume.
3. Obtain the reference (CIMObjectPath) of the IBMTSSVC_StorageConfigurationService instance that is associated with the IBMTSSVC_Cluster instance to which the selected volumes belong.
4. Invoke the IBMTSSVC_StorageConfigurationService.AttachReplica() method with the following parameter specifications:
   a. Set SourceElement to the reference (CIMObjectPath) of the source IBMTSSVC_StorageVolume instance.
   b. Set TargetElement to the reference (CIMObjectPath) of the target IBMTSSVC_StorageVolume.
   c. Optionally set ElementName to the name of the synchronization.
   d. Set CopyType to 3 for Synchronous and 2 for Asynchronous.

The source IBMTSSVC_StorageVolume instance and the target IBMTSSVC_StorageVolume are now connected through the RemoteStorageSynchronized association.

Creating a synchronous copy relationship between volumes in different clusters

The IBMTSSVC_StorageConfigurationService class provides the methods for creating a synchronous copy relationship between a source IBMTSSVC_StorageVolume instance and a target IBMTSSVC_RemoteStorageVolume instance belonging to different IBMTSSVC_Cluster instances.

Perform the following steps to create a synchronous copy relationship between two volumes with the source located in a local cluster and the target located in a remote cluster:

1. Identify an IBMTSSVC_Cluster instance as the source cluster for the desired synchronous copy relationship.
2. Obtain the reference (CIMObjectPath) of the IBMTSSVC_StorageConfigurationService instance that is associated with the source cluster.
3. Identify the IBMTSSVC_RemoteCluster on which you want the synchronous copy to reside by traversing the IBMTSSVC_ClusterScopeRemoteCluster association.
4. Invoke the IBMTSSVC_StorageConfigurationService.CreateRemoteClusterPartnerShip() method with the following parameter specifications:
   a. Set RemoteCluster to the reference (CIMObjectPath) of the IBMTSSVC_RemoteCluster instance.
   b. Optionally set Bandwidth to the desired bandwidth in megabytes (MB).

   Make sure to issue the method from both the source and candidate clusters to establish a fully configured partnership; otherwise, the synchronous copy relationship cannot be established.
5. Select an IBMTSSVC_StorageVolume as the source volume from the source IBMTSSVC_Cluster.
6. Select an IBMTSSVC_RemoteVolume as the target volume from the IBMTSSVC_RemoteCluster. (IBMTSSVC_StorageVolume instances on the remote cluster are seen on the local cluster as IBMTSSVC_RemoteVolume instance). To determine a candidate volume, use the IBMTSSVC_CopyCandidate association from the Source Volume.
7. Invoke the IBMTSSVC_StorageConfigurationService.AttachReplica() method with the following parameter specifications:
   a. Set SourceElement to the reference (CIMObjectPath) of the source IBMTSSVC_StorageVolume instance.
   b. Set TargetElement to the reference (CIMObjectPath) of the target IBMTSSVC_RemoteVolume.
   c. Optionally set ElementName to the name of the synchronization.
   d. Set CopyType to 3.

The source IBMTSSVC_StorageVolume instance and the target IBMTSSVC_StorageVolume or IBMTSSVC_RemoteVolume instance are now connected through the IBMTSSVC_SyncCopyStorageSynchronizedSet association.

Sample code to create and start a FlashCopy mapping

This information demonstrates how CIMOM Methods can control the cluster. The sample code includes a main method from a Java class that is designed to create and start a FlashCopy mapping and other methods that are called from the main method.

In this topic, the term *method* refers to a Java method. The term *Method* (initial capital) refers to a CIM Method.

Java main method

This example shows the Java main method for creating and starting a FlashCopy mapping. The assumption in this example is that your Java program is designed to control the same cluster every time. It is a relatively simple process to make it more flexible, but that decision is left to you.

```
/*
* FC Mapping states
*/
private static UnsignedInt16 INITIALIZED = new UnsignedInt16(2);
private static UnsignedInt16 PREPARING = new UnsignedInt16(3);
private static UnsignedInt16 PREPARED = new UnsignedInt16(4);

public static void main(String[] args) throws CIMException
{
   /*
    * First step is to connect to the CIMOM
   */
   UserPrincipal user = new UserPrincipal("superuser");
   PasswordCredential pwd = new PasswordCredential("itso13sj");
   CIMNameSpace ns = new CIMNameSpace("https://9.43.86.115:5989/root/ibm");

   CIMClient client = null;

   client = new CIMClient(ns,user,pwd);

   /*
    * Next, select the cluster that we are interested in
   */
   CIMInstance chosenCluster = getCluster("ITSOCL1",client);

   /*
    * At this point, the relevant cluster has been selected
    * and 'chosenCluster' is a CIMInstance of this cluster
    *
    * Get the Config Service of this cluster
    */
   CIMObjectPath cService = getConfigService(chosenCluster, client);

   /*
    * Now, get all of the VDisks in this cluster
    */
   Map<Integer,CIMObjectPath> vdisksById = getVDisks(chosenCluster,client);

   /*
    * Select the FlashCopy Source
    *
    * In this case, VDisk 10 is our source
    * VDisk 11 is our target
    */
   CIMObjectPath fcSrc = vdisksById.get(new Integer(10));
   CIMObjectPath fcTgt = vdisksById.get(new Integer(11));/*

   /*
```

```
     * Now create FC Mapping
     */
    CIMValue rc = makeFlashCopyMapping("CIMOMTestMap", fcSrc, fcTgt, cService,
       client,false);

    /*
     * Now that this has been created, we need to get an
     * Object Path to the newly created Association
     */
    List<CIMObjectPath> fcMaps = getFCMappings(fcSrc, client);
    CIMObjectPath fcMapping = fcMaps.get(0);

    /*
     * Now we prepare the FC Mapping
     */
    CIMArgument[] outArgs = new CIMArgument[2];
    rc = prepareFCMapping(cService, fcMapping, client, outArgs);
    System.out.println("Got value:"+
       Integer.toHexString(Integer.parseInt(rc.toString())));

    /*
     * Loop until it is prepared
     */
    CIMValue fcMapState = new CIMValue(PREPARING);
    while(fcMapState.equals(new CIMValue(PREPARING)))
    {
       CIMInstance fcMapInfo = client.getInstance(fcMapping);
       fcMapState = fcMapInfo.getProperty("SyncState").getValue();
    }

    /*
     * Now start the FC Mapping
     */
    rc = startFCMapping(cService, fcMapping, client, outArgs);
    System.out.println("Got value:"+
       Integer.toHexString(Integer.parseInt(rc.toString())));
}
```

getCluster method

The getCluster method returns the CIM Instance that corresponds to the cluster with the supplied name. It does this by enumerating all of the instances of the class IBMTSSVC_Cluster and then checking the name of each one. When one is found that matches the supplied name, an object path to that instance is returned.

```
static private CIMInstance getCluster(String clusterName, CIMClient client) throws
CIMException
{
   CIMInstance chosenCluster = null;
   Enumeration<CIMInstance> clusters =
      client.enumerateInstances(new CIMObjectPath("/root/ibm:IBMTSSVC_Cluster"));

   while(clusters.hasMoreElements())
   {
      CIMInstance possibleCluster = clusters.nextElement();
      String possibleName =
         possibleCluster.getProperty("ElementName").getValue().toString();

      if(possibleName.equals("\""+clusterName+"\""))
      {
         chosenCluster = possibleCluster;
      }
   }
   return chosenCluster;
}
```

getConfigService method

The CIM_StorageConfigurationService class has no direct equivalent in an SVC, but an Instance of this Class is required for invoking Methods against.

In this method, all of the instances that are associated with the supplied cluster are requested. The association that connects a cluster to its configuration service is CIM_HostedService. Because a cluster will only have configuration service associated with it, the first object path in the enumeration is selected.

```
static private CIMObjectPath getConfigService(CIMInstance cluster, CIMClient
client) throws CIMException
{
   Enumeration<CIMObjectPath> configServices = null;
   configServices = client.associatorNames(
         cluster.getObjectPath(),
         "CIM_HostedService",
         "CIM_StorageConfigurationService",
         null,
         null);
   return configServices.nextElement();
}
```

getVDisks method

This method returns a map that relates VDisk IDs (as integers) to IBMTSSVC_StorageVolume object paths. The method requests all of the IBMTSSVC_StorageVolume instances that are associated with the provided cluster instance.

```
static private Map<Integer,CIMObjectPath> getVDisks(CIMInstance cluster, CIMClient
client) throws CIMException
{
   Enumeration<CIMObjectPath> vdisks = client.associatorNames(
         cluster.getObjectPath(),
         null,
         "IBMTSSVC_StorageVolume",
         null,
         null);

   Map<Integer,CIMObjectPath> vdisksById = new HashMap<Integer, CIMObjectPath>();

   while(vdisks.hasMoreElements())
   {
      CIMObjectPath vdiskOP = vdisks.nextElement();
      CIMValue vdiskId = vdiskOP.getKey("DeviceID").getValue();
      String idAsString = vdiskId.toString();
      String idNoQuotes = idAsString.substring(1, idAsString.length()-1);
      vdisksById.put(Integer.parseInt(idNoQuotes), vdiskOP);
   }
   return vdisksById;
}
```

makeFlashCopyMapping method

This example invokes the AttachReplica against the cluster configuration service. CIM Methods take typed parameters. In this method, you can see the use of the argRef, argString, and argUint16 methods. These methods act as shortcuts to generating the required arguments for the CIM Method. The AttachReplica method is used for FlashCopy, Metro Mirror and Global Mirror. The CopyType argument indicates which type is required.

```
static private CIMValue makeFlashCopyMapping(
           String name,
           CIMObjectPath source,
           CIMObjectPath target,
           CIMObjectPath configService,
           CIMClient client,
           boolean autodelete) throws CIMException
{
   CIMArgument src = argRef("SourceElement", source, "IBMTSSVC_StorageVolume");
   CIMArgument tgt = argRef("TargetElement", target, "IBMTSSVC_StorageVolume");
   CIMArgument fcName = argString("ElementName",name);
   CIMArgument type = argUint16("CopyType",autodelete?5:4);
   CIMArgument[] inArgs = {src,tgt,fcName,type};
   CIMArgument[] outArgs = new CIMArgument[1];

   CIMValue rc = client.invokeMethod(configService,
      "AttachReplica",
      inArgs,
      outArgs);
   return rc;
}
```

getFCMappings method

The getFCMappings method returns a list of all the FCMappings that are associated with the provided VDisk. This method requests a list of all of the associations that reference the provided IBMTSSVC_StorageVolume. Currently, all of the Java WBEM Services methods of this type return enumerations. This method converts this to a list for ease of use.

```
static private List<CIMObjectPath> getFCMappings(CIMObjectPath vdisk, CIMClient
client) throws CIMException
{
   Enumeration<CIMObjectPath> assocs = client.referenceNames(
              vdisk,
              "IBMTSSVC_LocalStorageSynchronized",
              null);
   return Collections.list(assocs);
}
```

prepareFCMapping method

The prepareFCMapping method prepares a FlashCopy mapping. Much like the AttachReplica Method, the ModifySynchronization Method is used to control FlashCopy, Metro Mirror and Global Mirror. The operation parameter indicates what you actually want to do.

```
private static CIMValue prepareFCMapping(
           CIMObjectPath configService,
           CIMObjectPath fcMapping,
           CIMClient client,
           CIMArgument[] outArgs) throws CIMException
{
   CIMArgument operation = argUint16("Operation", 6);
   CIMArgument synch = argRef("Synchronization",
fcMapping,"IBMTSSVC_FlashCopyStorageSynchronized");

   CIMArgument[] inArgs = new CIMArgument[]{operation,synch};
   outArgs = new CIMArgument[2];

   return client.invokeMethod(configService,
         "ModifySynchronization",
         inArgs,
         outArgs);
```

startFCMapping method

The startFCMapping method starts a FlashCopy mapping. This method invokes the ModifySynchronization Method as in “prepareFCMapping method” on page 32 but uses different Operation parameter.

```
private static CIMValue startFCMapping(
      CIMObjectPath configService,
      CIMObjectPath fcMapping,
      CIMClient client,
      CIMArgument[] outArgs) throws CIMException
{
   CIMArgument operation = argUint16("Operation", 4);
   CIMArgument synch = argRef("Synchronization",
fcMapping,"IBMTSSVC_FlashCopyStorageSynchronized");

   CIMArgument[] inArgs = new CIMArgument[]{operation,synch};
   outArgs = new CIMArgument[2];

   return client.invokeMethod(configService,
         "ModifySynchronization",
         inArgs,
         outArgs);
}
```

Argument generators class

This class uses the following argument generators:

- The **argUint16 method** returns an unsigned 16-bit integer typed argument.

  ```
  static private CIMArgument argUint16(String name, int arg)
  {
     return new CIMArgument(
           name,
           new CIMValue(
           new UnsignedInt16(arg),
           new CIMDataType(CIMDataType.UINT16)
           )
     );
  }
  ```

- The **argString method** returns a string-typed argument.

  ```
  static private CIMArgument argString(String name, String str )
  {
     return new CIMArgument(
           name,
           new CIMValue(
                 str,
                 new CIMDataType(CIMDataType.STRING)
                 )
           );
  }
  ```

- The **argRef method** returns a reference typed argument. It is a reference to the instance that the provided object path indicates.

  ```
  static private CIMArgument argRef(
        String name,
        CIMObjectPath path,
        String className )
  {
     return new CIMArgument(
           name,
           new CIMValue(
                 path,
  ```

```
                new CIMDataType(className)
                )
        );
}
```

Chapter 4. CIM agent network considerations

You can manually set the CIM agent service or the user interface connection information. If the Secure Sockets Layer (SSL) certificate is expired or not valid, you can regenerate the SSL certificate file.

Manually registering the IP address with the SLP

When the CIMOM is running on an IBM System Storage Productivity Center (SSPC) server or on a master console server, the CIMOM automatically registers its IP address with the Service Location Protocol (SLP); however, you can manually modify the registration.

In an environment with multiple network adapters, the SLP Service Agent might register the CIM agent with the IP of a network adapter in a different subnet than the management application. As a result, the management application cannot discover the CIM agent.

The following example illustrates why this occurs:

- The management application runs in subnet A.
- The CIM agent machine has adapters for subnet A and subnet B.
- Using SLP based discovery, the CIM agent is registered for subnet B.
- When the management application runs discovery, it detects the CIM agent SLP registration with the IP of subnet B.
- The management application's connection attempt to the CIM agent fails because the IP of subnet B cannot be reached from subnet A.

To correct this issue, you can manually register the IP with the SLP. One method is to use the SAN Volume Controller CIM agent command line utility. Enter the following command:

```
svcutil setslpregip ip,ip,ip CimUser=superuser
 CimomPassword=current_superuser_password
```

where *ip,ip,ip* is the input-comma delimited list of IPs.

Another method you can use to manually register the IP with the SLP is to set an attribute within the **provider.configuration** file.

To set the attribute, follow these steps:

1. Stop the CIM agent service. Go to **Start -> Programs -> IBM System Storage SAN Volume Controller -> Stop CIMOM Service** .
2. Go to the CIM agent installation directory. For example, C:\Program Files\IBM\svcconsole\cimom\config
3. Open the provider.configuration file.
4. Find the attribute: preferredslpregip=Off.

   If this attribute is not set, the CIM agent automatically detects the primary network card.
5. Set preferredslpregip=*Network Adapter's IP Address*.

   This changes the IP address to the correct network adapter and allows the management application to discover the CIM agent. Ensure that you do not add any spaces to this line.

6. Restart the CIM agent service.

RemoteServiceAccessPoint instance

In an environment with multiple network adapters, it might be necessary to manually set the connection data of the RemoteServiceAccessPoint (RSAP) instance.

The IBMTSSVC_RemoteServiceAccessPoint class hosts the information necessary for connection to the Web user interface. Management applications can obtain an instance of the RSAP from the CIMOM to launch the user interface through the Web.

You can manually set the connection data of the RSAP. This is helpful in an environment with multiple network cards.

To set the connection data, follow these steps:

1. Obtain the IBMSVC_Cluster instance.
2. Modify the ConsoleIP and ConsolePort properties through the Modify instance on the Cluster with a property list that contains the Properties that have changed.

   The CIM Agent automatically updates the RSAP.

Updating SSL certificates

During installation, the Secure Sockets Layer (SSL) certificate is configured automatically. Beginning with SAN Volume Controller version 4.3.1, Secure Sockets Layer (SSL) certificates are managed from the SAN Volume Controller Console that is installed on the IBM System Storage Productivity Center (SSPC) server.

For SAN Volume Controller version 4.3.0 and earlier versions or whenever the SAN Volume Controller Console is installed on the master console server, you can verify that an SSL certificate is valid. You can also regenerate an SSL certificate that is expired or not valid.

Certificates that are not valid and expired certificates are considered valid when they are loaded by the CIM service; however, a warning message is logged if the certificate is expired or is not valid. Note that other non-IBM client applications might require a valid SSL key.

To verify that the currently configured SSL key is valid, complete the following steps:

1. From a command prompt window, go to the installation svcconsole\cimom\bin directory.
2. Issue the command chkcertificate *certname*.

   The following lines are displayed:

   ```
   C:\Program Files\IBM\svcconsole\cimom\bin>mkcertificate ssl
   C:\Program Files\IBM\svcconsole\cimom\bin>chkcertificate ssl
   notBefore=Mar 28 01:56:05 2008 GMT
   notAfter=Mar 28 01:56:05 2009 GMT
   ```

To regenerate a certificate, complete the following steps:

1. From a command prompt window, go to the C:\Program Files\IBM\svcconsole\cimom directory.

2. Issue the command mkcertificate.bat ssl. This creates an ssl.cert file in the certificate directory.
3. Stop the CIM agent server.
4. Issue the command cimconfig -s slCertificateFilePath=C:\"Program Files"\IBM\svcconsole\cimom\certificate\ssl.cert -p.
5. Issue the command cimconfig -s sslKeyFilePath=C:\"Program Files"\IBM\svcconsole\cimom\certificate\ssl.key -p.
6. Copy the files to the following subdirectories:

   Note: Each directory begins with C:\Program Files\IBM\svcconsole\console\embeddedWAS.

   C:\...\config\cells\DefaultNode\applications\ICAConsole.ear\deployments\ICAConsole\ICAConsole.war\WEB-INF

   C:\...\config\cells\DefaultNode\applications\SVCConsole.ear\deployments\SVCConsole\SVCConsole.war\WEB-INF

   C:\...\config\installedApps\DefaultNode\ICAConsole.ear\ICAConsole.war\WEB-INF

   C:\...\config\installedApps\DefaultNode\SVCConsole.ear\SVCConsole.war\WEB-INF
7. Stop and then restart the following applications:
   - IBM System Storage SAN Volume Controller Pegasus Server.

     This service is located in **Start -> Programs -> IBM System Storage SAN Volume Controller -> Stop CIMOM Service and Start CIMOM Service**.
   - IBM WebSphere® Application Server V6 - SVC.

     Go to **Start -> Settings -> Control Panel -> Administrative Tools -> Component Services**.

   To stop and then restart the services, right-click on the application and select **Stop**, and then **Start**.

   Note: If the stop command times-out in the IBM WebSphere application, you can restart the SSPC or master console because this restarts the application, as well.
8. Ensure that both applications are running again. Launch the SAN Volume Controller Console and log on.

Chapter 5. CIM agent maintenance and diagnostic tasks

The SAN Volume Controller CIM agent command-line utility simplifies many CIM agent maintenance and diagnostic tasks.

After the CIM agent is installed and the system is restarted, you can access the command-line utility by opening a DOS windows display and typing the command name `svcutil`. The utility can interactively control the SAN Volume Controller CIM agent log settings, and it collects all required trace logs into an archive.

Collecting CIM log files

When the CIMOM is running on an IBM System Storage Productivity Center (SSPC) server or on a master console server, the SAN Volume Controller CIM agent command-line utility supports the collection of CIM agent logging information for maintenance and diagnostic reporting to the IBM Support Center.

The svcutil utility runs on the SSPC for the SSPC-resident CIM agent. If you collect logs from the CIMOM that resides on the cluster, normal cluster log collection is used. Log levels can be set using the SAN Volume Controller Console.

Note: The command-line utility recognizes the authority from the superuser user name and the initial default password that was configured for superuser. If you changed the password for superuser from the initial default password (passw0rd), enter the current superuser password when you invoke the svcutil commands as in the following example:

```
svcutil setloglevel info CimomUser=superuser
 CimomPassword=current_superuser_password
```

To collect your debug log files, follow these steps:

1. Increase the tracing levels by running the following commands:
   a. `svcutil setloglevel info`
   b. `svcutil settracecomponents all`
   c. `svcutil settracecategories all`
2. Increase the SAN Volume Controller Console tracing levels by running the following command:

   ```
   svcconsole/console/embeddedWAS/profiles/SVCProfile/bin/enableConsoleTrace.bat
   ```
3. Reproduce the error.
4. Enter the `svcutil collectlogs` command to collect the logs. This gathers all the required trace logs and puts them into a ZIP file in the current directory. Use this ZIP file and other defect information to report the problem.
5. After you collect the information you need, run the following commands to decrease the tracing levels and return the server to its normal performance:
   a. `svcutil setloglevel error`
   b. `svcutil settracecomponents cim`
   c. `svcutil settracecategories entryexit`

Table 2 on page 40 describes the commands that are used to log and trace CIM agent activity.

Table 2. Commands for logging and tracing CIM agent

Command	Description
collectlogs	Collects the SVC CIM Agent logs
lsloglevel - [-allValid]	Lists the current/valid logging level
setloglevel	Sets the current logging level
lstracecomponents [-allValid]	Lists the current/valid trace components
lstracecategories - [-allValid]	Lists the current/valid trace categories
settracecomponents []	Sets the current trace components
setslpregip []	Sets the preferred Service Location Protocol (SLP) registered IPs for multinetwork environments

Chapter 6. CIM agent classes, methods, and SMI-S profiles supported

The CIM agent classes are the building blocks of the Common Information Model (CIM) agent and use functions such as storage configuration, Copy Services, and logical unit number (LUN) masking. The Storage Management Initiative Specification (SMI-S) is based on a number of existing technologies that include the CIM.

To view the complete Managed Object Format (MOF) documentation of these classes and methods, select the documentation information from the following Web site:

www.ibm.com/storage/support/2145

The descriptions are included with the *IBM System Storage SAN Volume Controller CIM Agent Developer's Guide*.

Table 3 identifies the SMI-S profiles that CIM agent for SAN Volume Controller supports.

Table 3. SMI-S profiles and subprofiles supported by CIM agent for the SAN Volume Controller

Profiles	Subprofiles
SNIA:Storage Virtualizer Storage virtualizers act in a manner similar to RAID arrays but can use storage that is provided by systems that are external to the storage virtualizer and local disks. A storage virtualizer system combines both remote and local storage to create a seamless pool. The virtualization system allocates volumes from the pool for host systems to use. The basic virtualizer system profile provides a read-only view of the system. The various subprofiles extend this description and also enable configuration.	SNIA:Storage Virtualizer:Access Points
	SNIA:Storage Virtualizer:Block Services
	SNIA:Storage Virtualizer:Cascading
	SNIA:Storage Virtualizer:Copy Services
	SNIA:Storage Virtualizer:FC Initiator Ports
	SNIA:Storage Virtualizer:FC Target Ports
	SNIA:Storage Virtualizer:Health
	SNIA:Storage Virtualizer:Masking and Mapping
	SNIA:Storage Virtualizer:Multiple Computer System
	SNIA:Storage Virtualizer:Physical Package
	SNIA:Storage Virtualizer:Software
SNIA:Server The server profile is mandatory for all compliant SMI-S servers. The object manager part of the model defines the capabilities of a CIM object manager based on the communication mechanisms that it supports.	SNIA:Server:Profile Registration
	SNIA:Server:Indication

Chapter 7. Return codes

The Common Information Model (CIM) return codes provide information on the status of CIM agent operations.

Common Information Model

Table 4 is a condensed list of possible CIM return codes.

Table 4. Common Information Model return codes

CIM return code	Description	Method	Explanation
0	Success	GetFreeExtends() ListConfiguration Backups()	The parameters are valid. The method completed successfully.
		AddNode()	The node was successfully added.
		CheckValidity()	The information about the certificate was successfully obtained.
		DeleteAccount()	The account was successfully deleted.
		GenerateCIMOM Certificate() EnableAuto Generation() DisableAuto Generation()	The certificate was successfully deleted.
		CreateCode()	The new account was successfully created.
		SetDefault Validity()	The validity was successfully set.
		GrantGlobal Access() GrantSystem Access()	The role was successfully changed.
		CreateGatewayID() AddHardwareIDs ToCollection()	The collection was successfully created.
		DeleteStorage HardwareID()	The StorageHardwareID was successfully deleted.
		CreateStorage HardwareID()	The StorageHardwareID was successfully created.

Table 4. Common Information Model return codes (continued)

CIM return code	Description	Method	Explanation
0	Success (continued)	AttachDevice()	The volume was successfully attached.
		DeleteProtocol Controller()	The controller was successfully deleted.
		CreateProtocol ControllerWith Ports()	A clone was successfully created.
		DeleteRemote Cluster Partnership()	The cluster partnership was successfully deleted.
		CreateRemote Cluster Partnership()	The cluster partnership was successfully established.
		DeleteHardwareID Collection()	The collection was successfully created.
		DeleteCertificate()	The certificate was successfully deleted.
		DeleteSynchronized Set()	The SynchronizedSet was successfully deleted.
		Modify Synchronisation()	The method was successfully run.
		EvictNode()	The node was successfully evicted.

Table 4. Common Information Model return codes (continued)

CIM return code	Description	Method	Explanation
0	Success (continued)	RestartService()	The CIMOM reboots.
		Shutdown()	The shutdown for the node/cluster was successfully initiated.
		SetLocale()	The locale was set.
		SetTimezone()	The time zone for the cluster was successfully set.
		SetPasswords() ModifyReset Password ChangeFeature()	The passwords were changed.
		GetResetPassword ChangeFeature Status()	The feature status was successfully retrieved.
		StartStatistics Collection()	The statistics collection was started.
		DetachDevice()	The volume was successfully detached.
		StopStatistics Collection()	The statistics collection was stopped.
		Backup Configuration()	A backup was successfully created.
		Reload Configuration()	The configuration was reloaded.
		Restore Configuration() Delete Configuration Backup()	A restore was successfully made.
		AttachReplica()	The copy relationship was successfully established.
		CreateSynchronized Set()	The SynchronizedSet was successfully created.
		SetPassword()	The password was successfully changed.

Table 4. Common Information Model return codes (continued)

CIM return code	Description	Method	Explanation
0	Job completed with no error	CreateOrModify StoragePool()	The pool was successfully created.
		CreateOrModify ElementFrom StoragePool()	The volume was successfully created. The pool was successfully modified.
		DeleteStorage Pool()	The pool was successfully deleted.
		ReturnToStorage Pool()	The volume was successfully deleted.
		RequestDiscovery()	BackendVolume discovery was successful.
		SetIOGroup()	The change was successful.
		SetQuorum()	The method was successful.
		IncludeBackend Volume()	The volume was successfully included.
		ModifySynchronized Set()	The CLI command was successfully run.
0	Job started successfully	MigrateVolume() MigrateVolumeTo ImageMode()	The migration job was started.
1	Not supported	SetLocales()	The cluster does not support locales.
		SetPasswords()	The cluster does not support password change (CISCO).
		ModifyReset PasswordChange Feature() GetResetPassword ChangeFeature Status()	The cluster does not support the reset password change feature.
		Upgrade()	The method was called on a 2145 Cluster Configuration Service.

Table 4. Common Information Model return codes (continued)

CIM return code	Description	Method	Explanation
2	Failed	Dump() Clean() Enter() Exit() Clean() GetDump() ClearLog() GetRecord() GetAllRecords() FixRecord() UnfixRecord() ModifyError Settings() Create2062 Cluster()	An unexpected error occurred. A CLI command failed.
		GetDump()	Failure during command processing. The file was not found.
		Reload Configuration()	Failed to reload the configuration.
		CreateCode()	Failed to create the account.
		GrantGlobal Access() GrantSystem Access()	Failed to change the role.
		SetPassword()	Failed to change the password.
		DeleteAccount()	Failed to delete the account.
2	Unknown error	GenerateCIMOM Certificate() DeleteCertificate()	Failed to generate new certificate due to provider internal reasons.
		EnableAuto Generation() DisableAuto Generation()	Failed due to provider internal reasons.
		SetDefault Validity()	Failed to set validity.
		CheckValidity()	Failed to obtain information on certificate.
4	Failed	GenerateCIMOM Certificate() DeleteCertificate()	Unexpected error occurred. Failed to generate new certificate due to truststore problems.

Table 4. Common Information Model return codes (continued)

CIM return code	Description	Method	Explanation
5	Wrong Parameter Set	Delete Configuration Backup()	The wrong number or type of parameters were passed. The given backup could not be found.
		Modify Synchronisation()	The wrong number or type of parameters were passed or other parameter checking failed.
		CreateCode() GrantGlobal Access() SetPassword() GrantSystem Access() DeleteAccount() DeleteCertificate() SetDefault Validity() CheckValidity()	One of the parameters is not valid.
5	Parameter not valid	Dump(), GetDump() PositionToFirst RecordRoot() GetRecord() FixRecord() UnfixRecord()	One of the mandatory parameters is missing.
		ModifyIP Address() Create2062 Cluster() Add2062Cluster() Add2145Cluster() Reset2062Node() Reload2062Node()	One of the mandatory parameters is missing or not valid.
		CreateOrModify StoragePool() CreateOrModify ElementFrom StoragePool() Delete StoragePool() ReturnTo StoragePool()	At least one of the parameters is not valid.
		CreateGatewayID() GenerateCIMOM Certificate()	One of the parameters was not valid.
		PositionAtRecord()	One of the mandatory parameters is missing or having a negative number of records is not allowed.

Table 4. Common Information Model return codes (continued)

CIM return code	Description	Method	Explanation
6	CopyType not supported	ModifySynchronized Set()	The type of copy passed in was different from 3 or 4.
6	Operation not supported	ModifySynchronized Set()	The operation code submitted is not valid for the copy type of the synchronized set.
6	SynchronizedSet is not empty	DeleteSynchronized Set()	There are still StorageSynchronized associations in the set. All StorageSynchronized associations must be removed before deletion of the set can be run or the Force flag must be set.
6	User ID already exists	CreateCode()	The user ID that you submitted exists in another account.
6	In use	GenerateCIMOM Certificate()	Failed to generate new certificate. Existing certificate is still valid and in use.
7	StorageSynchronized not in the Set		The synchronized storage does not exist in the set.
8	StorageSynchronized already in the Set		The synchronized storage already exists in the set and cannot be added.
9	StorageSynchronized incompatible with Set		The synchronized storage is not compatible with the Set. For example, a Flash Copy is synchronized to a Sync Copy set.
0*x*1000	Parameters checked – Job started		The CLI copy command was run and a job object was returned.
0*x*1000	LogicalDevices associated to other ProtocolControllers not deleted	DeleteProtocol Controller()	At least one of the attached storage volumes is attached to another controller so it cannot be deleted.
0*x*1000	LogicalDevice instance not valid	AttachDevice()	The device is not a volume of the RedundancyGroup of the controller.

Table 4. Common Information Model return codes (continued)

CIM return code	Description	Method	Explanation
0*x*1000	LogicalDevice not associated to Controller	DetachDevice()	The device has no Protocol ControllerFor Unit association to this controller.
0*x*1000	ID already created	CreateStorage HardwareID()	The WWPN is already assigned to an existing storage hardware ID.
0*x*1000	Specified instance not found	DeleteStorage HardwareID()	The storage hardware ID could not be found.
0*x*1000	HardwareID instance not valid	CreateGateway ID() AddHardwareIDs ToCollection()	The storage hardware ID could not be found or is already a member of another collection.
0*x*1001	Size not supported	CreateOrModify ElementFrom StoragePool()	The requested size is not supported by the primordial pools. The size parameter contains the nearest supported size larger than the requested one. The size requested was not a multiple of 512. The nearest supported size that can be requested is returned in size.
0*x*1001	Device Number Conflict	AttachDevice()	The specified device number is already occupied.
0*x*1001	Hardware implementation does not support specified IDType	CreateStorage HardwareID()	The type of ID is different from 2.
0*x*8000	ComputerSystem not valid	AddNode()	The submitted ComputerSystem was not a IBMTSSVC_ CandidateNode.
		EvictNode()	The submitted ComputerSystem was not a IBMTSSVC_Node.
		Shutdown()	The submitted ComputerSystem was not a IBMTSSVC_Node of IBMTSSVC_Cluster.
0*x*8000	Locale not valid	SetLocale()	The submitted Locale was greater than 9.

Table 4. Common Information Model return codes (continued)

CIM return code	Description	Method	Explanation
0x8000	Type not valid	Dump()	A type greater than 2 was passed in.
0x8000	Connection refused	GetDump()	We lost connection to the cluster or failed to connect to a node (CISCO only).
0x8000	Backup not found	Restore Configuration()	The specified backup was not found.
0x8000	Delete failed	Delete Configuration Backup()	The deletion of the backup directory failed. The failure might have been caused by a sharing violation.
0x8000	IOGroup must have Nodes aggregated	SetIOGroup()	The I/O group does not have any nodes.
0x8000	ID not valid	SetQuorum()	The quorum ID is a number greater than 2.
0x8000	Volume not valid	IncludeBackend Volume()	The volume is not expelled.
0x8000	CopyType not supported	AttachReplica()	The type of copy passed in was different from 2 or 3.
		CreateReplica()	The type of copy passed in was different from 3 or 4.
0x8000	Ports are from multiple IOGroups	CreateProtocol ControllerWith Ports()	All ports are required to belong to the same I/O group.
0x8000	HardwareID still bound to AuthorizationSubject. Force required	DeleteStorage HardwareID()	The hardware ID has access granted to a storage volume and Force was not specified.
0x8000	Host is member of a LUN mapping	DeleteHardware IDCollection()	To delete this host either use this host to run the RemoveAccess method for each privilege and controller this host is associated to or set “Force” equal to “True.”
0x8000	Record(s) not found	GetRecord() GetAllRecords()	No records were found.
0x8000	Cannot connect to cluster	Create2062 Cluster() Add2062 Cluster()	Unable to connect to the cluster.

Table 4. Common Information Model return codes (continued)

CIM return code	Description	Method	Explanation
0*x*8000	Connection to cluster refused	Add2145Cluster()	The connection to the cluster was refused.
0*x*8000	Connection to switch refused	Reset2062Node() Reload2062Node()	The connection to the switch was refused.
0*x*8000	Cluster IP not found	RemoveCluster()	The IP for the cluster cannot be found.
0*x*8001	Maximum number of Nodes for Cluster exceeded	AddNode()	All I/O groups already have two nodes assigned to them.
0*x*8001	Prefix not valid	Dump()	A file prefix and feature log type were passed in at the same time.
0*x*8001	File not found	GetDump()	The given file path was not found (CISCO).
0*x*8001	Backup script failed	Backup Configuration()	The backup script returned with an error.
0*x*8001	Restore script failed	Restore Configuration()	The backup script returned with an error.
0*x*8001	Operation not allowed for current state	Modify Configuration()	The operation submitted is not allowed in the current state of the synchronized storage. For example, you cannot have a “prepare” operation on a synchronized storage in “synchronized” state.
0*x*8001	Operation not allowed for current SyncState	Modify Synchronized Set()	The operation is not allowed with the current SyncState of the set.
0*x*8001	Unsupported protocol	CreateProtocol ControllerWith Ports()	Protocol != 2.
0*x*8001	Syntax error in ClusterName	Create2062 Cluster() Add2062Cluster() Reset2062Node() Reload2062Node()	The cluster name is not valid because of a syntax error.
0*x*8002	ExtraCapacitySet not valid	AddNode()	The submitted ExtraCapacitySet was not a IBMTSSVC_ IOGroupSet.
0*x*8002	Secure copy failed	Backup Configuration()	The download of the backup file using secure copy failed.

Table 4. Common Information Model return codes (continued)

CIM return code	Description	Method	Explanation
0x8002	Secure copy failed	Upload Configuration()	The upload of the backup file using secure copy failed.
		CreateStorage HardwareID()	The name of the element and setting are required to be null.
0x8002	Syntax error in Node or Node is not valid	Create2062 Cluster() Add2062Cluster() Reset2062Node() Reload2062 Node()	The node contains a syntax error, or the specified node is not valid.
0x8003	Maximum number of Nodes for IOGroup exceeded	AddNode()	The submitted I/O group set already has two nodes assigned to it.
0x8003	Creation of backup dir failed	Backup Configuration()	The backup directory cannot be created.
0x8003	Clear command failed	Upload Configuration()	The cluster /tmp/ directory cannot be cleared.
0x8003	Username or password not valid (only ResetNode)	Add2062Cluster() Reset2062Node() Reload2062Node()	The user name or password are not valid.
0x8004	Delete/rename of old backup files failed	N/A	The backup directory cannot be renamed or deleted.
0x8004	Wrong SwitchIP / can't connect to switch	Create2062 Cluster() Add2062Cluster()	The IP for the switch is not correct, so a connection to the switch cannot be made.
0x8004	SwitchIP is not configured	Reset2062Node() Reload2062Node()	The IP for the switch is not configured.
0x8005	Syntax error in ClusterIP	N/A	The IP for the cluster contains a syntax error.
0x8006	Slot not valid	N/A	The slot is not valid.
0x8007	Cannot upload public key to switch	N/A	The public key cannot be uploaded to the switch.
0x8100	Cluster Scope Violation	N/A	One or more parameters were out of the cluster scope.
0x8200	N/A	N/A	The method was run successfully but one or more parameters were ignored.

Common Information Model and command-line interface

Table 5 is a condensed list of CIM return codes and their corresponding SAN Volume Controller command-line interface (CLI) error codes. For a complete listing of the message explanations and actions, see *Command-line interface messages* in the *IBM System Storage SAN Volume Controller Command-Line Interface User's Guide*.

Table 5. CIM return codes and corresponding CLI error codes

CIM return code	SAN Volume Controller CLI error code
36865	CMMVC5700E
36866	CMMVC5701E
36867	CMMVC5702E
36868	CMMVC5703E
36869	CMMVC5704E
36870	CMMVC5705E
36871	CMMVC5706E
36872	CMMVC5707E
36873	CMMVC5708E
36874	CMMVC5709E
36875	CMMVC5710E
36876	CMMVC5711E
36877	CMMVC5712E
36878	CMMVC5713E
36879	CMMVC5714E
36880	CMMVC5715E
36881	CMMVC5716E
36882	CMMVC5717E
36883	CMMVC5718E
36884	CMMVC5719E
36885	CMMVC5720E
36886	CMMVC5721E
36887	CMMVC5722E
36888	CMMVC5723E
36889	CMMVC5724E
36890	CMMVC5725E
36891	CMMVC5726E
36892	CMMVC5727E
36893	CMMVC5728E
36894	CMMVC5729E
36895	CMMVC5730E
36896	CMMVC5731E
36897	CMMVC5732E
36898	CMMVC5733E

Table 5. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code
36899	CMMVC5734E
36900	CMMVC5735E
36901	CMMVC5736E
36902	CMMVC5737E
36903	CMMVC5738E
36904	CMMVC5739E
36905	CMMVC5740E
36906	CMMVC5741E
36922	CMMVC5987E
36923	CMMVC6007E
36924	CMMVC6009E
37121	CMMVC5742E
37122	CMMVC5743E
37123	CMMVC5744E
37124	CMMVC5745E
37125	CMMVC5746E
37126	CMMVC5747E
37127	CMMVC5748E
37128	CMMVC5749E
37129	CMMVC5750E
37130	CMMVC5751E
37131	CMMVC5752E
37132	CMMVC5753E
37133	CMMVC5754E
37134	CMMVC5755E
37135	CMMVC5756E
37136	CMMVC5757E
37137	CMMVC5758E
37138	CMMVC5759E
37139	CMMVC5760E
37140	CMMVC5761E
37141	CMMVC5762E
37142	CMMVC5763E
37143	CMMVC5764E
37144	CMMVC5765E
37145	CMMVC5766E
37146	CMMVC5767E
37147	CMMVC5768E
37148	CMMVC5769E
37149	CMMVC5770E

Table 5. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code
37150	CMMVC5771E
37151	CMMVC5772E
37152	CMMVC5773E
37153	CMMVC5774E
37154	CMMVC5775E
37155	CMMVC5776E
37156	CMMVC5777E
37157	CMMVC5778E
37158	CMMVC5779E
37159	CMMVC5780E
37160	CMMVC5781E
37161	CMMVC5782E
37162	CMMVC5783E
37163	CMMVC5784E
37164	CMMVC5785E
37165	CMMVC6024E
37166	CMMVC6025E
37168	CMMVC6026E
37169	CMMVC6027E
37170	CMMVC6002E
37171	CMMVC6003E
37172	CMMVC6008E
37173	CMMVC6019E
37174	CMMVC6020E
37175	CMMVC6021E
37176	CMMVC6022E
37177	CMMVC6023E
37178	CMMVC5993E
37179	CMMVC5994E
37180	CMMVC5995E
37181	CMMVC5996E
37182	CMMVC6028E
37183	CMMVC6029E
37184	CMMVC6200E
37185	CMMVC6073E
37186	CMMVC6079E
37188	CMMVC6081E
37189	CMMVC6082E
37190	CMMVC6083E
37191	CMMVC6084E

Table 5. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code
37192	CMMVC6085E
37193	CMMVC6086E
37194	CMMVC6087E
37195	CMMVC6088E
37196	CMMVC6089E
37197	CMMVC6090E
37198	CMMVC6091E
37199	CMMVC6092E
37200	CMMVC6093E
37202	CMMVC6095E
37203	CMMVC6096E
37204	CMMVC6097E
37205	CMMVC6077E
37206	CMMVC6201E
37207	CMMVC6098E
37208	CMMVC6203E
37209	CMMVC6204E
37210	CMMVC6205E
37211	CMMVC6206E
37212	CMMVC6034E
37213	CMMVC6207E
37214	CMMVC6208E
37215	CMMVC6213E
37216	CMMVC6214E
37217	CMMVC6215E
37218	CMMVC6216E
37219	CMMVC6227I
37220	CMMVC6228E
37221	CMMVC6236E
37261	CMMVC6347E
37376	CMMVC5786E
37377	CMMVC5787E
37378	CMMVC5788E
37379	CMMVC5789E
37380	CMMVC5790E
37381	CMMVC5791E
37382	CMMVC5792E
37383	CMMVC5793E
37384	CMMVC5794E
37385	CMMVC5795E

Table 5. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code
37386	CMMVC5796E
37387	CMMVC5797E
37388	CMMVC5798E
37389	CMMVC5799E
37390	CMMVC5800E
37391	CMMVC5801E
37392	CMMVC5802E
37393	CMMVC5803E
37394	CMMVC5804E
37395	CMMVC5805E
37396	CMMVC6013E
37397	CMMVC6014E
37398	CMMVC6018E
37632	CMMVC5806E
37792	CMMVC5807E
37793	CMMVC5808E
37794	CMMVC5809E
37795	CMMVC5810E
37796	CMMVC5811E
37797	CMMVC5812E
37798	CMMVC5813E
37799	CMMVC5814E
37800	CMMVC5808E
38858	CMMVC6006E
37803	CMMVC6349E
37804	CMMVC6364E
37805	CMMVC6365E
37812	CMMVC6212E
37817	CMMVC6217E
37818	CMMVC6218E
37819	CMMVC6219E
37822	CMMVC6220E
37823	CMMVC6221E
37827	CMMVC6222E
37828	CMMVC6223E
37829	CMMVC6224E
37830	CMMVC6225E
37841	CMMVC6317E
37843	CMMVC6011E
37844	CMMVC6033E

Table 5. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code
37845	CMMVC6034E
37846	CMMVC6035E
37847	CMMVC6036E
37848	CMMVC6037E
37849	CMMVC6038E
37850	CMMVC6039E
37851	CMMVC6040E
37854	CMMVC6041E
37855	CMMVC6042E
37856	CMMVC6043E
37858	CMMVC6044E
37857	CMMVC6045E
37859	CMMVC6046E
37860	CMMVC6047E
37861	CMMVC6048E
37862	CMMVC6049E
37863	CMMVC6050E
37864	CMMVC6051E
37865	CMMVC6052E
37866	CMMVC6053E
37867	CMMVC6054E
37868	CMMVC6055E
37869	CMMVC6056E
37870	CMMVC6057E
37871	CMMVC6058E
37872	CMMVC6059E
37873	CMMVC6060E
37874	CMMVC6061E
37875	CMMVC6062E
37876	CMMVC6063E
37877	CMMVC6064E
37878	CMMVC6065E
37879	CMMVC6066E
37880	CMMVC6067E
37881	CMMVC6068E
37882	CMMVC6069E
37883	CMMVC6071E
37888	CMMVC5815E
37889	CMMVC5816E
37890	CMMVC5817E

Table 5. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code
37891	CMMVC5818E
37892	CMMVC5819E
37893	CMMVC5820E
37894	CMMVC5821E
37895	CMMVC5822E
37896	CMMVC5823E
37897	CMMVC5824E
37898	CMMVC5825E
38144	CMMVC5826E
38145	CMMVC5827E
38146	CMMVC5828E
38147	CMMVC5829E
38148	CMMVC5830E
38150	CMMVC5831E
38151	CMMVC5832E
38152	CMMVC5833E
38153	CMMVC5834E
38154	CMMVC5835E
38155	CMMVC5836E
38156	CMMVC5837E
38157	CMMVC5838E
38158	CMMVC5839E
38159	CMMVC5840E
38160	CMMVC5841E
38163	CMMVC5842
38164	CMMVC5843E
38165	CMMVC5844E
38166	CMMVC5845E
38167	CMMVC5846E
38168	CMMVC5847E
38169	CMMVC6348E
38170	CMMVC6319E
38171	CMMVC6320E
38172	CMMVC6321E
38173	CMMVC6322E
39175	CMMVC6324E
38176	CMMVC6325E
38177	CMMVC6326E
38178	CMMVC6327E
38179	CMMVC6328E

Table 5. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code
38180	CMMVC6329E
38181	CMMVC6330E
38182	CMMVC6331E
38183	CMMVC6332E
38184	CMMVC6333E
38185	CMMVC6334E
38186	CMMVC6335E
38187	CMMVC6350E
38188	CMMVC6351E
38189	CMMVC6352E
38190	CMMVC6353E
38191	CMMVC6354E
38192	CMMVC6355E
38193	CMMVC6356E
38194	CMMVC6357E
38195	CMMVC6358E
38196	CMMVC6359E
38197	CMMVC6360E
38198	CMMVC6361E
38199	CMMVC6362E
38200	CMMVC6363E
38201	CMMVC6366E
38202	CMMVC6367E
38203	CMMVC6368E
38204	CMMVC6369E
38205	CMMVC6370E
38206	CMMVC6371E
38207	CMMVC6372E
38208	CMMVC6373E
38209	CMMVC6374E
38210	CMMVC6375E
38211	CMMVC6376E
38212	CMMVC6289E
38213	CMMVC6290E
38214	CMMVC6291E
38215	CMMVC6292E
38305	CMMVC6078E
38306	CMMVC5848E
38307	CMMVC6010E
38308	CMMVC6015E

Table 5. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code
38309	CMMVC5849E
38313	CMMVC5850E
38314	CMMVC5851E
38315	CMMVC5852E
38316	CMMVC5853E
38324	CMMVC5854E
38325	CMMVC5855E
38326	CMMVC5856E
38327	CMMVC5857E
38328	CMMVC5858E
38329	CMMVC5859E
38333	CMMVC5860E
38334	CMMVC5861E
38335	CMMVC5862E
38336	CMMVC5863E
38337	CMMVC6074E
38338	CMMVC5864E
38339	CMMVC6075E
38340	CMMVC5865E
38341	CMMVC5866E
38342	CMMVC5998W
38343	CMMVC6012W
38344	CMMVC6076E
38345	CMMVC6210E
38346	CMMVC6211E
38347	CMMVC6226E
38348	CMMVC6336E
38349	CMMVC6337E
38350	CMMVC6338E
38351	CMMVC6339E
38352	CMMVC6340E
38353	CMMVC6341E
38354	CMMVC6248E
38355	CMMVC6249E
38356	CMMVC6250E
38357	CMMVC6251E
38358	CMMVC6252E
38359	CMMVC6253E
38360	CMMVC6254E
38361	CMMVC6255E

Table 5. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code
38362	CMMVC6263E
38370	CMMVC6342E
38371	CMMVC6343E
38372	CMMVC6344E
38373	CMMVC6345E
38400	CMMVC5867E
38401	CMMVC5868E
38402	CMMVC5869E
38403	CMMVC5870E
38404	CMMVC5871E
38405	CMMVC5872E
38406	CMMVC5873E
38560	CMMVC5874E
38561	CMMVC5875E
38562	CMMVC5876E
38563	CMMVC5877E
38564	CMMVC5878E
38565	CMMVC5879E
38566	CMMVC5880E
38569	CMMVC6346E
38611	CMMVC6016E
38656	CMMVC5881E
38657	CMMVC5882E
38658	CMMVC5883E
38659	CMMVC5884E
38660	CMMVC5885E
38661	CMMVC5886E
38662	CMMVC5887E
38663	CMMVC5888E
38664	CMMVC5889E
38665	CMMVC5890E
38666	CMMVC5891E
38667	CMMVC5892E
38668	CMMVC5893E
38669	CMMVC5894E
38670	CMMVC5895E
38816	CMMVC5896E
38817	CMMVC5897E
38818	CMMVC5898E
38819	CMMVC5899E

Table 5. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code
38820	CMMVC5900E
38821	CMMVC5901E
38822	CMMVC5902E
38823	CMMVC5903E
38824	CMMVC5904E
38825	CMMVC5905E
38826	CMMVC5906E
38827	CMMVC5907E
38828	CMMVC5908E
38829	CMMVC5909E
38830	CMMVC5910E
38831	CMMVC5911E
38832	CMMVC5912E
38833	CMMVC5913E
38834	CMMVC5914E
38835	CMMVC5915E
38836	CMMVC5916E
38837	CMMVC5917E
38838	CMMVC5918E
38839	CMMVC5919E
38840	CMMVC5920E
38841	CMMVC5921E
38842	CMMVC5922E
38843	CMMVC5923E
38844	CMMVC5924E
38845	CMMVC5999W
38846	CMMVC6209
38849	CMMVC6215E
38850	CMMVC6316E
38851	CMMVC6318E
38855	CMMVC6288E
38858	CMMVC6006E
38859	CMMVC6001E
38860	CMMVC5990E
38861	CMMVC5991E
38862	CMMVC5992E
38912	CMMVC5925E
38913	CMMVC5926E
38914	CMMVC5927E
38915	CMMVC5928E

Table 5. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code
38916	CMMVC5929E
38917	CMMVC5930E
38918	CMMVC5931E
38919	CMMVC5932E
38920	CMMVC5933E
38921	CMMVC5934E
38922	CMMVC5935E
38923	CMMVC5936E
38924	CMMVC5937E
38925	CMMVC5938E
38926	CMMVC6216E
39072	CMMVC5939E
39073	CMMVC5940E
39074	CMMVC5941E
39075	CMMVC5942E
39076	CMMVC5943E
39077	CMMVC5944E
39078	CMMVC5945E
39079	CMMVC5946E
39080	CMMVC5947E
39081	CMMVC5948E
39082	CMMVC5949E
39083	CMMVC5950E
39084	CMMVC5951E
39085	CMMVC5952E
39086	CMMVC5953E
39087	CMMVC5954E
39088	CMMVC5955E
39089	CMMVC5956E
39090	CMMVC5957E
39091	CMMVC5958E
39092	CMMVC5959E
39093	CMMVC5960E
39094	CMMVC5961E
39095	CMMVC5962E
39096	CMMVC5963E
39097	CMMVC5964E
39098	CMMVC5965E
39099	CMMVC5966E
39100	CMMVC5967E

Table 5. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code
39101	CMMVC5968E
39102	CMMVC5969E
39103	CMMVC5970E
39104	CMMVC5971E
39105	CMMVC5972E
39106	CMMVC5973E
39107	CMMVC5974E
39108	CMMVC5975E
39109	CMMVC5976E
39110	CMMVC5977E
39111	CMMVC5978E
39112	CMMVC5989E
39113	CMMVC5980E
39114	CMMVC5981E
39115	CMMVC5982E
39118	CMMVC6202E
39425	CMMVC5983E
39246	CMMVC5984E
39427	CMMVC5985E
39429	CMMVC5986E
39430	CMMVC6030E
39431	CMMVC6031E
39432	CMMVC6032E
39690	CMMVC5890E
39691	CMMVC6005E
39692	CMMVC5890E

Accessibility

Accessibility features help a user who has a physical disability, such as restricted mobility or limited vision, to use software products successfully.

Features

These are the major accessibility features in the SAN Volume Controller Console:

- You can use screen-reader software and a digital speech synthesizer to hear what is displayed on the screen. The following screen reader has been tested: Window-Eyes v6.1.
- You can operate all features using the keyboard instead of the mouse.
- You can change the initial delay and repeat rate of the up and down buttons to two seconds when you use the front panel of the SAN Volume Controller to set or change an IPv4 address. This feature is documented in the applicable sections of the SAN Volume Controller publications.

Navigating by keyboard

You can use keys or key combinations to perform operations and initiate many menu actions that can also be done through mouse actions. You can navigate the SAN Volume Controller Console and help system from the keyboard by using the following key combinations:

- To traverse to the next link, button, or topic, press Tab inside a frame (page).
- To expand or collapse a tree node, press → or ←, respectively.
- To move to the next topic node, press V or Tab.
- To move to the previous topic node, press ^ or Shift+Tab.
- To scroll all the way up or down, press Home or End, respectively.
- To go back, press Alt+←.
- To go forward, press Alt+→.
- To go to the next frame, press Ctrl+Tab.
- To move to the previous frame, press Shift+Ctrl+Tab.
- To print the current page or active frame, press Ctrl+P.
- To select, press Enter.

Accessing the publications

You can view the publications for the SAN Volume Controller in Adobe Portable Document Format (PDF) using the Adobe Acrobat Reader. The PDFs are provided at the following Web site:

www.ibm.com/storage/support/2145

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Glossary

This glossary includes terms for the IBM System Storage SAN Volume Controller.

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The following cross-references are used in this glossary:

See Refers the reader to one of two kinds of related information:

- A term that is the expanded form of an abbreviation or acronym. This expanded form of the term contains the full definition.
- A synonym or more preferred term.

See also
Refers the reader to one or more related terms.

Contrast with
Refers the reader to a term that has an opposite or substantively different meaning.

Numerics

2145 A hardware machine type for the IBM System Storage SAN Volume Controller. Models of the SAN Volume Controller are expressed as the number 2145 followed by ″-xxx″, such as 2145-8G4. Hardware models for the 2145 include 2145-4F2, 2145-8F2, 2145-8F4, 2145-8G4, and 2145-8A4.

A

access mode
One of three different modes in which a logical unit (LU) in a disk controller system can operate. See also *image mode*, *managed space mode*, and *unconfigured mode*.

Address Resolution Protocol (ARP)
A protocol that dynamically maps an IP address to a network adapter address in a local area network.

agent code
An open-systems standard that interprets Common Information Model (CIM) requests and responses as they transfer between the client application and the device.

application server
A host that is attached to the storage area network (SAN) and that runs applications.

ARP See *Address Resolution Protocol*.

array An ordered collection, or group, of physical storage devices that are used to define logical volumes or devices.

association
A class that contains two references that define a relationship between two referenced objects.

asymmetric virtualization
A virtualization technique in which the virtualization engine is outside the data path and performs a metadata-style service. The metadata server contains all the mapping and locking tables while the storage devices contain only data. See also *symmetric virtualization*.

auxiliary virtual disk
The virtual disk that contains a backup copy of the data and that is used in disaster recovery scenarios. See also *master virtual disk*.

availability
The ability of a system to continue working, with perhaps a decrease in performance, after individual components fail.

B

bandwidth
The range of frequencies an electronic system can transmit or receive. The greater the bandwidth of a system, the more information the system can transfer in a given period of time.

bitmap
A coded representation in which each bit, or group of bits, represents or corresponds to an item; for example, a configuration of bits in main storage in which each bit indicates whether a peripheral device or a storage block is available or in which each group of bits corresponds to one pixel of a display image.

blade One component in a system that is designed to accept some number of components (blades). Blades could be individual servers that plug into a multiprocessing system or individual port cards that add connectivity to a switch. A blade is typically a hot-swappable hardware device.

block A unit of data storage on a disk drive.

block virtualization
The act of applying virtualization to one or more block-based (storage) services for the purpose of providing a new aggregated, higher-level, richer, simpler, or secure block service to clients. Block virtualization functions can be nested. A disk drive, RAID system, or volume manager all perform some form of block-address to (different) block-address mapping or aggregation. See also *virtualization*.

Boolean
Pertaining to the processes used in the algebra formulated by George Boole.

C

cache A high-speed memory or storage device used to reduce the effective time required to read data from or write data to lower-speed memory or a device. Read cache holds data in anticipation that it will be requested by a client. Write cache holds data written by a client until it can be safely stored on more permanent storage media such as disk or tape.

Call Home
In SAN Volume Controller, a communication service that sends data and event notifications to a service provider. The machine can use this link to place a call to IBM or to another service provider when service is required.

capacity licensing
A type of licensing that grants you the use of a number of terabytes (TB) for virtualization, a number of terabytes for Metro Mirror and Global Mirror relationships, and a number of terabytes for FlashCopy mappings.

cascading
The process of connecting two or more fibre-channel hubs or switches together to increase the number of ports or extend distances.

CIM See *Common Information Model*.

CIM object manager (CIMOM)
The common conceptual framework for data management that receives, validates, and authenticates the CIM requests from the client application. It then directs the requests to the appropriate component or service provider.

CIMOM
See *CIM object manager*.

class The definition of an object within a specific hierarchy. A class can have properties and methods and can serve as the target of an association.

CLI See *command line interface*.

client A computer system or process that requests a service of another computer system or process that is typically referred to as a server. Multiple clients can share access to a common server.

client application
A storage management program that initiates Common Information Model (CIM) requests to the CIM agent for the device.

cluster
In SAN Volume Controller, up to four pairs of nodes that provide a single configuration and service interface.

command line-interface (CLI)
A type of computer interface in which the input command is a string of text characters.

Common Information Model (CIM)
A set of standards developed by the Distributed Management Task Force (DMTF). CIM provides a conceptual framework for storage management and an open approach to the design and implementation of storage systems, applications, databases, networks, and devices.

concurrent maintenance
Service that is performed on a unit while it is operational.

In SAN Volume Controller, the ability for one node in the cluster to be turned off for maintenance without interrupting access to the VDisk data provided by the cluster.

configuration node
A node that acts as the focal point for configuration commands and manages the data that describes the cluster configuration.

connected
In a Global Mirror relationship, pertaining to the status condition that occurs when two clusters can communicate.

consistency group
A group of copy relationships between virtual disks that are managed as a single entity.

consistent copy
In a Metro or Global Mirror relationship, a copy of a secondary virtual disk (VDisk) that is identical to the primary VDisk from the viewpoint of a host system, even if a power failure occurred while I/O activity was in progress.

consistent-stopped
In a Global Mirror relationship, the state that occurs when the secondary virtual disk (VDisk) contains a consistent image, but the image might be out-of-date with respect to the primary VDisk. This state can happen when a relationship was in the consistent-synchronized state when an error occurred that forced a freeze of the consistency group. This state can also happen when a relationship is created with the create-consistent flag set to `TRUE`.

consistent-synchronized
In a Global Mirror relationship, the status condition that occurs when the primary virtual disk (VDisk) is accessible for read and write I/O operations. The secondary VDisk is accessible for read-only I/O operations. See also *primary virtual disk* and *secondary virtual disk*.

container
A data storage location; for example, a file, directory, or device.

A software object that holds or organizes other software objects or entities.

contingency capacity
Initially, a fixed amount of unused real capacity that is maintained on a space-efficient virtual disk that is configured to automatically expand its real capacity. It is also the difference between the used capacity and the new real capacity when the real capacity is changed manually.

copied
In a FlashCopy mapping, a state that indicates that a copy has been started after the copy relationship was created. The copy process is complete and the target disk has no further dependence on the source disk.

copying
A status condition that describes the state of a pair of virtual disks (VDisks) that have a copy relationship. The copy process has been started but the two virtual disks are not yet synchronized.

Copy Services
The services that enable you to copy virtual disks (VDisks): FlashCopy, Metro, and Global Mirror.

counterpart SAN
A nonredundant portion of a redundant storage area network (SAN). A counterpart SAN provides all the connectivity of the redundant SAN but without the redundancy. Each counterpart SANs provides an alternate path for each SAN-attached device. See also *redundant SAN*.

cross-volume consistency
In SAN Volume Controller, a consistency group property that guarantees consistency between virtual disks when an application issues dependent write operations that span multiple virtual disks.

D

data migration
The movement of data from one physical location to another without disrupting I/O operations.

degraded
Pertaining to a valid configuration that has suffered a failure but continues to be supported and legal. Typically, a repair action can be performed on a degraded configuration to restore it to a valid configuration.

dense wavelength division multiplexing (DWDM)
A technology that places many optical signals onto one single-mode fiber using slightly different optical frequencies. DWDM enables many data streams to be transferred in parallel.

dependent write operations
A set of write operations that must be applied in the correct order to maintain cross-volume consistency.

destage
A write command initiated by the cache to flush data to disk storage.

device
In the CIM Agent, the storage server that processes and hosts client application requests.

IBM definition: A piece of equipment that is used with the computer and does not generally interact directly with the system, but is controlled by a controller.

HP definition: In its physical form, a magnetic disk that can be attached to a SCSI bus. The term is also used to indicate a physical device that has been made part of a controller configuration; that is, a physical device that is known to the controller. Units (virtual disks) can be created from devices after the devices have been made known to the controller.

device provider
A device-specific handler that serves as a plug-in for the Common Information Model (CIM); that is, the CIM object manager (CIMOM) uses the handler to interface with the device.

directed maintenance procedures
The set of maintenance procedures that can be run for a cluster. These procedures are run from within the SAN Volume Controller application and are documented in the *IBM System Storage SAN Volume Controller Troubleshooting Guide*.

disconnected
In a Metro or Global Mirror relationship, pertains to two clusters when they cannot communicate.

discovery
The automatic detection of a network topology change, for example, new and deleted nodes or links.

disk controller
A device that coordinates and controls the operation of one or more disk drives and synchronizes the operation of the drives with the operation of the system as a whole. Disk controllers provide the storage that the cluster detects as managed disks (MDisks).

disk drive
A disk-based, nonvolatile, storage medium.

disk zone
A zone defined in the storage area network (SAN) fabric in which the SAN Volume Controller can detect and address the logical units that the disk controllers present.

Distributed Management Task Force (DMTF)
An organization that defines standards for the management of distributed systems. See also *Common Information Model*.

DMP See *directed maintenance procedures*.

DMTF See *Distributed Management Task Force*.

domain name server
In the Internet suite of protocols, a server program that supplies name-to-address conversion by mapping domain names to IP addresses.

DRAM See *dynamic random access memory*.

DWDM
See *dense wavelength division multiplexing*.

dynamic random access memory (DRAM)
A storage in which the cells require repetitive application of control signals to retain stored data.

E

EC See *engineering change.*

EIA See *Electronic Industries Alliance*.

Electronic Industries Alliance (EIA)
An alliance of four trade associations: The Electronic Components, Assemblies & Materials Association (ECA); the Government Electronics and Information Technology Association (GEIA); the JEDEC Solid State Technology Association (JEDEC); and the Telecommunications Industry Association (TIA). Prior to 1998, EIA was the Electronic Industries Association and the group dates back to 1924.

empty In a Global Mirror relationship, a status condition that exists when the consistency group contains no relationships.

engineering change (EC)
A correction for a defect of hardware or software that is applied to a product.

error code
A value that identifies an error condition.

ESS See *IBM TotalStorage Enterprise Storage Server®*.

exclude
To remove a managed disk (MDisk) from a cluster because of certain error conditions.

excluded
In SAN Volume Controller, the status of a managed disk that the cluster has removed from use after repeated access errors.

extent A unit of data that manages the mapping of data between managed disks and virtual disks.

F

fabric In fibre-channel technology, a routing structure, such as a switch, that receives addressed information and routes it to the appropriate destination. A fabric can consist of more than one switch. When multiple fibre-channel switches are interconnected, they are described as cascading. See also *cascading*.

fabric port (F_port)
A port that is part of a fibre-channel fabric. An F_port on a fibre-channel fabric connects to the node port (N_port) on a node.

failover
In SAN Volume Controller, the function that occurs when one redundant part of the system takes over the workload of another part of the system that has failed.

FCIP See *Fibre Channel over IP*.

fibre channel
A technology for transmitting data between computer devices at a data rate of up to 4 Gbps. It is especially suited for attaching computer servers to shared storage devices and for interconnecting storage controllers and drives.

fibre-channel extender
A device that extends a fibre-channel link over a greater distance than is supported by the standard, usually a number of miles or kilometers. Devices must be deployed in pairs at each end of a link.

Fibre Channel over IP (FCIP)
A network storage technology that combines the features of the Fibre Channel Protocol and the Internet Protocol (IP) to connect distributed SANs over large distances.

Fibre Channel Protocol (FCP)
A protocol that is used in fibre-channel communications with five layers that define how fibre-channel ports interact through their physical links to communicate with other ports.

field replaceable unit (FRU)
An assembly that is replaced in its entirety when any one of its components fails. An IBM service representative performs the replacement. In some cases, a field replaceable unit might contain other field replaceable units.

FlashCopy mapping
A relationship between two virtual disks.

FlashCopy relationship
See *FlashCopy mapping*.

FlashCopy service
In SAN Volume Controller, a copy service that duplicates the contents of a source virtual disk (VDisk) to a target VDisk. In the process, the original contents of the target VDisk are lost. See also *point-in-time copy.*

F_port
See *fabric port*.

FRU See *field replaceable unit*.

G

gateway
An entity that operates above the link layer and translates, when required, the interface and protocol used by one network into those used by another distinct network.

GB See *gigabyte*.

GBIC See *gigabit interface converter*.

gigabit interface converter (GBIC)
An interface module that converts the light stream from a fibre-channel cable into electronic signals for use by the network interface card.

gigabyte (GB)
In decimal notation, 1 073 741 824 bytes.

Global Mirror
An asynchronous copy service that enables host data on a particular source virtual disk (VDisk) to be copied to the target VDisk that is designated in the relationship.

grain In a FlashCopy bitmap, the unit of data represented by a single bit.

graphical user interface (GUI)
A type of computer interface that presents a visual metaphor of a real-world scene, often of a desktop, by combining high-resolution graphics, pointing devices, menu bars and other menus, overlapping windows, icons and the object-action relationship.

GUI See *graphical user interface*.

H

hardcoded
Pertaining to software instructions that are statically encoded and not intended to be altered.

HBA See *host bus adapter*.

HLUN See *virtual disk*.

hop One segment of a transmission path between adjacent nodes in a routed network.

host An open-systems computer that is connected to the SAN Volume Controller through a fibre-channel interface.

host bus adapter (HBA)
In SAN Volume Controller, an interface card that connects a host bus, such as a peripheral component interconnect (PCI) bus, to the storage area network.

host ID
In SAN Volume Controller, a numeric identifier assigned to a group of host fibre-channel ports for the purpose of logical unit number (LUN) mapping. For each host ID, there is a separate mapping of Small Computer System Interface (SCSI) IDs to virtual disks (VDisks).

host zone
A zone defined in the storage area network (SAN) fabric in which the hosts can address the SAN Volume Controllers.

hub A fibre-channel device that connects nodes into a logical loop by using a

physical star topology. Hubs will automatically recognize an active node and insert the node into the loop. A node that fails or is powered off is automatically removed from the loop.

A communications infrastructure device to which nodes on a multi-point bus or loop are physically connected. Commonly used in Ethernet and fibre-channel networks to improve the manageability of physical cables. Hubs maintain the logical loop topology of the network of which they are a part, while creating a “hub and spoke” physical star layout. Unlike switches, hubs do not aggregate bandwidth. Hubs typically support the addition or removal of nodes from the bus while it is operating. (S) Contrast with *switch*.

I

IBM System Storage Productivity Center (SSPC)
An integrated hardware and software solution that provides a single point of entry for managing SAN Volume Controller clusters, IBM System Storage DS8000™ systems, and other components of a data storage infrastructure.

IBM TotalStorage Enterprise Storage Server (ESS)
An IBM product that provides an intelligent disk-storage system across an enterprise.

ID See *identifier*.

identifier (ID)
A sequence of bits or characters that identifies a user, program device, or system to another user, program device, or system.

idle In a FlashCopy mapping, the state that occurs when the source and target virtual disks (VDisks) act as independent VDisks even if a mapping exists between the two. Read and write caching is enabled for both the source and the target.

idling The status of a pair of virtual disks (VDisks) that have a defined copy relationship for which no copy activity has yet been started.

In a Metro or Global Mirror relationship, the state that indicates that the master virtual disks (VDisks) and auxiliary VDisks are operating in the primary role. Consequently, both VDisks are accessible for write I/O operations.

idling-disconnected
In a Global Mirror relationship, the state that occurs when the virtual disks (VDisks) in this half of the consistency group are all operating in the primary role and can accept read or write I/O operations.

illegal configuration
A configuration that will not operate and will generate an error code to indicate the cause of the problem.

image mode
An access mode that establishes a one-to-one mapping of extents in the managed disk (MDisk) with the extents in the virtual disk (VDisk). See also *managed space mode* and *unconfigured mode*.

image VDisk
A virtual disk (VDisk) in which there is a direct block-for-block translation from the managed disk (MDisk) to the VDisk.

IML See *initial microcode load*.

inconsistent
In a Metro or Global Mirror relationship, pertaining to a secondary virtual disk (VDisk) that is being synchronized with the primary VDisk.

inconsistent-copying
In a Global Mirror relationship, the state that occurs when the primary virtual disk (VDisk) is accessible for read and write input/output (I/O) operations, but the secondary VDisk is not accessible for either. This state occurs after a **start** command is issued to a consistency group that is in the inconsistent-stopped state. This state also occurs when a **start** command is issued, with the force option, to a consistency group that is in the idling or consistent-stopped state.

inconsistent-disconnected
In a Global Mirror relationship, a state that occurs when the virtual disks (VDisks) in the half of the consistency group that is operating in the secondary role are not accessible for either read or write I/O operations.

inconsistent-stopped
In a Global Mirror relationship, the state that occurs when the primary virtual disk (VDisk) is accessible for read and write input/output (I/O) operations, but the secondary VDisk is not accessible for either read or write I/O operations.

indication
An object representation of an event.

initial microcode load (IML)
In SAN Volume Controller, the process by which the run-time code and data for a node are loaded into memory and initialized.

initiator
The system component that originates an I/O command over an I/O bus or network. I/O adapters, network interface cards, and intelligent controller device I/O bus control ASICs are typical initiators. (S) See also *logical unit number*.

input/output (I/O)
Pertaining to a functional unit or communication path involved in an input process, an output process, or both, concurrently or not, and to the data involved in such a process.

instance
An individual object that is a member of some class. In object-oriented programming, an object is created by instantiating a class.

integrity
The ability of a system to either return only correct data or respond that it cannot return correct data.

Internet Protocol (IP)
In the Internet suite of protocols, a connectionless protocol that routes data through a network or interconnected networks and acts as an intermediary between the higher protocol layers and the physical network. IPv4 is the dominant network layer protocol on the Internet, and IPv6 is designated as its successor. IPv6 provides a much larger address space, which enables greater flexibility in assigning addresses and simplifies routing and renumbering.

interswitch link (ISL)
The physical connection that carries a protocol for interconnecting multiple routers and switches in a storage area network.

I/O See *input/output.*

I/O group
A collection of virtual disks (VDisks) and node relationships that present a common interface to host systems.

I/O throttling rate
The maximum rate at which an I/O transaction is accepted for this virtual disk (VDisk).

IP See *Internet Protocol*.

IP address
The unique 32-bit address that specifies the location of each device or workstation in the Internet. For example, 9.67.97.103 is an IP address.

ISL See *interswitch link*.

ISL hop
A hop on an interswitch link (ISL). Considering all pairs of node ports (N-ports) in a fabric and measuring distance only in terms of interswitch links (ISLs) in the fabric, the number of ISLs traversed is the number of ISL hops on the shortest route between the pair of nodes that are farthest apart in the fabric.

J

JBOD (just a bunch of disks)
IBM definition: See *non-RAID*.

HP definition: A group of single-device logical units not configured into any other container type.

L

LBA See *logical block address*.

least recently used (LRU)
An algorithm used to identify and make available the cache space that contains the least-recently used data.

line card
See *blade*.

local fabric
In SAN Volume Controller, those storage area network (SAN) components (such as switches and cables) that connect the components (nodes, hosts, switches) of the local cluster together.

local/remote fabric interconnect
The storage area network (SAN) components that are used to connect the local and remote fabrics together.

logical block address (LBA)
The block number on a disk.

logical unit (LU)
An entity to which Small Computer System Interface (SCSI) commands are addressed, such as a virtual disk (VDisk) or managed disk (MDisk).

logical unit number (LUN)
The SCSI identifier of a logical unit within a target. (S)

longitudinal redundancy check (LRC)
A method of error checking during data transfer that involves checking parity.

LRC See *longitudinal redundancy check*.

LRU See *least recently used*.

LU See *logical unit*.

LUN See *logical unit number*.

LUN masking
A process that allows or prevents I/O to the disk drives through the host-bus-adapter (HBA) device or operating-system device driver.

M

managed disk (MDisk)
A Small Computer System Interface (SCSI) logical unit that a redundant array of independent disks (RAID) controller provides and a cluster manages. The MDisk is not visible to host systems on the storage area network (SAN).

managed disk group
A collection of managed disks (MDisks) that, as a unit, contain all the data for a specified set of virtual disks (VDisks).

Managed Object Format (MOF)
A language for defining Common Information Model (CIM) schemas.

managed space mode
An access mode that enables virtualization functions to be performed. See also *image mode* and *unconfigured mode*.

Management Information Base (MIB)
Simple Network Management Protocol (SNMP) units of managed information that specifically describe an aspect of a system, such as the system name, hardware number, or communications configuration. A collection of related MIB objects is defined as a MIB.

mapping
See *FlashCopy mapping*.

master console
A single point from which to manage the IBM System Storage SAN Volume Controller. For SAN Volume Controller version 4.2.1 and earlier, the master console was purchased either as software that was installed and configured on a server or as a hardware platform with preinstalled operating system and master console software. See *IBM System Storage Productivity Center*.

master virtual disk
The virtual disk (VDisk) that contains a production copy of the data and that an application accesses. See also *auxiliary virtual disk.*

MB See *megabyte*.

MDisk See *managed disk*.

megabyte (MB)
In decimal notation, 1 048 576 bytes.

mesh configuration
A network that contains a number of small SAN switches configured to create a larger switched network. With this configuration, four or more switches are connected together in a loop with some of the paths short circuiting the loop. An example of this configuration is to have four switches connected together in a loop with ISLs for one of the diagonals.

method
A way to implement a function on a class.

Metro Mirror
A synchronous copy service that enables host data on a particular source virtual disk (VDisk) to be copied to the target VDisk that is designated in the relationship.

MIB See *Management Information Base*.

migration
See *data migration*.

mirrored virtual disk
A virtual disk (VDisk) with two VDisk copies.

mirrorset
IBM definition: See *RAID-1*.

HP definition: A RAID storageset of two or more physical disks that maintain a complete and independent copy of the data from the virtual disk. This type of storageset has the advantage of being highly reliable and extremely tolerant of device failure. Raid level 1 storagesets are referred to as mirrorsets.

MOF See *Managed Object Format (MOF)*.

N

namespace
The scope within which a Common Information Model (CIM) schema applies.

node One SAN Volume Controller. Each node provides virtualization, cache, and Copy Services to the storage area network (SAN).

node name
A name identifier associated with a node. (SNIA)

node port (N_port)
A port that connects a node to a fabric or to another node. N_ports connect to fabric ports (F_ports) or to other N_ports of other nodes. N_ports handle creation, detection, and flow of message units to and from the connected systems. N_ports are end points in point-to-point links.

node rescue
In SAN Volume Controller, the process by which a node that has no valid software installed on its hard disk drive can copy the software from another node connected to the same fibre-channel fabric.

non-RAID
Disks that are not in a redundant array of independent disks (RAID). HP definition: See *JBOD*.

N_port
See *node port*.

O

object In object-oriented design or programming, a concrete realization of a class that consists of data and the operations associated with that data.

object model
A representation, such as a diagram, of objects in a given system. Using symbols similar to standard flowchart symbols, an object model depicts the classes the objects belong to, their associations with each other, the attributes that make them unique, and the operations that the objects can perform and that can be performed on them.

object name
An object that consists of a namespace path and a model path. The namespace path provides access to the Common Information Model (CIM) implementation managed by the CIM Agent, and the model path provides navigation within the implementation.

object path
An object that consists of a namespace path and a model path. The namespace path provides access to the Common Information Model (CIM) implementation managed by the CIM Agent, and the model path provides navigation within the implementation.

offline Pertaining to the operation of a functional unit or device that is not under the continual control of the system or of a host.

online Pertaining to the operation of a functional unit or device that is under the continual control of the system or of a host.

operating set
In SAN Volume Controller, the set of nodes that are operating together to deliver storage services.

overallocated volume
See *space-efficient virtual disk*.

oversubscription
The ratio of the sum of the traffic that is on the initiator N-node connections to the traffic that is on the most heavily loaded interswitch links (ISLs), where more than one ISL is connected in parallel between these switches. This definition assumes a symmetrical network and a specific workload that is applied equally from all initiators and sent equally to all targets. See also *symmetrical network*.

P

partition
IBM definition: A logical division of storage on a fixed disk.

HP definition: A logical division of a container represented to the host as a logical unit.

partner node
The other node that is in the I/O group to which this node belongs.

partnership
In Metro or Global Mirror operations, the relationship between two clusters. In a cluster partnership, one cluster is defined as the local cluster and the other cluster as the remote cluster.

paused
In SAN Volume Controller, the process by which the cache component quiesces all ongoing I/O activity below the cache layer.

pend To cause to wait for an event.

petabyte (PB)
In decimal notation, 1 125 899 906 842 624 bytes.

PDU See *power distribution unit*.

physical disk licensing
A type of licensing that grants you the use of a number of physical disks for virtualization. You can also license the use of the Metro Mirror and Global Mirror feature, the use of the FlashCopy feature, or both of these features.

PLUN See *managed disk*.

point-in-time copy
The instantaneous copy that the FlashCopy service makes of the source virtual disk (VDisk). In some contexts, this copy is known as a T_0 *copy*.

port The physical entity within a host, SAN Volume Controller, or disk controller system that performs the data communication (transmitting and receiving) over the fibre channel.

port ID
An identifier associated with a port.

power distribution unit (PDU)
A device that distributes electrical power to multiple devices in the rack. It typically is rack-mounted and provides circuit breakers and transient voltage suppression.

power-on self-test
A diagnostic test that servers or computers run when they are turned on.

prepared
In a Global Mirror relationship, the state that occurs when the mapping is ready to start. While in this state, the target virtual disk (VDisk) is offline.

preparing
In a Global Mirror relationship, the state that occurs when any changed write data for the source virtual disk (VDisk) is flushed from the cache. Any read or write data for the target VDisk is discarded from the cache.

primary virtual disk
In a Metro or Global Mirror relationship, the target of write operations issued by the host application.

property
In the Common Information Model (CIM), an attribute that is used to characterize instances of a class.

PuTTY
A client program that allows you to run remote sessions on your computer through specific network protocols, such as SSH, Telnet, and Rlogin.

Q

qualifier
A value that provides additional information about a class, association, indication, method, method parameter, instance, property, or reference.

quorum
A set of nodes that operates as a cluster. Each node has a connection to every other node in the cluster. If a connection failure causes the cluster to split into two or more groups of nodes that have full connection within the group, the quorum is the group that is selected to operate as the cluster. Typically, this is the larger group of nodes, but the quorum disk serves as a tiebreaker if the groups are the same size.

queue depth
The number of I/O operations that can be run in parallel on a device.

quorum disk
A managed disk (MDisk) that contains a reserved area that is used exclusively for cluster management. The quorum disk is accessed in the event that it is necessary to determine which half of the cluster continues to read and write data.

quorum index
A number that can be either: 0, 1 or 2

R

rack A free-standing framework that holds the devices and card enclosure.

RAID See *redundant array of independent disks*.

RAID 0
IBM definition: RAID 0 allows a number of disk drives to be combined and presented as one large disk. RAID 0 does not provide any data redundancy. If one drive fails, all data is lost.

HP definition: A RAID storageset that stripes data across an array of disk drives. A single logical disk spans multiple physical disks, allowing parallel data processing for increased I/O performance. While the performance characteristics of RAID level 0 is excellent, this RAID level is the only one that does not provide redundancy. Raid level 0 storagesets are referred to as stripesets.

RAID 1
SNIA dictionary definition: A form of storage array in which two or more identical copies of data are maintained on separate media. (S)

IBM definition: A form of storage array in which two or more identical copies of data are maintained on separate media. Also known as mirrorset.

HP definition: See *mirrorset*.

RAID 5
SNIA definition: A form of parity RAID in which the disks operate independently, the data strip size is no smaller than the exported block size, and parity check data is distributed across the array's disks. (S)

IBM definition: See the SNIA definition.

HP definition: A specially developed RAID storageset that stripes data and parity across three or more members in a disk array. A RAIDset combines the best characteristics of RAID level 3 and RAID level 5. A RAIDset is the best choice for most applications with small to medium I/O requests, unless the application is write intensive. A RAIDset is sometimes called parity RAID. RAID level 3/5 storagesets are referred to as RAIDsets.

RAID 10
A type of RAID that optimizes high performance while maintaining fault

tolerance for up to two failed disk drives by striping volume data across several disk drives and mirroring the first set of disk drives on an identical set.

real capacity
The amount of storage that is allocated to a virtual disk copy from a managed disk group.

redundant ac-power switch
A device that provides input power redundancy by attaching a SAN Volume Controller to two independent power sources. If the main source becomes unavailable, the redundant ac-power switch automatically provides power from a secondary (backup) source. When power is restored, the redundant ac-power switch automatically changes back to the main power source.

redundant array of independent disks (RAID)
A collection of two or more disk drives that present the image of a single disk drive to the system. In the event of a single device failure, the data can be read or regenerated from the other disk drives in the array.

redundant SAN
A storage area network (SAN) configuration in which any one single component might fail, but connectivity between the devices within the SAN is maintained, possibly with degraded performance. This configuration is normally achieved by splitting the SAN into two, independent, counterpart SANs. See also *counterpart SAN.*

reference
A pointer to another instance that defines the role and scope of an object in an association.

rejected
A status condition that describes a node that the cluster software has removed from the working set of nodes in the cluster.

relationship
In Metro or Global Mirror, the association between a master virtual disk (VDisk) and an auxiliary VDisk. These VDisks also have the attributes of a primary or secondary VDisk. See also *auxiliary virtual disk, master virtual disk, primary virtual disk, and secondary virtual disk.*

reliability
The ability of a system to continue to return data even if a component fails.

remote fabric
In Global Mirror, the storage area network (SAN) components (switches and cables) that connect the components (nodes, hosts, and switches) of the remote cluster.

roles Authorization is based on roles that map to the administrator and service roles in an installation. The switch translates these roles into SAN Volume Controller administrator and service user IDs when a connection is made to the node for the SAN Volume Controller.

S

SAN See *storage area network*.

SAN Volume Controller fibre-channel port fan in
The number of hosts that can see any one SAN Volume Controller port.

SATA See *Serial Advanced Technology Attachment*.

schema
A group of object classes defined for and applicable to a single namespace. Within the CIM Agent, the supported schemas are the ones that are loaded through the managed object format (MOF).

SCSI See *Small Computer Systems Interface*.

SCSI back-end layer
The layer in a Small Computer Systems Interface (SCSI) network that performs the following functions: controls access to individual disk controller systems that are managed by the cluster; receives requests from the virtualization layer, processes them, and sends them to managed disks; addresses SCSI-3 commands to the disk controller systems on the storage area network (SAN).

SCSI front-end layer
The layer in a Small Computer Systems Interface (SCSI) network that receives I/O commands sent from hosts and provides the SCSI-3 interface to hosts. SCSI logical unit numbers (LUNs) are mapped to virtual disks (VDisks) in this layer as well. Thus, the layer converts SCSI read and write commands that are addressed to LUNs into commands that are addressed to specific VDisks.

SDD See *subsystem device driver (SDD)*.

secondary virtual disk
In Metro or Global Mirror, the virtual disk (VDisk) in a relationship that contains a copy of data written by the host application to the primary VDisk.

Secure Shell (SSH)
A program to log in to another computer over a network, to run commands in a remote machine, and to move files from one machine to another.

Secure Sockets Layer (SSL)
A security protocol that provides communication privacy. With SSL, client/server applications can communicate in a way that is designed to prevent eavesdropping, tampering, and message forgery.

sequential VDisk
A virtual disk that uses extents from a single managed disk.

Serial Advanced Technology Attachment (SATA)
The evolution of the ATA interface from a parallel bus to serial connection architecture. (S)

Serial ATA
See *Serial Advanced Technology Attachment*.

server In a network, the hardware or software that provides facilities to other stations; for example, a file server, a printer server, a mail server. The station making the request of the server is usually called the client.

Service Location Protocol (SLP)
In the Internet suite of protocols, a protocol that identifies and uses network hosts without having to designate a specific network host name.

fibre-channel SFP connector
See *small form-factor pluggable connector*.

Simple Mail Transfer Protocol (SMTP)
An Internet application protocol for transferring mail among users of the

Internet. SMTP specifies the mail exchange sequences and message format. It assumes that the Transmission Control Protocol (TCP) is the underlying protocol.

Simple Network Management Protocol (SNMP)
In the Internet suite of protocols, a network management protocol that is used to monitor routers and attached networks. SNMP is an application-layer protocol. Information on devices managed is defined and stored in the application's Management Information Base (MIB).

SLP See *Service Location Protocol*.

Small Computer System Interface (SCSI)
A standard hardware interface that enables a variety of peripheral devices to communicate with one another.

small form-factor pluggable (SFP) connector
A compact optical transceiver that provides the optical interface to a fibre-channel cable.

SMI-S See *Storage Management Initiative Specification*.

SMTP See *Simple Mail Transfer Protocol*.

SNIA See *Storage Networking Industry Association*.

SNMP See *Simple Network Management Protocol*.

space-efficient VDisk
See *space-efficient virtual disk*.

space-efficient virtual disk
A virtual disk that has different virtual capacities and real capacities.

SSH See *Secure Shell*.

SSPC See *IBM System Storage Productivity Center (SSPC)*.

SSL See *Secure Sockets Layer*.

stand-alone relationship
In FlashCopy, Metro Mirror, and Global Mirror, relationships that do not belong to a consistency group and that have a null consistency group attribute.

stop A configuration command that is used to stop the activity for all copy relationships in a consistency group.

stopped
The status of a pair of virtual disks (VDisks) that have a copy relationship that the user has temporarily broken because of a problem.

storage area network (SAN)
A network whose primary purpose is the transfer of data between computer systems and storage elements and among storage elements. A SAN consists of a communication infrastructure, which provides physical connections, and a management layer, which organizes the connections, storage elements, and computer systems so that data transfer is secure and robust. (S)

Storage Management Initiative Specification (SMI-S)
A design specification developed by the Storage Networking Industry Association (SNIA) that specifies a secure and reliable interface that allows storage management systems to identify, classify, monitor, and control physical and logical resources in a storage area network. The interface is

intended as a solution that integrates the various devices to be managed in a storage area network (SAN) and the tools used to manage them.

Storage Networking Industry Association (SNIA)
An association of producers and consumers of storage networking products whose goal is to further storage networking technology and applications. See www.snia.org.

striped
Pertains to a virtual disk (VDisk) that is created from multiple managed disks (MDisks) that are in the MDisk group. Extents are allocated on the MDisks in the order specified.

stripeset
See *RAID 0*.

subsystem device driver (SDD)
An IBM pseudo device driver designed to support the multipath configuration environments in IBM products.

superuser authority
Can issue any command-line interface (CLI) command. A superuser can view and work with the following panels: View users, Add cluster, Remove cluster, Add users, and Modify users. Only one Superuser role is available.

suspended
The status of a pair of virtual disks (VDisks) that have a copy relationship that has been temporarily broken because of a problem.

switch
A network infrastructure component to which multiple nodes attach. Unlike hubs, switches typically have internal bandwidth that is a multiple of link bandwidth, and the ability to rapidly switch node connections from one to another. A typical switch can accommodate several simultaneous full link bandwidth transmissions between different pairs of nodes. (S) Contrast with *hub*.

symmetrical network
A network in which all the initiators are connected at the same level and all the controllers are connected at the same level.

symmetric virtualization
A virtualization technique in which the physical storage in the form of Redundant Array of Independent Disks (RAID) is split into smaller chunks of storage known as *extents*. These extents are then concatenated, using various policies, to make virtual disks (VDisks). See also *asymmetric virtualization*.

synchronized
In Metro or Global Mirror, the status condition that exists when both virtual disks (VDisks) of a pair that has a copy relationship contain the same data.

system
A functional unit, consisting of one or more computers and associated software, that uses common storage for all or part of a program and also for all or part of the data necessary for the execution of the program. A computer system can be a stand-alone unit, or it can consist of multiple connected units.

T

terabyte
In decimal notation, 1 099 511 628 000 bytes.

thinly provisioned volume
See *space-efficient virtual disk*.

topology
The logical layout of the components of a computer system or network and their interconnections. Topology deals with questions of what components are directly connected to other components from the standpoint of being able to communicate. It does not deal with questions of physical location of components or interconnecting cables. (S)

trigger
To initiate or reinitiate copying between a pair of virtual disks (VDisks) that have a copy relationship.

U

UID See *unique identifier*.

unconfigured mode
A mode in which I/O operations cannot be performed. See also *image mode* and *managed space mode*.

uninterruptible power supply
A device that is connected between a computer and its power source that protects the computer against blackouts, brownouts, and power surges. The uninterruptible power supply contains a power sensor to monitor the supply and a battery to provide power until an orderly shutdown of the system can be performed.

unique identifier (UID)
An identifier that is assigned to storage system logical units when they are created. It is used to identify the logical unit regardless of the logical unit number (LUN), status of the logical unit, or whether alternate paths exist to the same device. Typically, a UID is only used once.

unmanaged
An access mode that pertains to a managed disk (MDisk) that is not used by the cluster.

V

valid configuration
A configuration that is supported.

VDisk See *virtual disk (VDisk)*.

VDisk copy
See *virtual disk copy*.

virtual capacity
The amount of storage that is available to a server on a virtual disk (VDisk) copy. In a space-efficient virtual disk, the virtual capacity can be different from the real capacity. In a standard virtual disk, the virtual capacity and real capacity are the same.

virtual disk copy
A physical copy of the data that is stored on a virtual disk (VDisk). Mirrored VDisks have two such copies. Nonmirrored VDisks have one copy.

virtual disk (VDisk)
A device that host systems in a storage area network (SAN) recognize as a Small Computer System Interface (SCSI) disk.

virtualization
In the storage industry, a concept in which a pool of storage is created that contains several disk subsystems. The subsystems can be from various vendors. The pool can be split into virtual disks that are visible to the host systems that use them.

virtualized storage
Physical storage that has virtualization techniques applied to it by a virtualization engine.

virtual storage area network (VSAN)
A fabric within the SAN.

vital product data (VPD)
Information that uniquely defines system, hardware, software, and microcode elements of a processing system.

VLUN See *managed disk*.

VPD See *vital product data*.

VSAN See *virtual storage area network*.

W

WBEM
See *Web-Based Enterprise Management*.

Web-Based Enterprise Management (WBEM)
A tiered, enterprise-management architecture that was developed by the Distributed Management Task Force (DMTF). This architecture provides the management design framework that consists of devices, device providers, the object manager, and the messaging protocol for the communication between client applications and the object manager.

worldwide node name (WWNN)
An identifier for an object that is globally unique. WWNNs are used by Fibre Channel and other standards.

worldwide port name (WWPN)
A unique 64-bit identifier that is associated with a fibre-channel adapter port. The WWPN is assigned in an implementation- and protocol-independent manner.

WWNN
See *worldwide node name*.

WWPN
See *worldwide port name*.

Z

zoning
In fibre-channel environments, the grouping of multiple ports to form a virtual, private, storage network. Ports that are members of a zone can communicate with each other, but are isolated from ports in other zones.

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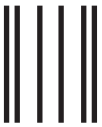

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