IBM System Storage SAN Volume Controller

CIM Agent Developer's Guide

Version 5.1.0

SC23-6665-02

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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 5.1.0, and to all subsequent releases and modifications until otherwise indicated in new editions. This edition replaces SC23-6665-01.

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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
- Web sites that provide information about the SAN Volume Controller or related products or technologies
- How to order IBM publications
- How to send in your feedback on this book

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 SC23-6665-02 and SC23-6665-01 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 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) is now located on the SAN Volume Controller cluster only. The CIMOM is no longer on the SAN Volume Controller console.

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Removed information

This section lists the content that was removed from this document.

- In SAN Volume Controller 5.1.0, updating SSL certificates does not apply to the CIMOM.

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 were removed from this guide. The actual error code reference comparisons remain. For information on their specific messages and action plans, see the *IBM System Storage SAN Volume Controller Command-Line Interface User's Guide*.
- Several FlashCopy consistency groups have the autodelete 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.

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

Product manuals, other publications, and Web sites contain information that relates to SAN Volume Controller.

SAN Volume Controller Information Center

The IBM System Storage SAN Volume Controller Information Center contains all of the information that is required to install, configure, and manage the SAN Volume Controller. The information center is updated between SAN Volume Controller product releases to provide the most current documentation. The information center is available at the following Web site:

http://publib.boulder.ibm.com/infocenter/svcic/v3r1m0/index.jsp

SAN Volume Controller library

Table 1 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

Table 1. SAN Volume Controller library

Title	Description	Order number
IBM System Storage SAN Volume Controller Planning Guide	This guide introduces the SAN Volume Controller and lists the features that you can order. It also provides guidelines for planning the installation and configuration of the SAN Volume Controller.	GA32-0551
IBM System Storage SAN Volume Controller Model 2145-CF8 Hardware Installation Guide	This guide provides the instructions that the IBM service representative uses to install the hardware for SAN Volume Controller model 2145-CF8.	GC52-1356

Table 1. SAN Volume Controller library (continued)

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 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 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

Table 1. SAN Volume Controller library (continued)

Title	Description	Order number
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
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 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

Table 2 lists IBM publications that contain information related to the SAN Volume Controller.

Table 2. Other IBM publications

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
IBM System Storage Productivity Center User's Guide	This guide describes how to configure the IBM System Storage Productivity Center software.	SC27-2336

Table 2. Other IBM publications (continued)

Title	Description	Order number
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
Implementing the IBM System Storage SAN Volume Controller V4.3	This IBM Redbooks® publication is a detailed technical guide to the IBM System Storage SAN Volume Controller. It provides a high-level overview of storage virtualization and the SAN Volume Controller architecture, discusses implementing and configuring the SAN Volume Controller, tells you how to migrate existing storage to the SAN Volume Controller, and discusses different supported migration activities.	SG24-6423

IBM documentation and related Web sites

Table 3 lists Web sites that provide publications and other information about the SAN Volume Controller or related products or technologies.

Table 3. IBM documentation and related Web sites

Web site	Address
Support for SAN Volume Controller (2145)	www.ibm.com/storage/support/2145
Support for IBM System Storage and IBM TotalStorage® products	www.ibm.com/storage/support/
IBM Publications Center	www.ibm.com/shop/publications/order/
IBM Redbooks publications	www.redbooks.ibm.com/

Related accessibility information

To view a PDF file, you need Adobe Acrobat Reader, which can be downloaded from the Adobe Web site:

www.adobe.com/support/downloads/main.html

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/

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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, in SAN Volume Controller 5.1.0, CIM Schema 2.7 for Managing Storage Arrays specifies how to configure 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.

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. SAN Volume Controller 5.1.0 is based on the Open Pegasus version 2.7.0 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.

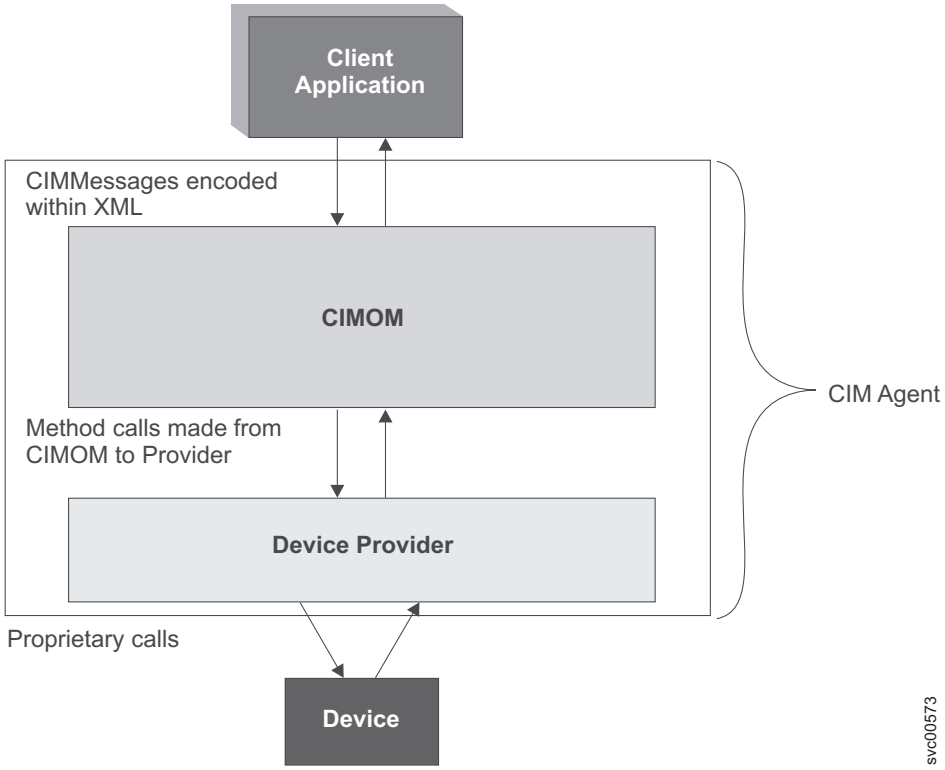

Figure 1. A typical CIM agent at work

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

In SAN Volume Controller 5.1, the CIMOM resides on the SAN Volume Controller cluster. The SAN Volume Controller Console uses the CIMOM that is on the cluster. Other IBM storage management tools continue to use the CIMOM that is on the cluster.

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

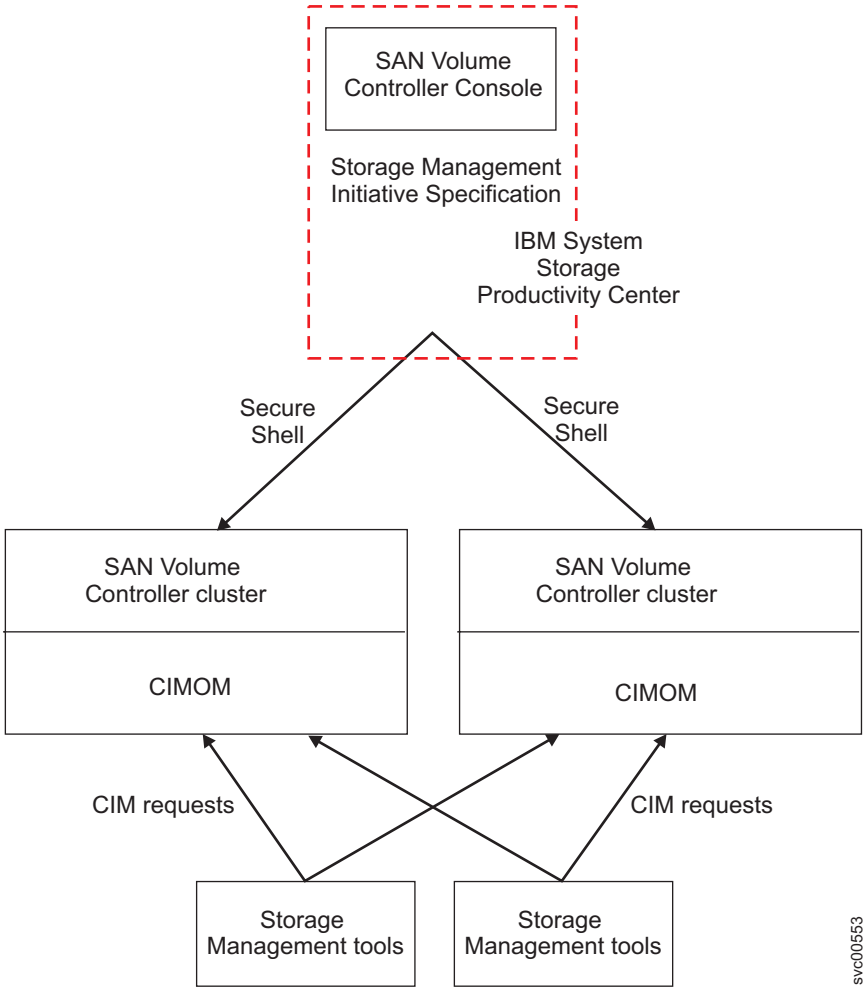

Figure 2. CIMOM on the cluster

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 4 shows how these concepts relate to one another.

Table 4. 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 4. 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.

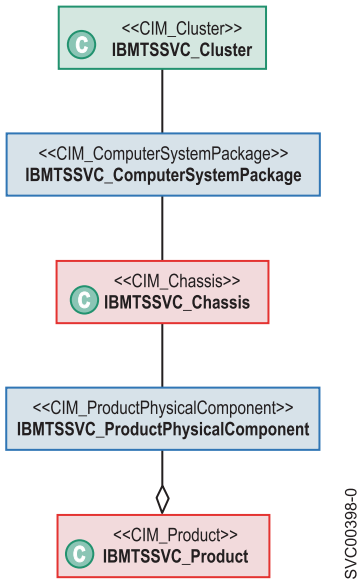

Figure 4. High-level overview of the physical package of the CIM agent for the SAN Volume Controller.

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.

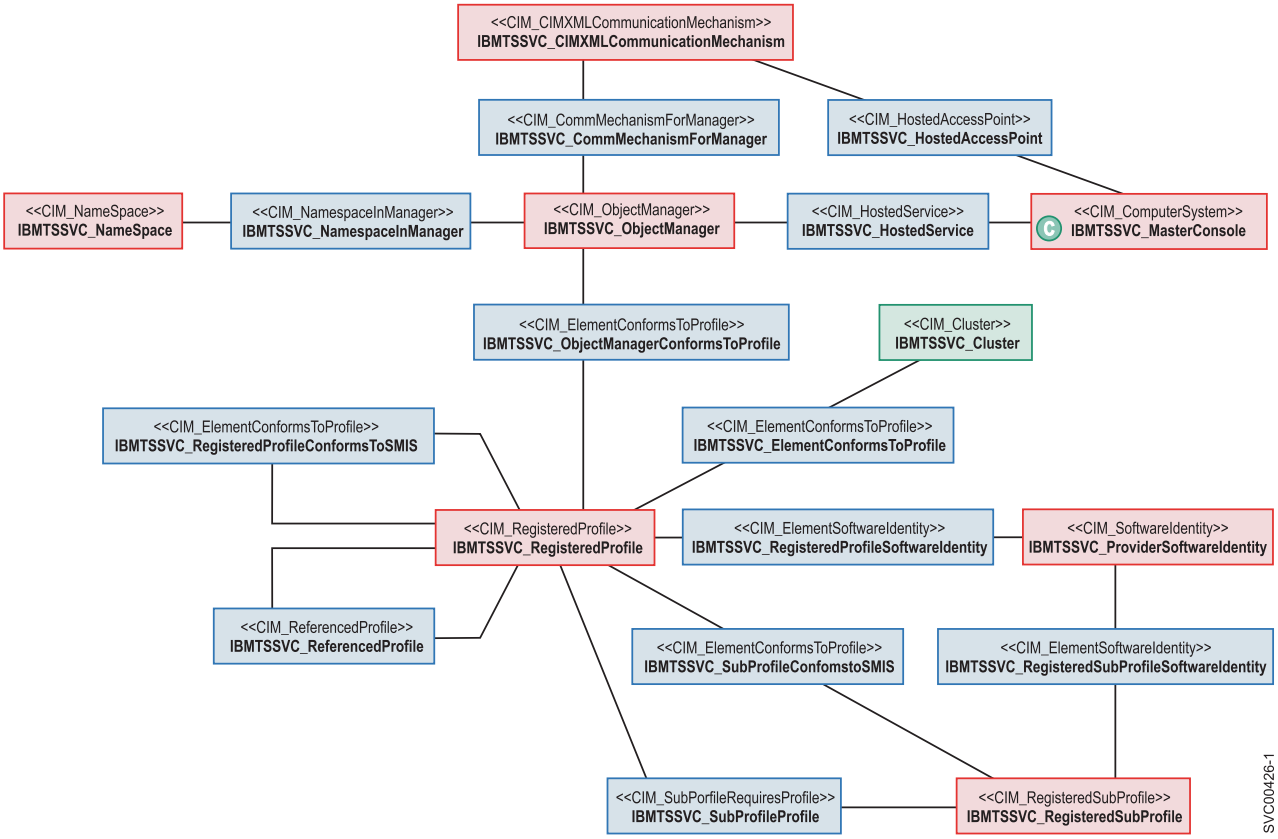

Figure 5. High-level overview of the server profile of the CIM agent for the SAN Volume Controller.

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.

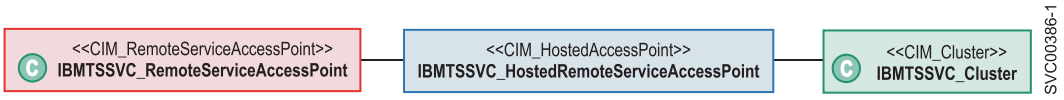

Figure 6. High-level overview of the access point subprofile of the CIM agent for the SAN Volume Controller.

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.

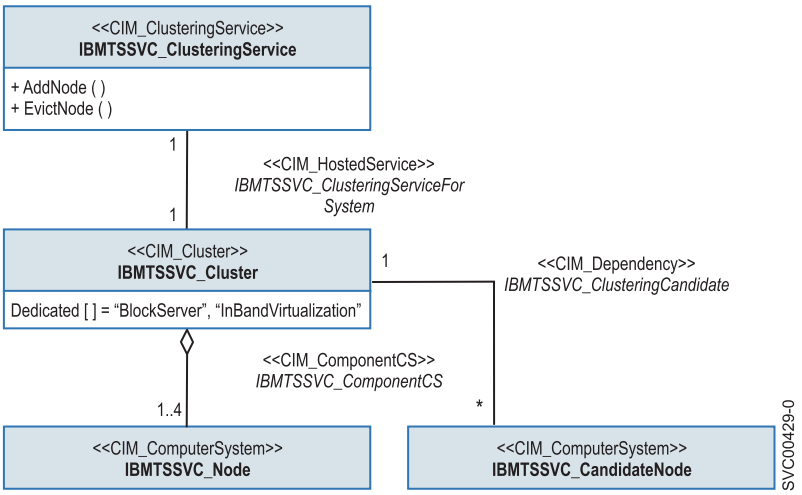

Figure 7. Class diagram of Clustering instance

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.

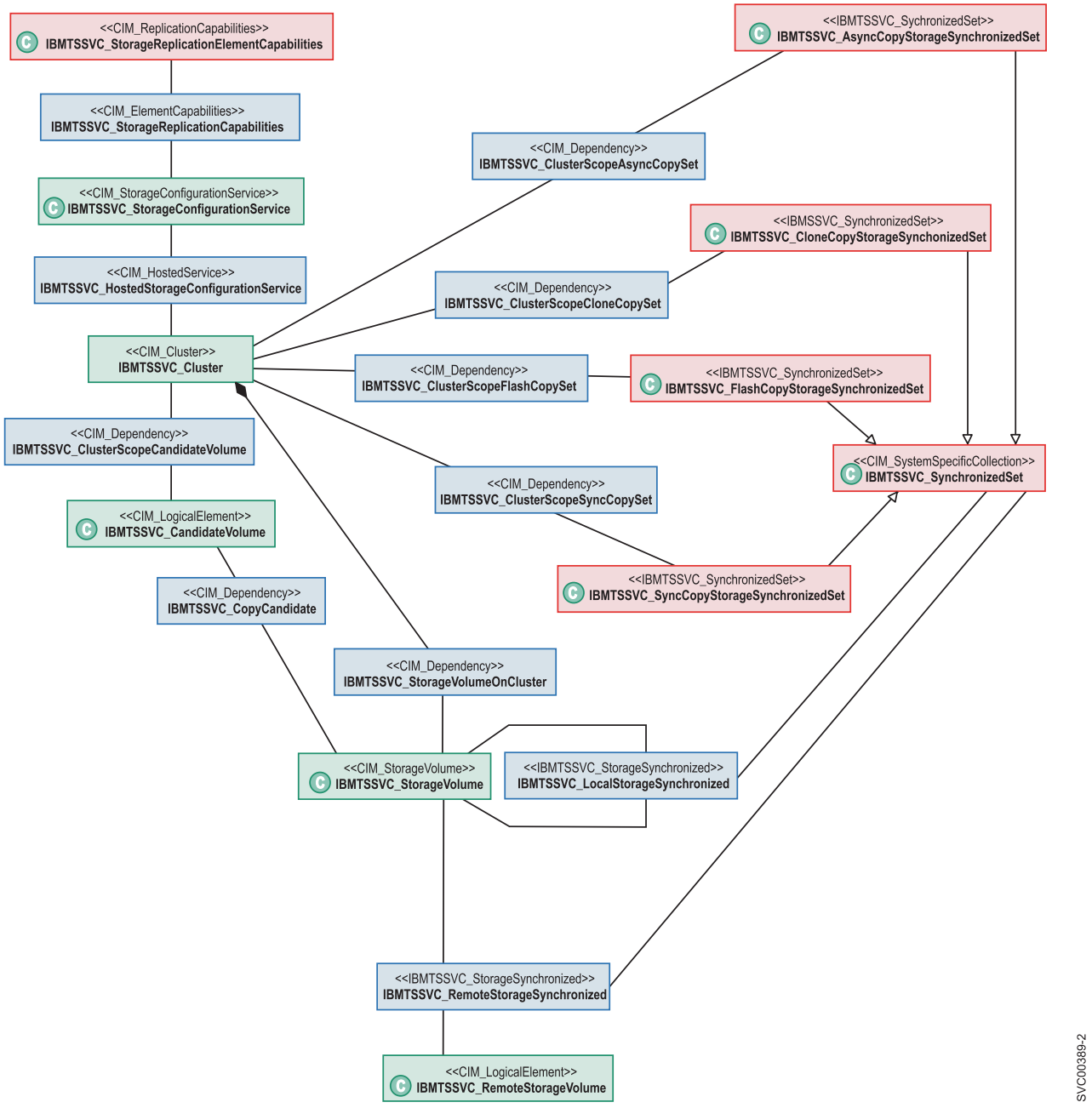

Figure 8. Class diagram of Copy Services instances

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.

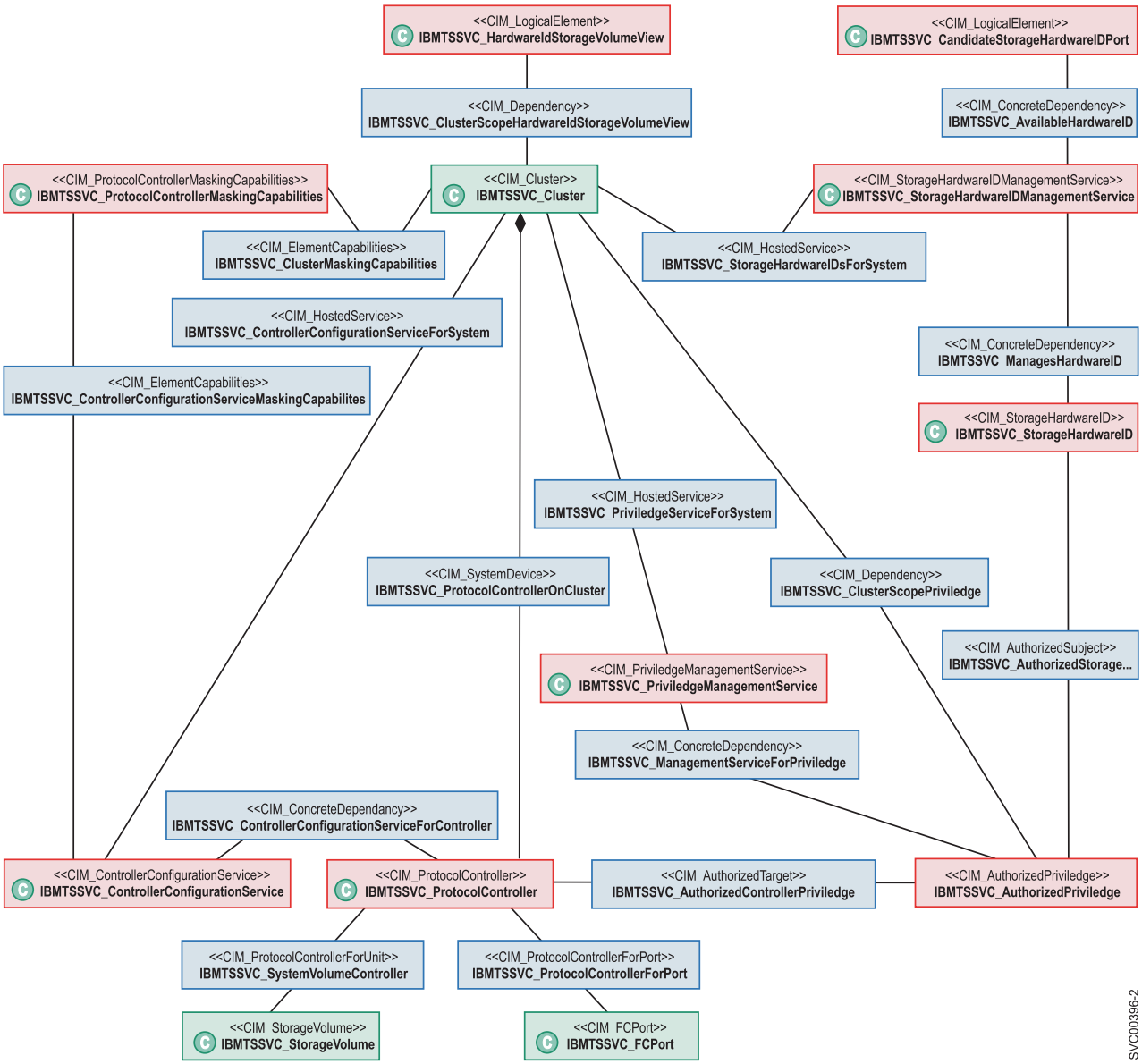

Figure 9. Class diagram of masking and mapping instances

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.

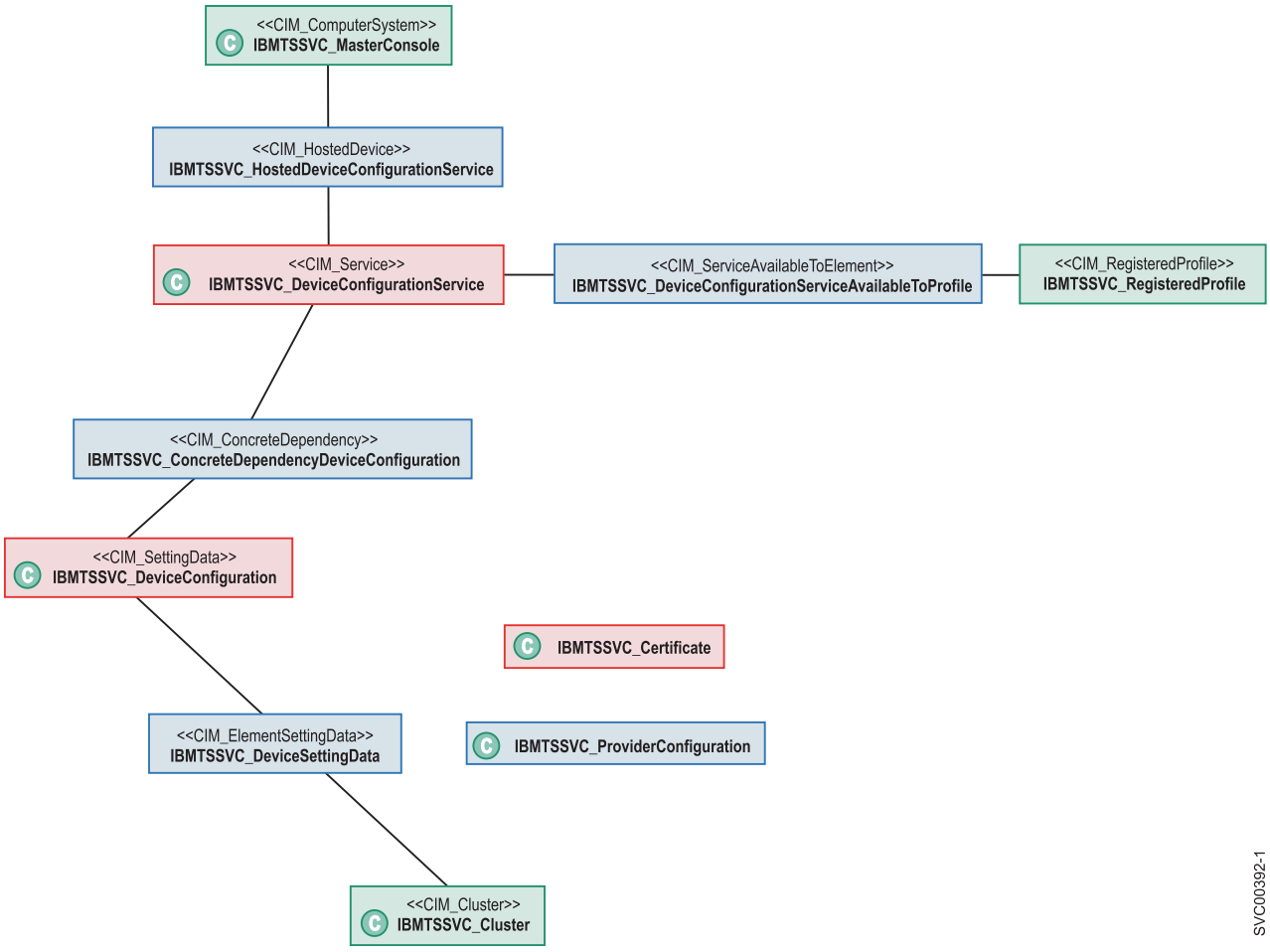

Figure 10. Class diagram of device configuration instances

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.

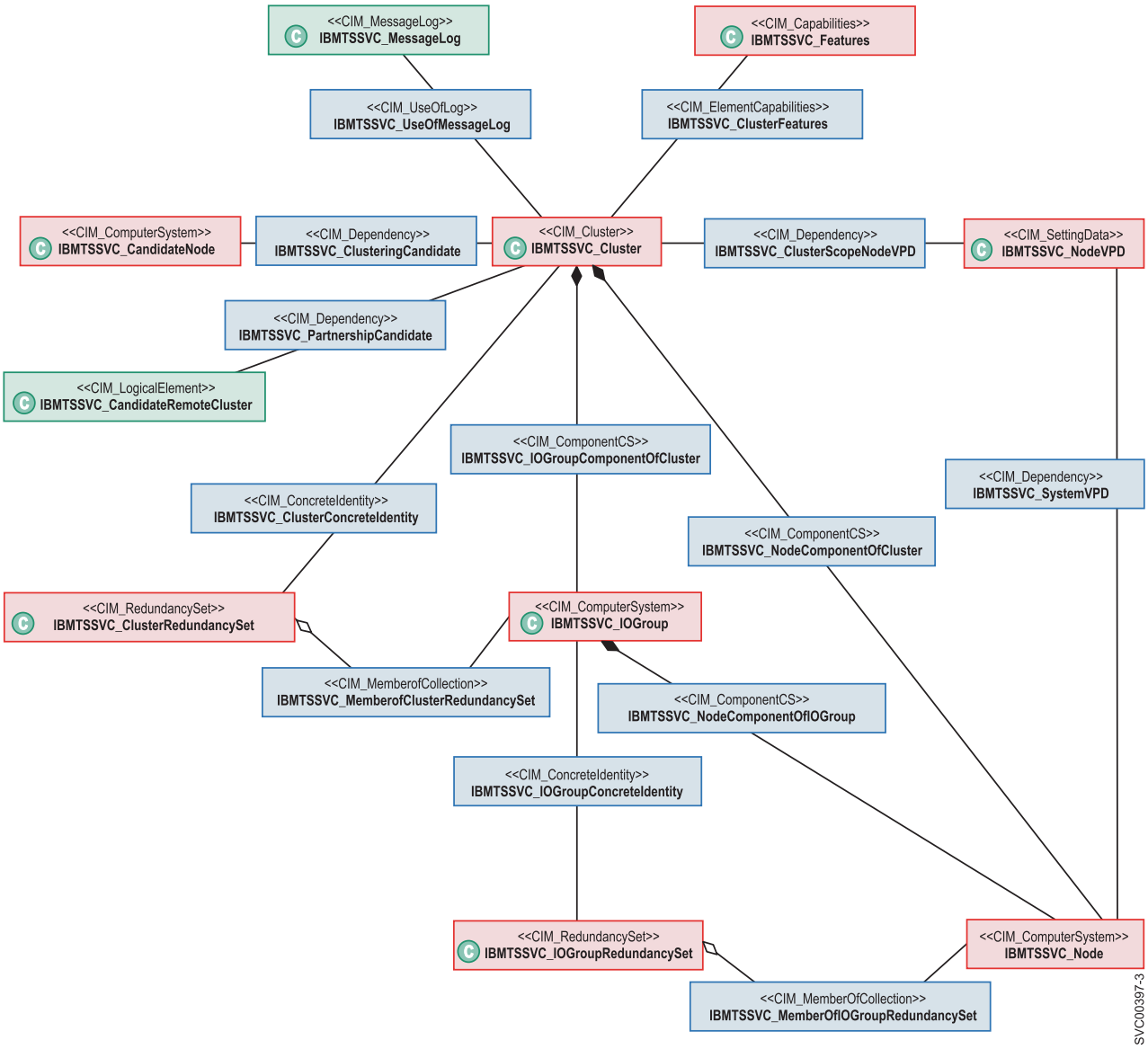

Figure 11. Class diagram of multiple computer system instances

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.

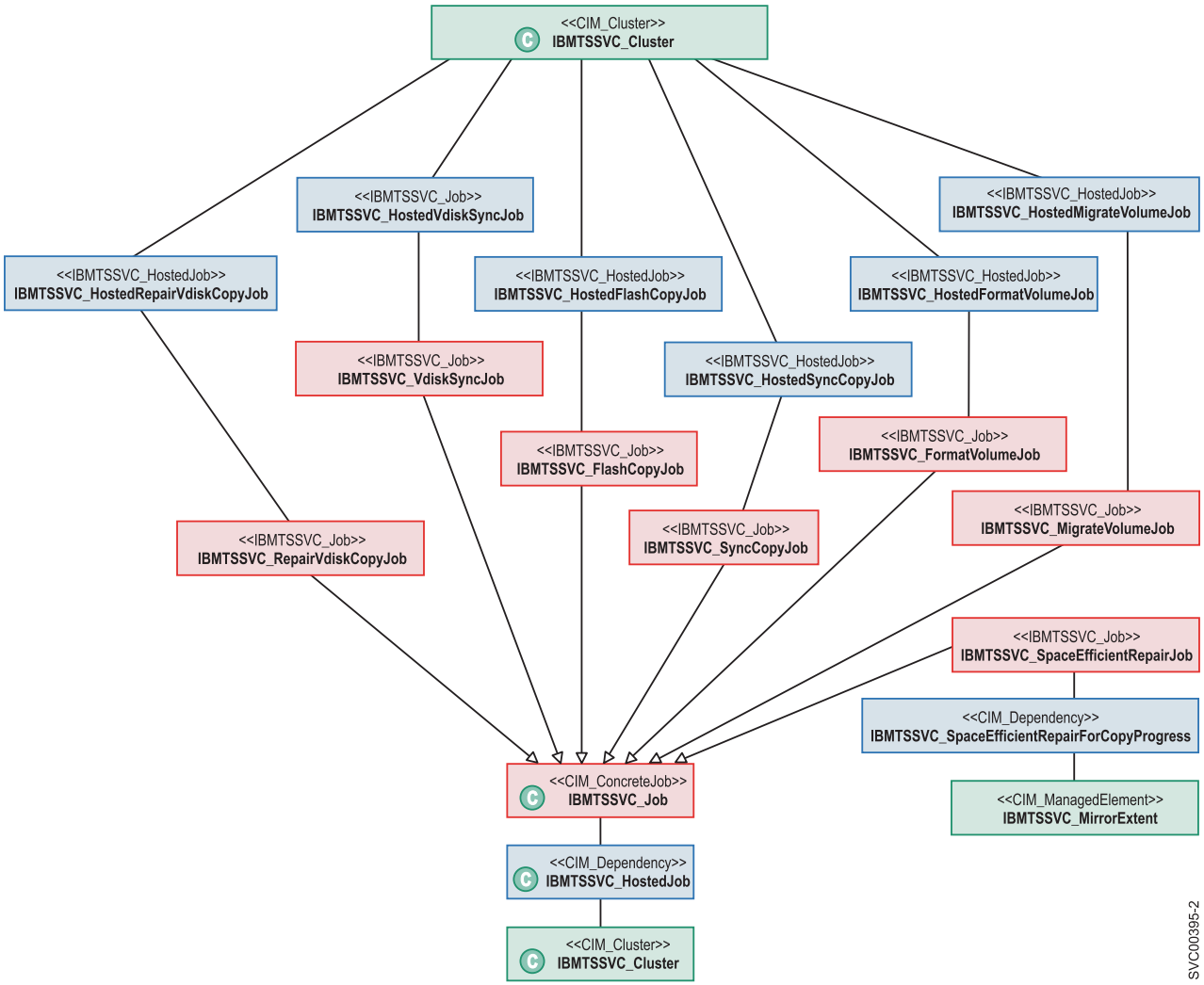

Figure 12. Class diagram of job control instances

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.

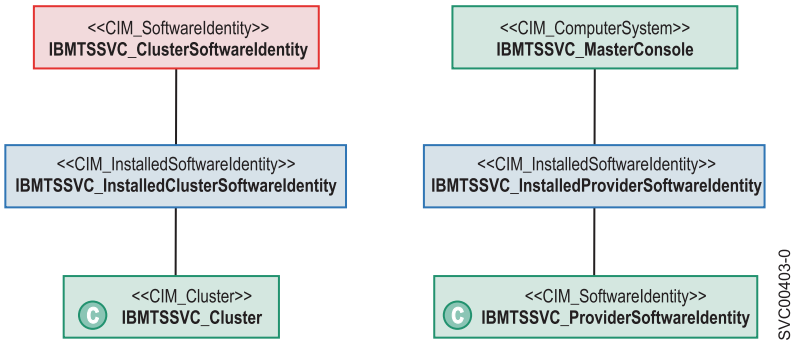

Figure 13. Class diagram of software instances

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.

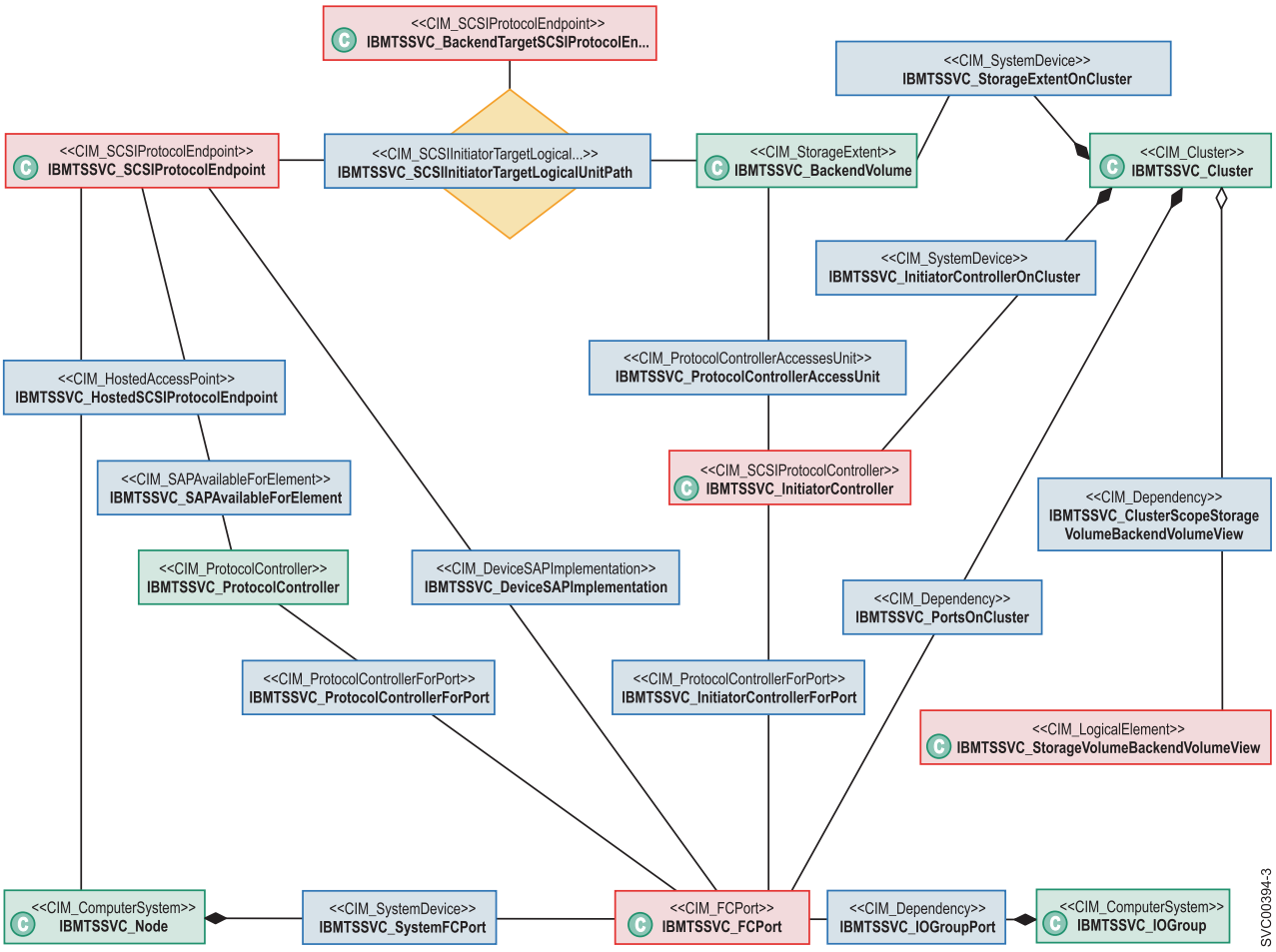

Figure 14. Class diagram of FC port instances

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.

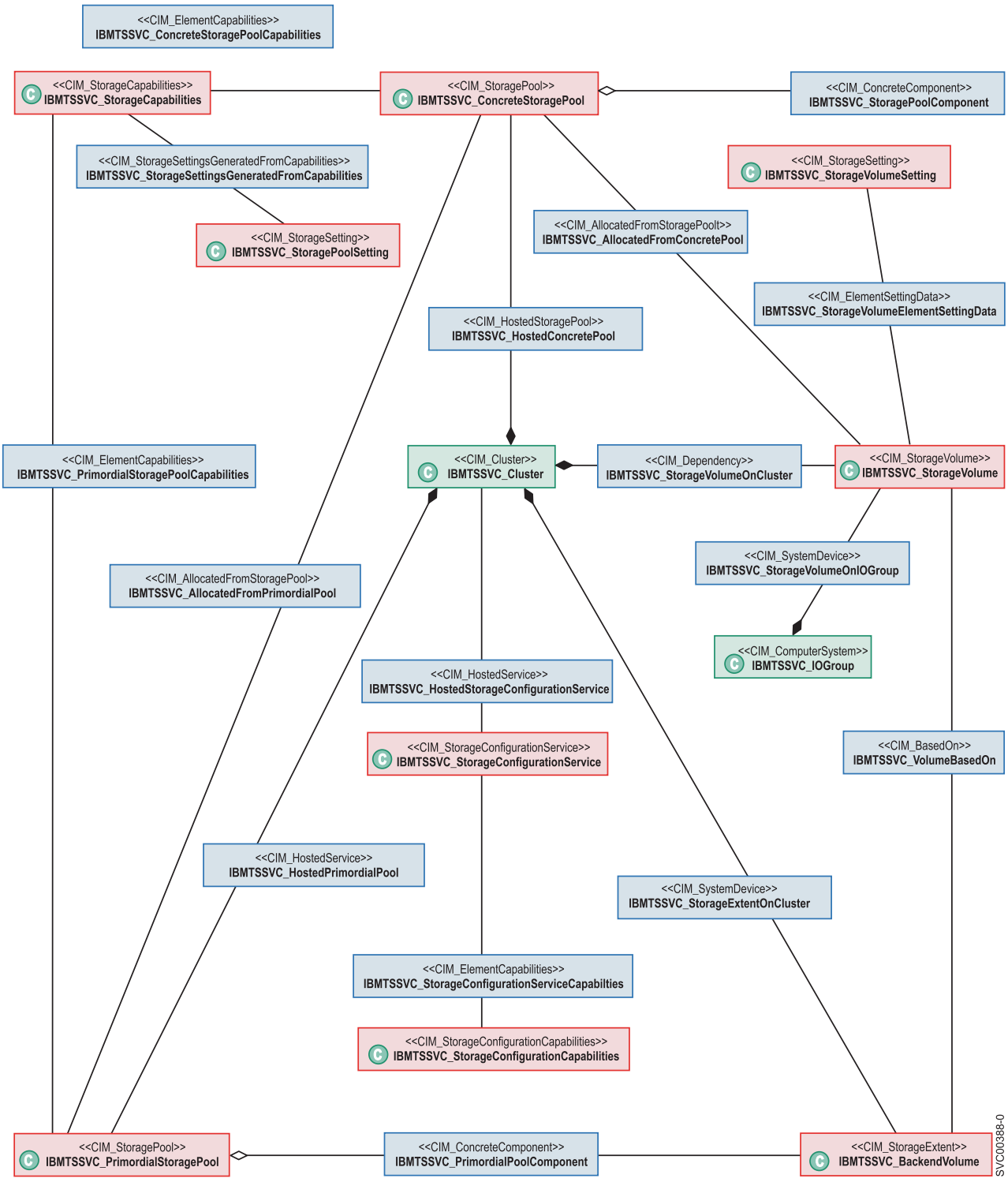

Figure 15. High-level overview of block services of the CIM agent for the SAN Volume Controller.

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.

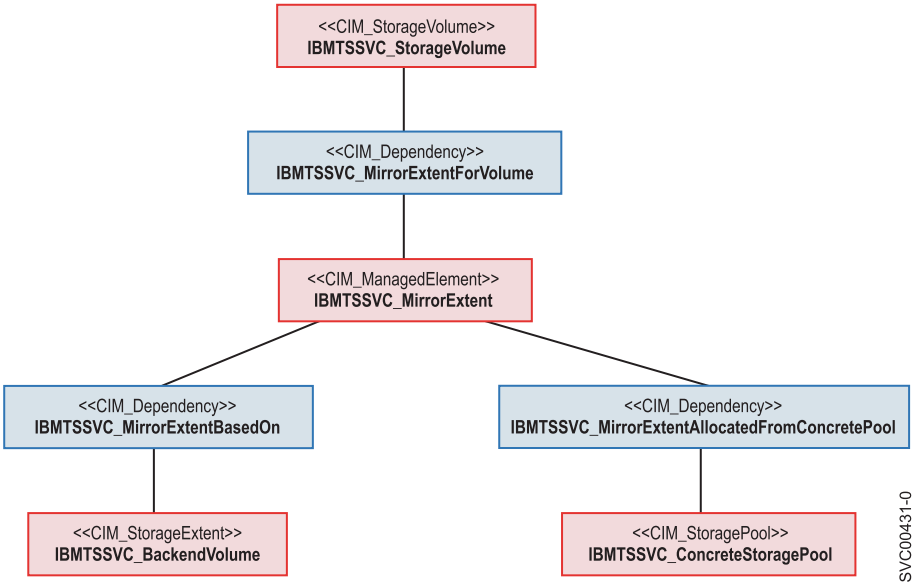

Figure 16. Classes and associations in mirroring storage volumes

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 5.1.0 installed, the CIM object manager (CIMOM) is already configured and resides on the cluster only.

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.

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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 the **WarningSizePercent** parameter.

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.

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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.

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.

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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.

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

The SAN Volume Controller CIM agent command-line interface (CLI) supports the collection of CIM agent logging information for maintenance and diagnostic reporting to the IBM Support Center.

To collect logs from the CIMOM that resides on the cluster, typical cluster log collection is used. Log levels can be set using the SAN Volume Controller Console by selecting **Service and Maintenance** > **CIMOM Log Configuration**.

To collect all cluster logs and CIMOM logs, issue the svctask cpdumps CLI command. You can also use the SAN Volume Controller Console to list the CIMOM logs by selecting **CIMOM Logs** > **Service and Maintenance** > **List Dumps**.

1. Increase the tracing levels:
   a. Launch the SAN Volume Controller Console
   b. Select **Service and Maintenance** > **CIMOM Log Configuration**
   c. To enable CIMOM trace log at the highest level, select **Max Level**
2. Reproduce the error.
3. Collect CIMOM logs:
   a. Launch the SAN Volume Controller Console
   b. Select **Service and Maintenance** > **List Dumps**
   c. Click **CIMOM Logs** and save all CIMOM log files in the list
4. After you collect the information, decrease the tracing levels and return the server to its typical performance level:
   a. Launch the SAN Volume Controller Console
   b. Select **Service and Maintenance** > **CIMOM Log Configuration**
   c. Choose the **Default Level** to decrease the CIMOM trace log level

Table 5 describes the commands that are used to log and trace CIM agent activity.

Table 5. Commands for logging and tracing CIM agent

Command	Description
collectlogs	Collects the SAN Volume Controller GUI logs

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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

Table 6 identifies the SMI-S profiles that CIM agent for SAN Volume Controller supports.

Table 6. 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

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Chapter 7. Return codes

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

Common Information Model

Table 7 is a condensed list of possible CIM return codes.

Table 7. 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.

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Table 7. 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 7. 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 7. 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 7. 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 7. 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 7. 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 7. 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 7. 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 7. 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 7. 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 8 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 8. 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 8. 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 8. 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 8. 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 8. 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 8. 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 8. 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 8. 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 8. 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 8. 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 8. 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 8. 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 8. 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

Appendix A. 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.
- When setting or changing an IP address on the SAN Volume Controller front panel, you can disable the fast increase and decrease address scrolling speed function of the up and down buttons to two seconds. This feature is documented in the topic that discusses initiating cluster creation from the front panel, which is located in the IBM System Storage SAN Volume Controller Information Center and the *IBM System Storage SAN Volume Controller Software Installation and Configuration Guide*.

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 find the HTML version of the IBM System Storage SAN Volume Controller information at the following Web site:

http://publib.boulder.ibm.com/infocenter/svcic/v3r1m0/index.jsp

You can access this information using screen-reader software and a digital speech synthesizer to hear what is displayed on the screen. JAWS version 10 has been tested.

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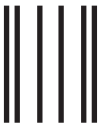

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