IBM System Storage SAN Volume Controller

IBM

CIM Agent Developer's Reference

Version 4.3.0

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

Contents

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About this guide

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

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

Who should use this guide?

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

This reference book is for CIM-based application programmers who want to do 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, 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 SC26-7904-03 SAN Volume Controller CIM Agent Developer's Reference

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

New information

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

This version includes the following general new information:
- The SAN Volume Controller CIM Agent version 4.3.0 is based on Open Pegasus version 2.7.0.

- This edition, SC26-7904-03, only applies if you are running SAN Volume Controller software version 4.3.0 or higher. If you are a running software version 4.2.1, use the previous edition, SC26-7904-02. If you are running 4.2.0 or earlier, use the edition SC26-7904-01.
- Virtual Disk (VDisk) mirroring feature additions.
- Space-efficient virtual disk feature additions.
- Implementation of Internet Protocol Version 6 (IPv6). IPv4 formats also continue to be recognized. IPv4 keys, for example, are made unique by formatting them as `IP:ObjectID` and IPv6 keys are formatted as `ClusterIDString:ObjectID`.
- The SAN Volume Controller CIM agent command line utility

Changed information

This section lists the updates that were made in this document.
- A section was added about creating a synchronous copy relationship between volumes in different clusters.
- A topic was added about updating SSL certificates.
- A chapter was added about CIM agent maintenance and diagnostic tasks.
- Specific information about the CIM agent classes and methods was removed from this manual.

Summary of changes for SC26-7904-02 SAN Volume Controller CIM Agent Developer's Reference

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

New information

This topic describes the changes to this guide since the previous edition, SC26-7904-01. The following section summarizes the changes that have since been implemented from the previous version.

This version includes the following new information:
- The SAN Volume Controller software version 4.2.1 is now based on the Open Pegasus version 2.5.1 CIMOM. As a result, the architecture of the CIM Agent has changed.
- This edition, SC26-7904-02, only applies if you are running SAN Volume Controller software version 4.2.1 or higher. If you are a running software version 4.2.0 or earlier, use the previous edition, SC26-7904-01.

Emphasis

Different typefaces are used in this guide to show emphasis.

The following typefaces are used to show emphasis:

Boldface	Text in **boldface** represents menu items and command names.
Italics	Text in *italics* is used to emphasize a word. In command syntax, it is used for variables for which you supply actual values, such as a default directory or the name of a cluster.

Monospace	Text in `monospace` identifies the data or commands that you type, samples of command output, examples of program code or messages from the system, or names of command flags, parameters, arguments, and name-value pairs.

SAN Volume Controller library and related publications

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

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

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

SAN Volume Controller library

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

http://www.ibm.com/storage/support/2145

Title	Description	Order number
IBM System Storage SAN Volume Controller: CIM Agent Developer's Reference	This reference guide describes the objects and classes in a Common Information Model (CIM) environment.	SC26-7904
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: Software Installation and Configuration Guide	This guide provides guidelines for configuring your SAN Volume Controller.	SC23-6628
IBM System Storage SAN Volume Controller: Host Attachment Guide	This guide provides guidelines for attaching the SAN Volume Controller to your host system.	SC26-7905
IBM System Storage SAN Volume Controller: Hardware Installation Guide	This guide includes the instructions that the IBM service representative uses to install the SAN Volume Controller hardware.	GC27-2132

Title	Description	Order number
IBM System Storage SAN Volume Controller: Planning Guide	This guide introduces the SAN Volume Controller and lists the features you can order. It also provides guidelines for planning the installation and configuration of the SAN Volume Controller.	GA32-0551
IBM System Storage SAN Volume Controller: Service Guide	This guide includes the instructions that the IBM service representative uses to service the SAN Volume Controller.	GC26-7901
IBM Systems Safety Notices	This guide contains translated caution and danger statements. Each caution and danger statement in the SAN Volume Controller documentation has a number that you can use to locate the corresponding statement in your language in the *IBM Systems Safety Notices* document.	G229-9054

Other IBM publications

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

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

http://www-304.ibm.com/jct01004c/systems/support/

Title	Description	Order number
IBM System Storage Productivity Center Introduction and Planning Guide	This guide introduces the IBM System Storage Productivity Center hardware and software.	SC23-8824
IBM System Storage Productivity Center Hardware Installation and Configuration Guide	This guide describes how to install and configure the IBM System Storage Productivity Center hardware.	SC23-8822
IBM System Storage Productivity Center Software Installation and User's Guide	This guide describes how to install and use the IBM System Storage Productivity Center software.	SC23-8823

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 Version 1.6 for TotalStorage Products and how to use it with the SAN Volume Controller. This publication is referred to as the *IBM System Storage Multipath Subsystem Device Driver: User's Guide*.	GC27-2164
IBM TotalStorage DS4300 Fibre Channel Storage Subsystem Installation, User's, and Maintenance Guide	This guide describes how to install and configure the IBM TotalStorage DS4300 Fibre-Channel Storage Subsystem.	GC26-7722
IBM eServer xSeries 306m (Types 8849 and 8491) Installation Guide	This guide describes how to install the IBM eServer xSeries 306m, which is the hardware delivered for some versions of the hardware master console.	MIGR-61615
IBM xSeries 306m (Types 8849 and 8491) User's Guide	This guide describes how to use the IBM eServer xSeries 306m, which is the hardware delivered for some versions of the hardware master console.	MIGR-61901
IBM xSeries 306m (Types 8849 and 8491) Problem Determination and Service Guide	This guide can help you troubleshoot and resolve problems with the IBM eServer xSeries 306m, which is the hardware delivered for some versions of the hardware master console.	MIGR-62594
IBM eServer xSeries 306 (Type 8836) Installation Guide	This guide describes how to install the IBM eServer xSeries 306, which is the hardware delivered for some versions of the hardware master console.	MIGR-55080
IBM eServer xSeries 306 (Type 8836) User's Guide	This guide describes how to use the IBM eServer xSeries 306, which is the hardware delivered for some versions of the hardware master console.	MIGR-55079
IBM eServer xSeries 306 (Types 1878, 8489 and 8836) Hardware Maintenance Manual and Troubleshooting Guide	This guide can help you troubleshoot problems and maintain the IBM eServer xSeries 306, which is the hardware delivered for some versions of the hardware master console.	MIGR-54820

Title	Description	Order number
IBM eServer xSeries 305 (Type 8673) Installation Guide	This guide describes how to install the IBM eServer xSeries 305, which is the hardware delivered for some versions of the hardware master console.	MIGR-44200
IBM eServer xSeries 305 (Type 8673) User's Guide	This guide describes how to use the IBM eServer xSeries 305, which is the hardware delivered for some versions of the hardware master console.	MIGR-44199
IBM eServer xSeries 305 (Type 8673) Hardware Maintenance Manual and Troubleshooting Guide	This guide can help you troubleshoot problems and maintain the IBM eServer xSeries 305, which is the hardware delivered for some versions of the hardware master console.	MIGR-44094
IBM TotalStorage 3534 Model F08 SAN Fibre Channel Switch User's Guide	This guide introduces the IBM TotalStorage SAN Switch 3534 Model F08.	GC26-7454
IBM System x3250 (Types 4364 and 4365) Installation Guide	This guide describes how to install the IBM System x3250, which is the hardware delivered for some versions of the hardware master console.	MIGR-5069761
IBM System x3250 (Types 4364 and 4365) User's Guide	This guide describes how to use the IBM System x3250, which is the hardware delivered for some versions of the hardware master console.	MIGR-66373
IBM System x3250 (Types 4364 and 4365) Problem Determination and Service Guide	This guide can help you troubleshoot and resolve problems with the IBM System x3250, which is the hardware delivered for some versions of the hardware master console.	MIGR-66374
IBM TotalStorage SAN Switch 2109 Model F16 User's Guide	This guide introduces the IBM TotalStorage SAN Switch 2109 Model F16.	GC26-7439
IBM TotalStorage SAN Switch 2109 Model F32 User's Guide	This guide introduces the IBM TotalStorage SAN Switch 2109 Model F32. It also describes the features of the switch and tells you where to find more information about those features.	GC26-7517

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

http://www.ibm.com/storage/support/2145

Related Web sites

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

Type of information	Web site
SAN Volume Controller support	http://www.ibm.com/storage/support/2145
Technical support for IBM storage products	http://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 free of 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:

http://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.

CIM agent

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

1

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

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

CIM agent concepts

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

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

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

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

Indication
An object representation of an event.

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

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

Method
A way to implement a function on a class.

Namespace
The scope within which a CIM schema applies.

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

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

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

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

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

CIM agent components

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

Components

A CIM agent involves the following components:

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

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

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

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

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

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

Example of how CIM agent works

Figure 1 on page 4 shows the way a typical CIM agent works. 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 describing the CIM agents access point is registered.

Note: The standard secure port is 5989.

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.
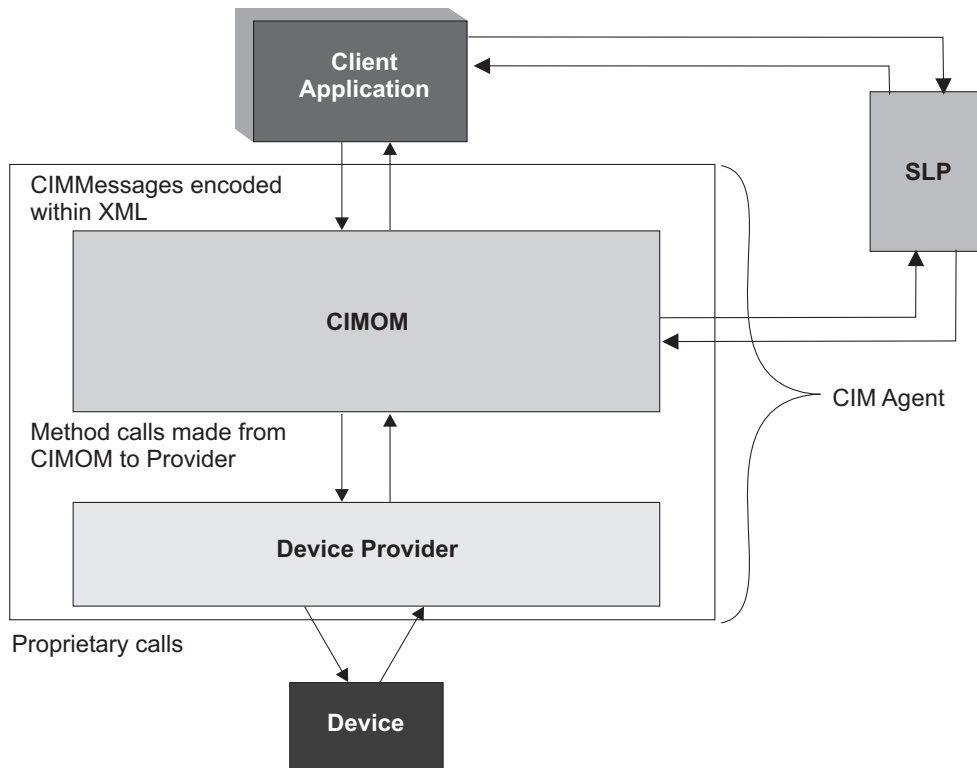
Figure 1. A typical CIM agent at work

The client application then 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.

SAN Volume Controller overview

The SAN Volume Controller combines software and hardware into a comprehensive, modular appliance that uses symmetric virtualization.

Symmetric virtualization is achieved by creating a pool of managed disks (MDisks) from the attached storage subsystems. Those storage systems are then mapped to a set of virtual disks (VDisks) for use by attached host systems. System administrators can view and access a common pool of storage on the SAN. This lets the administrators use storage resources more efficiently and provides a common base for advanced functions.

A *SAN* is a high-speed fibre-channel network that connects host systems and storage devices. It allows a host system to be connected to a storage device across the network. The connections are made through units such as routers, gateways, hubs, and switches. The area of the network that contains these units is known as the *fabric* of the network.

SAN Volume Controller software

The SAN Volume Controller software performs the following functions for the host systems that attach to SAN Volume Controller over the SAN:
- Creates a single pool of storage
- Provides logical unit virtualization
- Manages logical volumes
- Mirrors logical volumes

The SAN Volume Controller also provides the following functions:
- Large scalable cache
- Copy Services
    - FlashCopy® (point-in-time copy)
    - Metro Mirror (synchronous copy)
    - Global Mirror (asynchronous copy)
    - Data migration
- Space management
    - Mapping that is based on desired performance characteristics
    - Metering of service quality
    - Space-efficient logical volumes (thin provisioning)

SAN Volume Controller hardware

Each SAN Volume Controller node is an individual server in a SAN Volume Controller cluster on which the SAN Volume Controller software runs.

The nodes are always installed in pairs, with a minimum of one and a maximum of four pairs of nodes constituting a *cluster*. Each pair of nodes is known as an *I/O group*. All I/O operations that are managed by the nodes in an I/O group are cached on both nodes.

I/O groups take the storage that is presented to the SAN by the storage subsystems as MDisks and translates the storage into logical disks, known as

VDisks, that are used by applications on the hosts. A node resides in only one I/O group and provides access to the VDisks in that I/O group.

The SAN Volume Controller 2145-8G4 is the most current model that is available. In addition, the following models of SAN Volume Controller nodes have been available in previous releases and are still supported with the latest SAN Volume Controller software:
- SAN Volume Controller 2145-8F4
- SAN Volume Controller 2145-8F2
- SAN Volume Controller 2145-4F2

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.

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.

When you have a suitable framework, creating a CIM client is straightforward. The Java™ WBEM Service project is one of the more widely referenced ones. There are also implementations in other languages, including C++ and Python. For information on the Java WBEM Service project, go to this Web site:

http://wbemservices.sourceforge.net/

Figure 2 on page 7 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 2. Java program for connecting to a SAN Volume Controller CIMOM

Once connected to the CIMOM, the next step is to identify the cluster that you want to work with.

How SAN Volume Controller concepts map to CIM concepts

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

Table 1 shows how these concepts relate to one another.

Table 1. Relating SAN Volume Controller concepts to CIM concepts

SAN Volume Controller concept	CIM	
	CIM name	CIM concept
Cluster	IBMTSSVC_Cluster	Class
ClusterName	ElementName	Property
Cluster ID	Name	Property
VDisk	IBMTSSVC_StorageVolume	Class
VDisk ID	DeviceID	Property
FlashCopy Mapping	IBMTSSVC_LocalStorageSynchronized	Association
FlashCopy Mapping Status	SyncState	Property
mkfcmap	AttachReplica	Method
preparefcmap	ModifySynchronization	Method

SAN Volume Controller concept	CIM	
	CIM name	CIM concept
startfcmap	ModifySynchronization	Method
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 3 on page 9 shows the basic classes (building blocks) for the model.
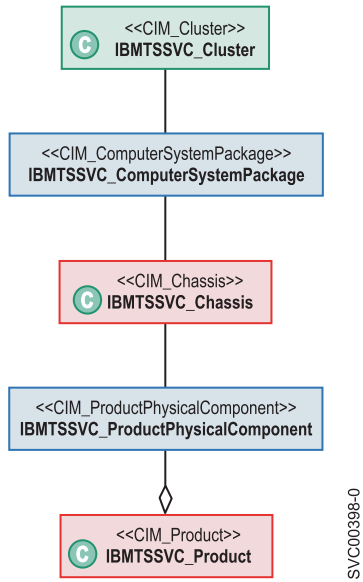
Figure 3. High-level overview of the physical package of the CIM Agent for the SAN Volume Controller.

Server profile

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

Figure 4 on page 10 shows the basic classes (building blocks) for the model.
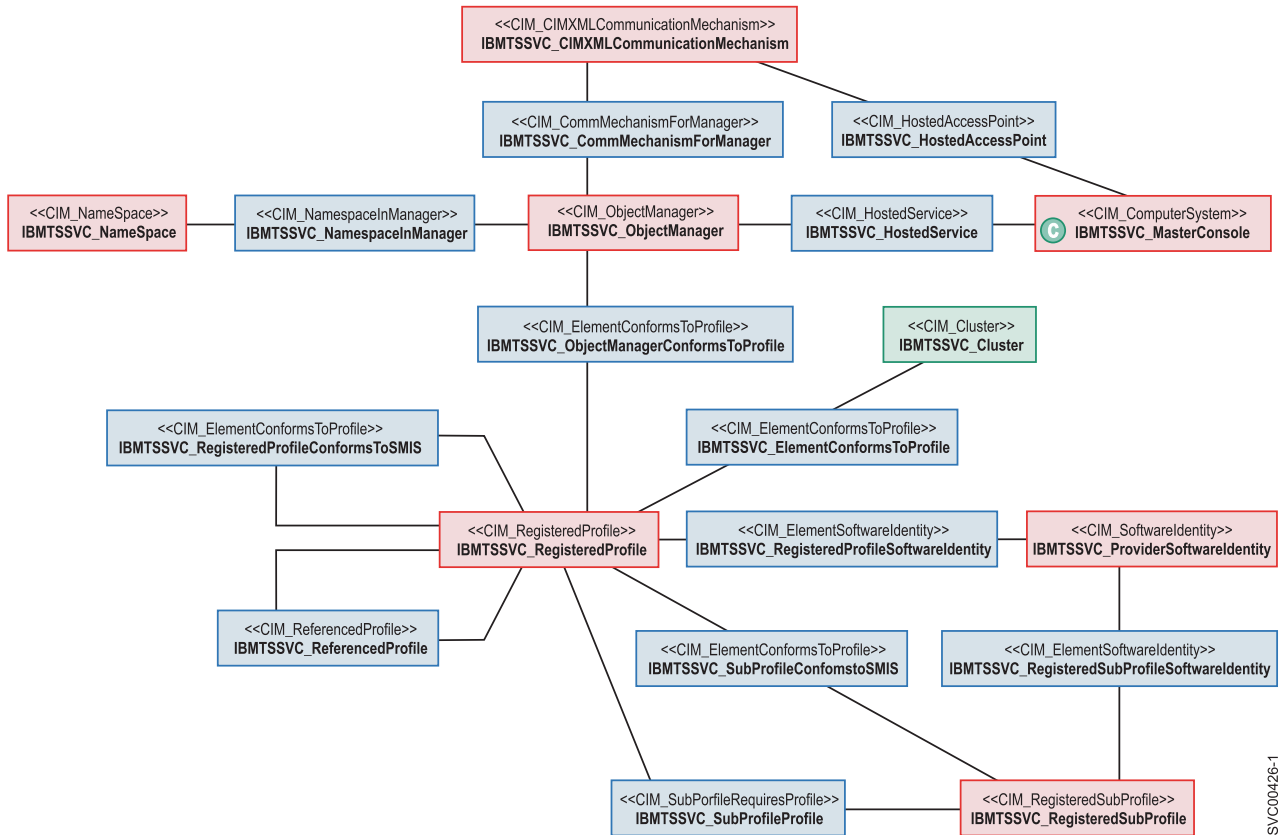
Figure 4. High-level overview of the server profile of the CIM Agent for the SAN Volume Controller.

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 5 shows the basic classes (building blocks) for the model.

Figure 5. 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 6 on page 11 shows the classes and associations that provide the function of a clustering service.

```
                ┌─────────────────────────────────┐
                │   <<CIM_ClusteringService>>     │
                │   IBMTSSVC_ClusteringService    │
                ├─────────────────────────────────┤
                │ + AddNode ( )                   │
                │ + EvictNode ( )                 │
                └─────────────────────────────────┘
                         │ 1
                         │          <<CIM_HostedService>>
                         │          IBMTSSVC_ClusteringServiceFor
                         │          System
                         │ 1
                ┌─────────────────────────────────┐
                │      <<CIM_Cluster>>            │        <<CIM_Dependency>>
                │      IBMTSSVC_Cluster          │ 1      IBMTSSVC_ClusteringCandidate
                ├─────────────────────────────────┤
                │ Dedicated [ ] = "BlockServer", │
                │ "InBandVirtualization"         │
                └─────────────────────────────────┘
```
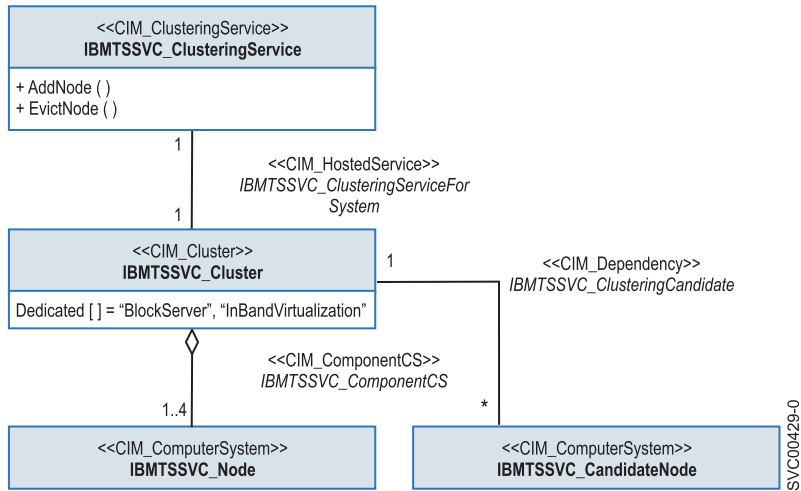
Figure 6. Class diagram of Clustering instance

Copy Services

The IBMTSSVC_StorageConfigurationService class provides the methods to create copy relationships.

Figure 7 on page 12 shows the object classes that provide FlashCopy, Metro Mirror, and Global Mirror Copy Services.
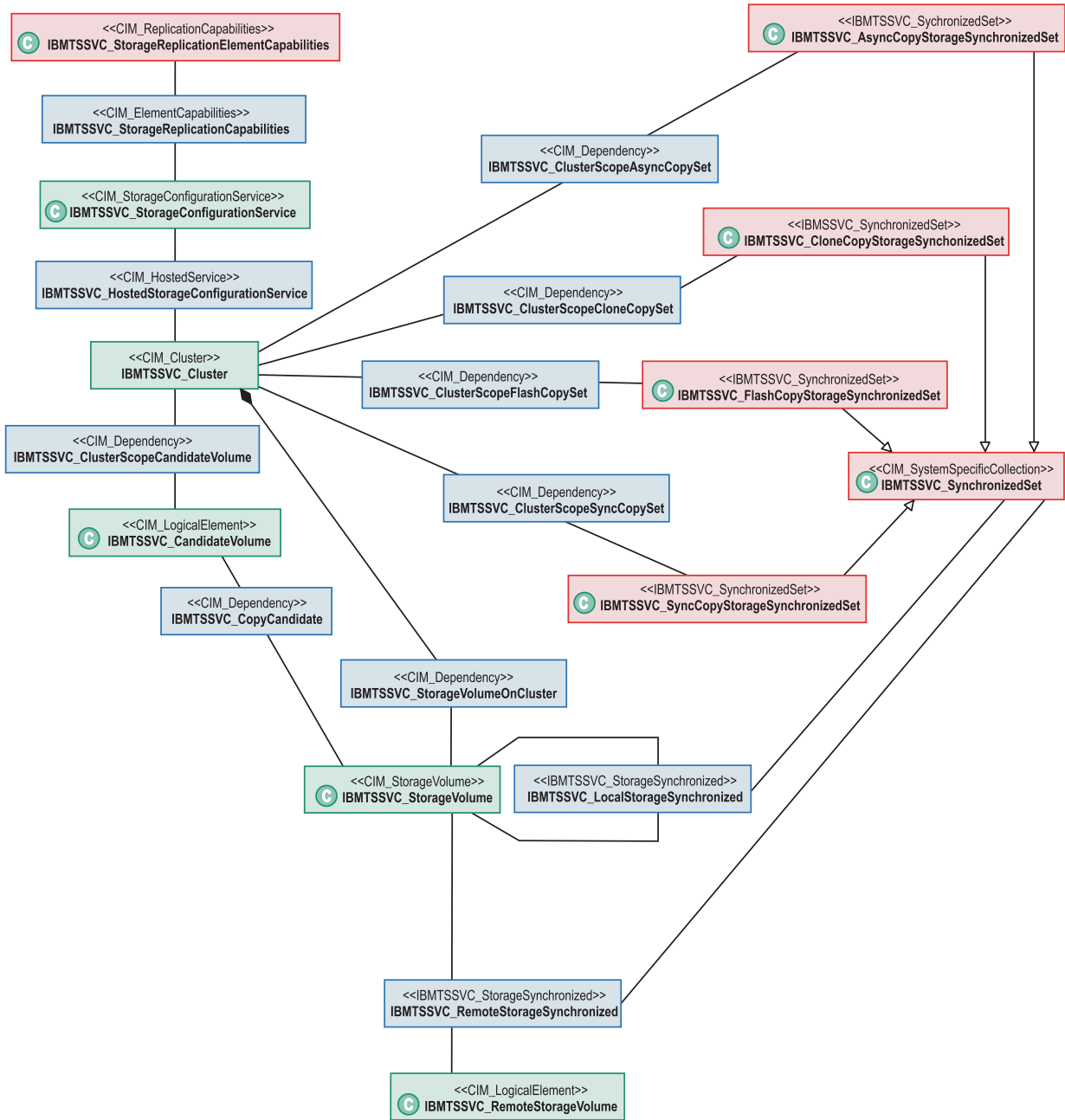
Figure 7. Class diagram of Copy Services instances

Masking and mapping profile

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

Figure 8 on page 13 shows the classes and associations for the masking and mapping profile.
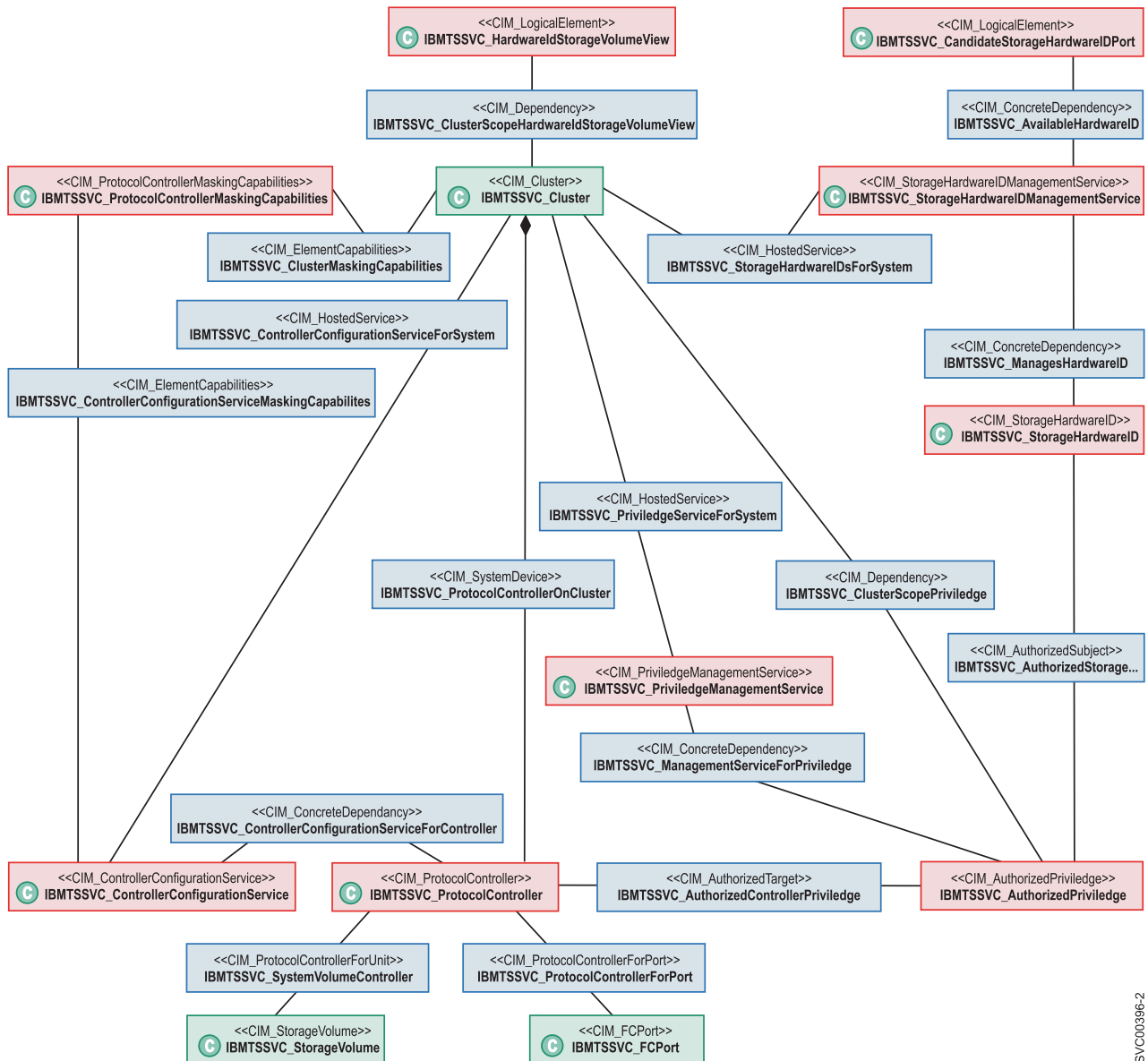
Figure 8. Class diagram of masking and mapping instances

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 9 on page 14 shows the classes and associations for the device configuration profile.
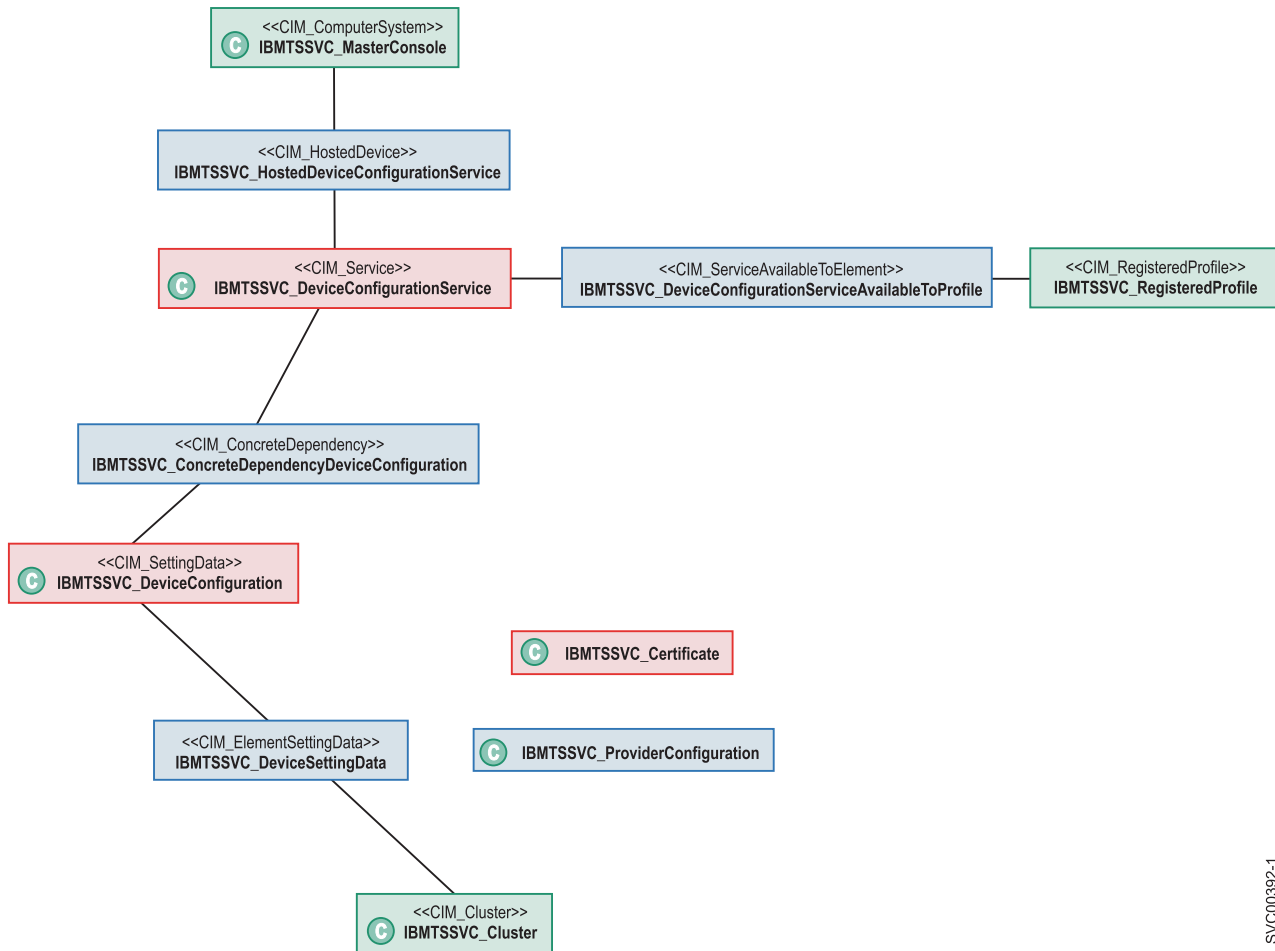
Figure 9. Class diagram of device configuration instances

Multiple computer system profile

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

Figure 10 on page 15 shows the classes and associations for the multiple computer system profile.
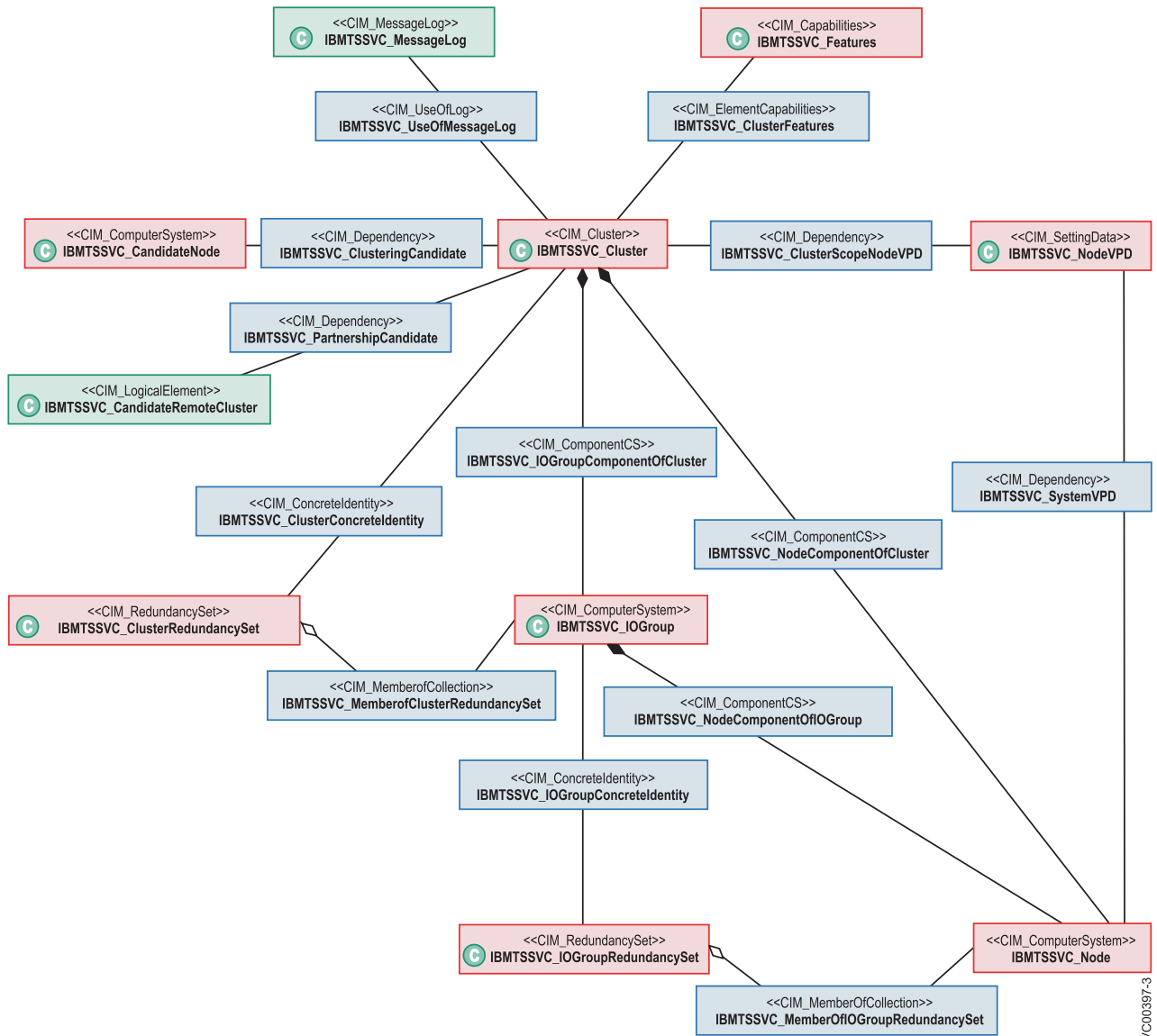
Figure 10. Class diagram of multiple computer system instances

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 11 on page 16 shows the classes and associations for the job control profile.
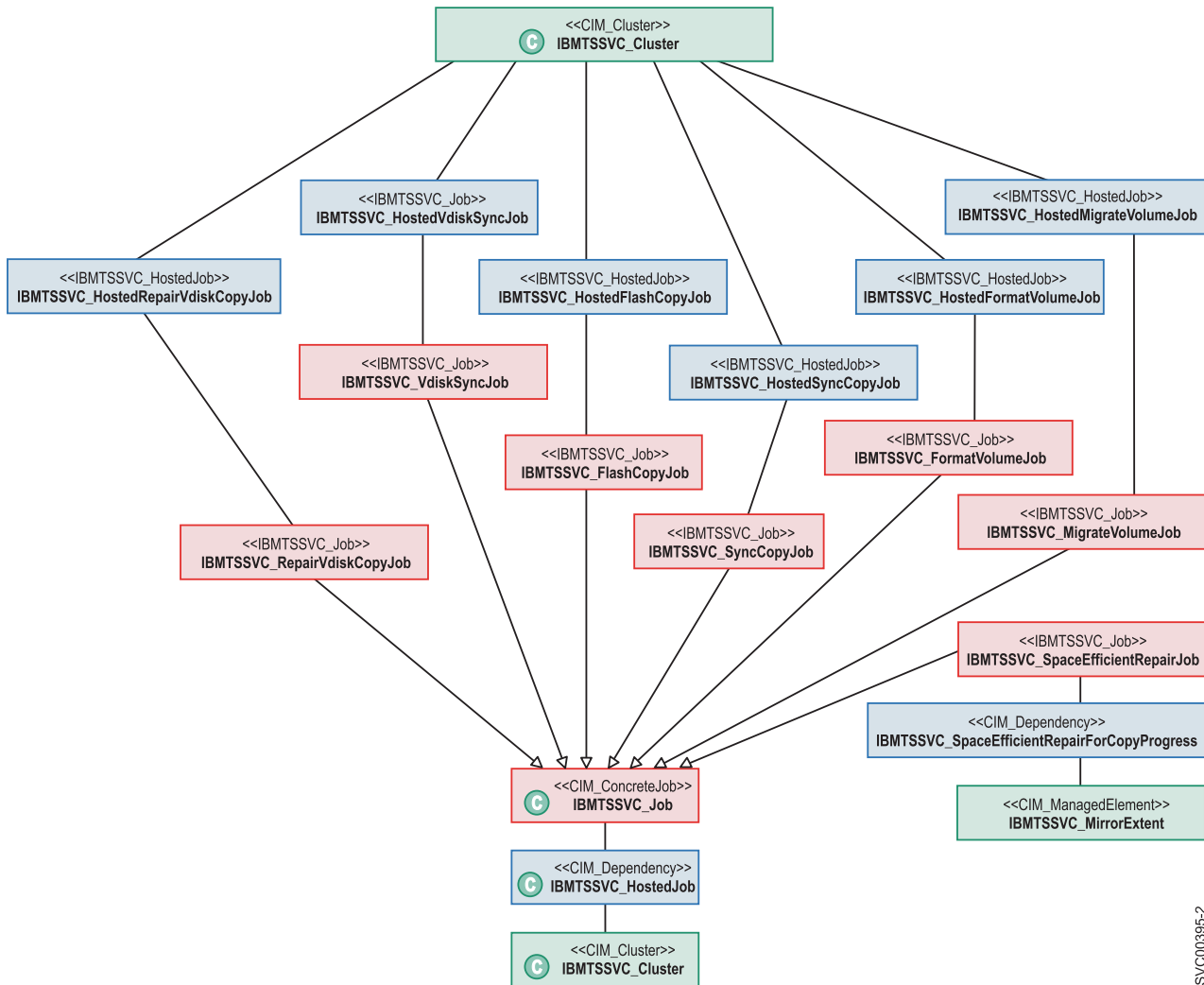
Figure 11. Class diagram of job control instances

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 12 on page 17 shows the classes and associations for the software profile.
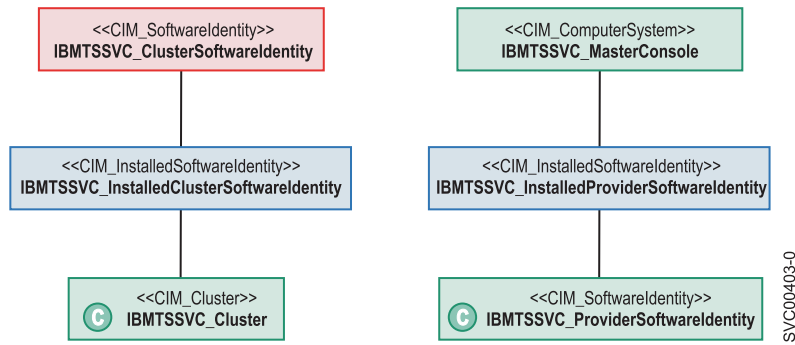
Figure 12. Class diagram of software instances

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 13 on page 18 shows the classes and associations for the FC port profile.
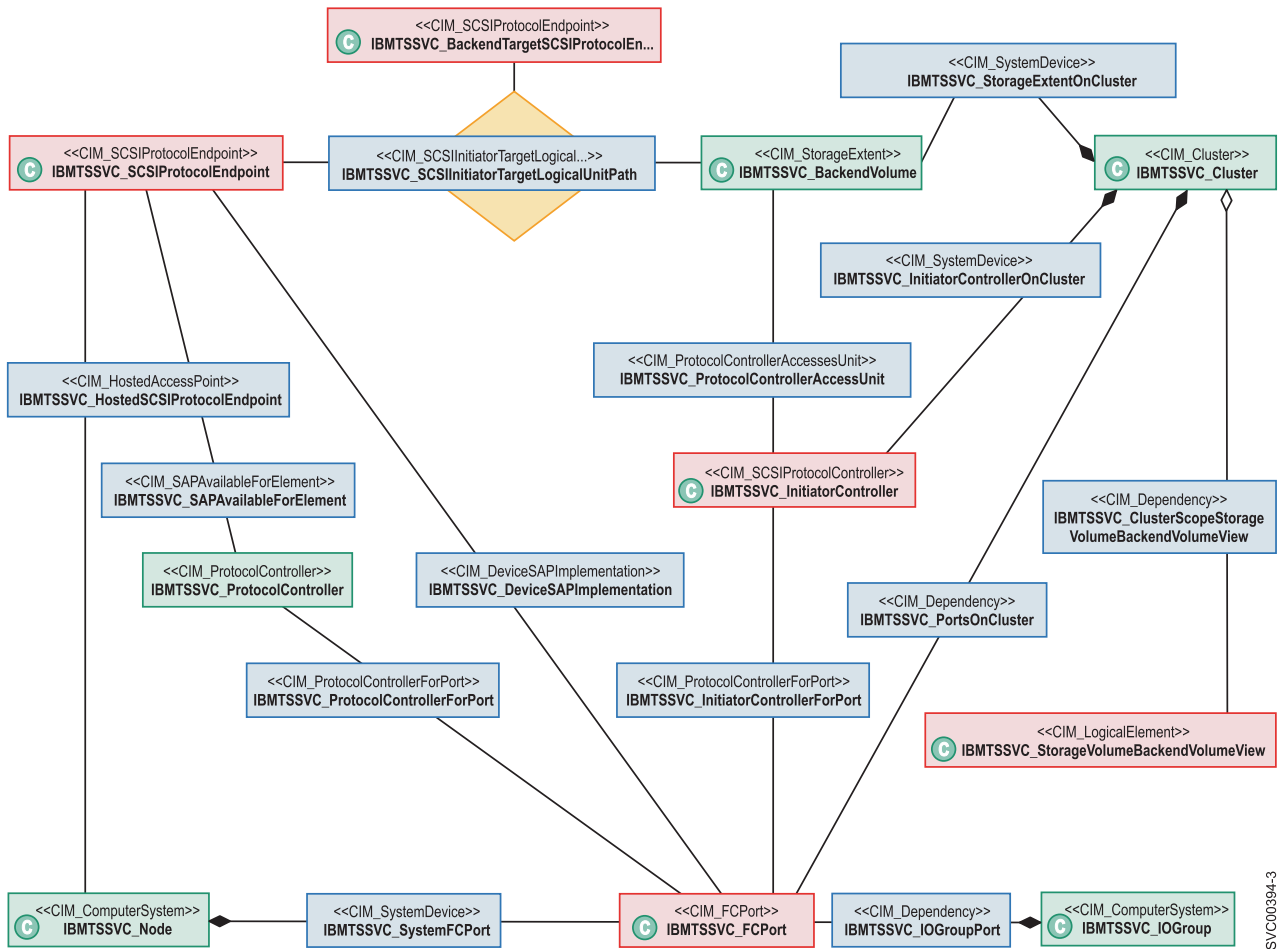
Figure 13. Class diagram of FC port instances

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 14 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.
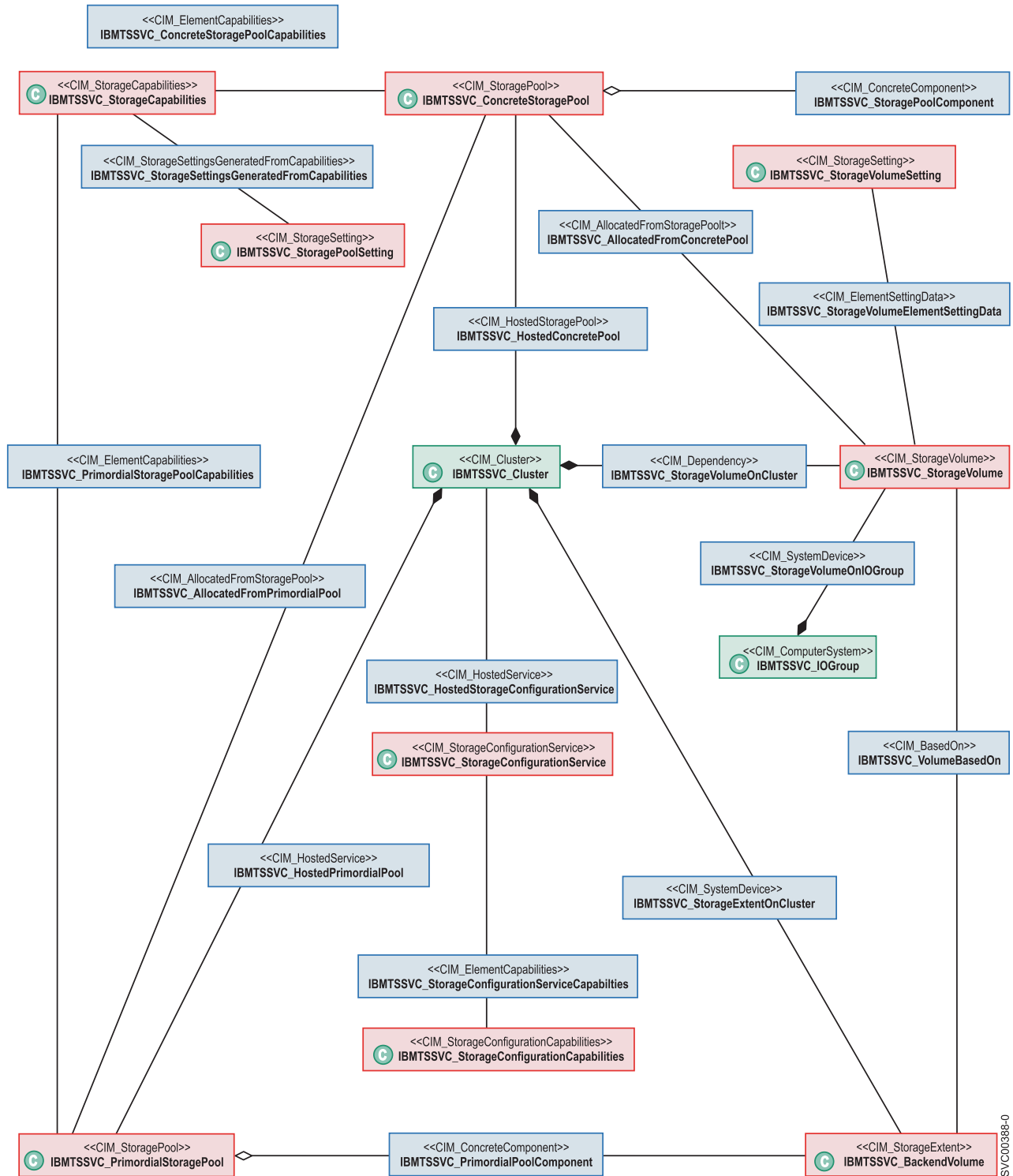
Figure 14. High-level overview of block services of the CIM Agent for the SAN Volume Controller.

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 15 shows the classes and associations that are involved in mirroring storage volumes.
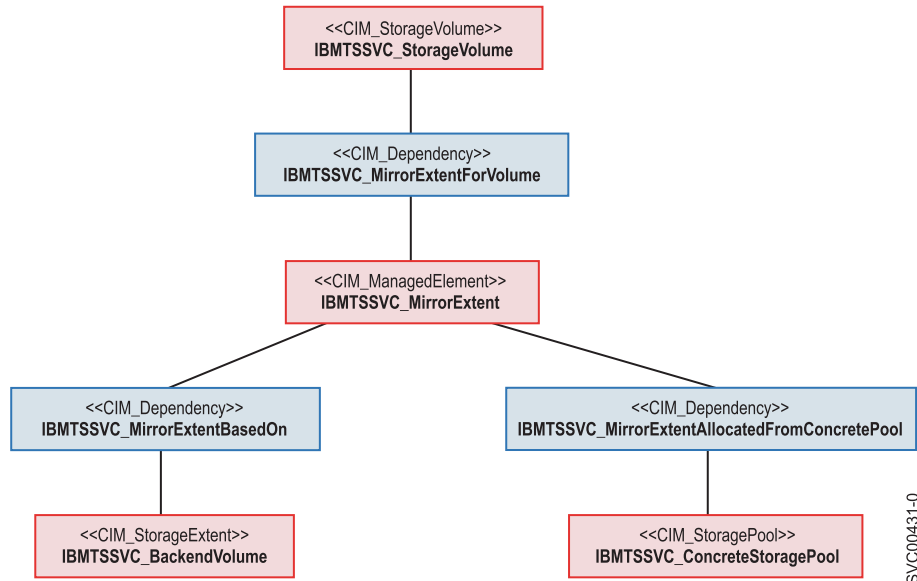
Figure 15. Classes and associations in mirroring storage volumes

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.

Before you complete the storage configuration tasks, you must complete the initial setup of the SAN Volume Controller. That means, you have already created and added clusters to the Common Information Model Object Manager (CIMOM) configuration file of the CIM agent, and as a result, the Common Information Model (CIM) agent has discovered all the back-end volumes that are required for the storage configuration.

Next, you add a device to the CIMOM and input the IP address of the IBMTSSVC_Cluster (DeviceConfigurationService addDevice Method).

To complete basic storage configuration, perform the following tasks:
1. Add a node to the cluster.
2. Create a storage pool.
3. Modify the storage pool.
4. Create a storage volume.
5. Modify a storage volume.

Adding a candidate node to a cluster

You can add an IBMTSSVC_CandidateNode to an existing IBMTSSVC_Cluster.

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

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

Creating a new storage pool

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

To create a new IBMTSSVC_StoragePool instance, follow these steps:

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

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

   You can also just specify the size and the CIM Agent performs a best fit Heuristic to match it. You can specify the Name of the pool using the ElementName Parameter and the Block Size using the BlockSize parameter.

Modifying a storage pool

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

To modify an IBMTSSVC_ConcreteStoragePool instance, follow these steps:

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

Creating a new storage volume

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

To create a new IBMTSSVC_StorageVolume instance, follow these steps:

1. Obtain the reference (CIMObjectPath) of the IBMTSSVC_StorageConfigurationService instance that is associated with the IBMTSSVC_Cluster to which you will assign the new volume.

2. Invoke the IBMTSSVC_StorageConfigurationService. CreateOrModifyElementFromStoragePool() method to create the new IBMTSSVC_StorageVolume with the following parameter specifications:

   - The Virtualization Type is set using the VirtualizationType parameter (0,1,2 for striped, sequential or image).
   - A Format flag can be used to specify that the volume is formatted on creation or expansion.
   - You can specify the BackendVolumes to place the extents for the volume using the BackendVolume REF parameter.
   - The PreferredNode parameter is used to set the preferred node for the volume.
   - The UnitDeviceID parameter can be used to set the Volume's Unit Device ID on clusters that run software level 4.1.0 or higher.
   - The ElementName parameter can be used to set the Volumes Name at creation.
   - The Autoexpand parameter

   a. Set ElementType to 2.

   b. Set Size to the desired volume size in bytes.

   c. Obtain the reference (CIMObjectPath) of the IBMTSSVC_ConcreteStoragePool instance from which you will allocate an IBMTSSVC_StorageVolume.

   d. Set InPool to the reference (obtained in the previous step) of the pool from which the volume will be allocated.

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

Autoexpand

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

Copies

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

Grainsize

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

Import

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

IsSpaceEfficient

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

RealSizeBytes and RealSizePercent

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

WarningSizeBytes

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

WarningSizePercent

Indicates the ratio of used capacity versus real capacity at which point a warning is triggered. This parameter cannot be used with WarningSizeBytes.

Chapter 3. Establishing Copy Services relationships

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

Copy Services

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

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

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

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

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

Creating a new FlashCopy relationship between storage volumes

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

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

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

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

c.   Optionally set ElementName to the name of the synchronization.

d.   Optionally set BackgroundCopyRate to the desired priority of the background copy rate 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.

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

Creating a FlashCopy relationship for a synchronized set

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

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

1.   Select an IBMTSSVC_StorageVolume instance as the source volume for the desired FlashCopy relationship.

2.   Select a valid IBMTSSVC_StorageVolume as a target. Valid volumes can be determined using IBMTSSVC_CandidateVolume.

     Make sure that the source IBMTSSVC_StorageVolume and target IBMTSSVC_StorageVolume instances belong to the same IBMTSSVC_Cluster instance.

3.   Retrieve the IBMTSSVC_StorageConfigurationService instance that is associated with the IBMTSSVC_Cluster instance to which the selected IBMTSSVC_StorageVolume instances belong.

4.   Invoke the IBMTSSVC_StorageConfigurationService.AttachReplica() method with the following parameter specifications:

a.   Set SourceElement to the reference (CIMObjectPath) of the source IBMTSSVC_StorageVolume.

b.   Set TargetElement to the reference (CIMObjectPath) of the target IBMTSSVC_StorageVolume.

c.   Optionally set ElementName to the name of the synchronization.

d.   Optionally set BackgroundCopyRate to the desired priority of the background copy rate in percent (0 - 100%).

e.   Optionally specify Set to add the newly created FlashCopySynchronization to the set. If you specify a null value, the newly created FlashCopySynchronization will not be a member of a synchronized set.

f.   Optionally set CopyType to 5. This sets AutoDelete to true, which automatically deletes the FlashCopy mapping after the background copy is complete.

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

5. Create an IBMTSSVC_FlashCopySynchronizedSet instance by invoking the IBMTSSVC_StorageConfigurationService.CreateSynchronizedSet() method with the following parameter specifications:

   a. Set CopyType to 4 (flash).

   b. Optionally set ElementName to the name of the newly created IBMTSSVC_FlashCopySynchronizedSet instance.

6. Add the IBMTSSVC_FlashCopyStorageSynchronized instance to the IBMTSSVC_FlashCopySynchronizedSet instance by invoking the IBMTSSVC_StorageConfigurationService.ModifySynchronizedSet() method with the Operation parameter set to 0 (add). If the FlashCopy Added to the Set is CopyType 5, the Set becomes CopyType 5, and any other FlashCopy mappings that are added to the Set must have CopyType 5 or the add fails. Similarly, if a Set contains a FlashCopy of CopyType 4, all other FlashCopy mappings in the set must be of CopyType 4 or the Modify fails.

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

Creating a synchronous copy relationship between volumes in the same cluster

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

Perform the following steps to create the synchronous copy relationship:

1. Select an IBMTSSVC_StorageVolume instance as the source volume for the desired synchronous copy relationship.

2. Select an IBMTSSVC_StorageVolume instance as the target volume.

3. Obtain the reference (CIMObjectPath) of the IBMTSSVC_StorageConfigurationService instance that is associated with the IBMTSSVC_Cluster instance to which the selected volumes belong.

4. Invoke the IBMTSSVC_StorageConfigurationService.AttachReplica() method with the following parameter specifications:

   a. Set SourceElement to the reference (CIMObjectPath) of the source IBMTSSVC_StorageVolume instance.

   b. Set TargetElement to the reference (CIMObjectPath) of the target IBMTSSVC_StorageVolume.

   c. Optionally set ElementName to the name of the synchronization.

   d. Set CopyType to 3 for Synchronous and 2 for Asynchronous.

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

Creating a synchronous copy relationship between volumes in different clusters

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

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

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

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

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

Sample code to create and start a FlashCopy mapping

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

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

Java main method

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

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

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

    CIMClient client = null;

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

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

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

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

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

    /*
```

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

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

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

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

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

getCluster method

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

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

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

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

getConfigService method

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

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

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

getVDisks method

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

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

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

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

makeFlashCopyMapping method

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

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

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

getFCMappings method

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

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

prepareFCMapping method

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

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

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

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

startFCMapping method

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

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

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

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

Argument generators class

This class uses the following argument generators:

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

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

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

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

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

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

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

Chapter 4. CIM Agent network considerations

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

Manually registering the IP address with the SLP

The CIMOM automatically registers its IP address with the Service Location Protocol (SLP); however, you can manually modify the registration.

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

The following example illustrates why this occurs:

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

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

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

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

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

To set the attribute, follow these steps:

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

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

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

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RemoteServiceAccessPoint instance

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

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

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

To set the connection data, follow these steps:
1. Obtain the IBMSVC_Cluster instance.
2. Modify the ConsoleIP and ConsolePort properties through the Modify instance on the Cluster with a property list that contains the Properties that have changed.

   The CIM Agent automatically updates the RSAP.

Updating SSL certificates

Before you can successfully log onto the IBM System Storage Productivity Center (SSPC) or the master console server, you must have a Secure Sockets Layer (SSL) certificate. During the installation, the SSL certificate is configured automatically. You can also regenerate the SSL certificate file.

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

To verify that the currently configured SSL key is valid, complete the following steps:
1. From a command prompt window, go to the installation svcconsole\cimom\bin directory.
2. Issue the command chkcertificate *certname*.

   The following lines are displayed:

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

To regenerate a certificate, complete the following steps:
1. From a command prompt window, go to the C:\Program Files\IBM\svcconsole\cimom directory.
2. Issue the command mkcertificate.bat ssl. This creates an ssl.cert file in the certificate directory.
3. Stop the CIM agent server.
4. Issue the command cimconfig -s slCertificateFilePath=C:\"Program Files"\IBM\svcconsole\cimom\certificate\ssl.cert -p.
5. Issue the command cimconfig -s sslKeyFilePath=C:\"Program Files"\IBM\svcconsole\cimom\certificate\ssl.key -p.

6. Copy the files to the following subdirectories:

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

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

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

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

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

7. Stop and then restart the following applications:
   * IBM System Storage SAN Volume Controller Pegasus Server.

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

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

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

   Note: If the stop command times-out in the IBM WebSphere application, you can restart the SSPC or master console because this restarts the application, as well.

8. Ensure that both applications are running again. Launch the SAN Volume Controller Console and log on.

Chapter 5. CIM agent maintenance and diagnostic tasks

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

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

Collecting CIM log files

The SAN Volume Controller CIM agent command-line utility allows you to gather CIM agent logging information for maintenance and diagnostic reporting to the IBM Support Center.

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

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

To collect your debug log files, follow these steps:

1. Increase the tracing levels by running the following commands:
    a. `svcutil setloglevel info`
    b. `svcutil settracecomponents all`
    c. `svcutil settracecategories all`

2. Increase the SAN Volume Controller Console tracing levels by running the following command:

    `svcconsole/console/embeddedWAS/profiles/SVCProfile/bin/enableConsoleTrace.bat`

3. Reproduce the error.

4. Enter the `svcutil collectlogs` command to collect the logs. This gathers all the required trace logs and puts them into a ZIP file in the current directory. Use this ZIP file and other defect information to report the problem.

5. After you collect the information you need, run the following commands to decrease the tracing levels and return the server to its normal performance:
    a. `svcutil setloglevel error`
    b. `svcutil settracecomponents cim`
    c. `svcutil settracecategories entryexit`

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

Table 2. Commands for logging and tracing CIM agent

Command	Description
collectlogs	Collects the SVC CIM Agent logs
lsloglevel - [-allValid]	Lists the current/valid logging level
setloglevel	Sets the current logging level
lstracecomponents [-allValid]	Lists the current/valid trace components

Table 2. Commands for logging and tracing CIM agent (continued)

Command	Description
lstracecategories - [-allValid]	Lists the current/valid trace categories
settracecomponents []	Sets the current trace components
setslpregip []	Sets the preferred Service Location Protocol (SLP) registered IPs for multinetwork environments

Chapter 6. CIM agent classes and methods

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.

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

http://www.ibm.com/storage/support/2145

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

AccessPoints Class IBMTSSVC_HostedRemoteServiceAccessPoint

AccessPoints Class IBMTSSVC_RemoteServiceAccessPoint

Authorization Class IBMTSSVC_User

BlockServices Class IBMTSSVC_AllocatedFromConcretePool

BlockServices Class IBMTSSVC_AllocatedFromPrimordialPool

BlockServices Class IBMTSSVC_BackendVolume

BlockServices Class IBMTSSVC_ConcreteStoragePoolCapabilities

BlockServices Class IBMTSSVC_HostedConcretePool

BlockServices Class IBMTSSVC_HostedStorageConfigurationService

BlockServices Class IBMTSSVC_HostedPrimordialPool

BlockServices Class IBMTSSVC_MirrorExtent

BlockServices Class IBMTSSVC_MirrorExtentAllocatedFromConcretePool

BlockServices Class IBMTSSVC_MirrorExtentBasedOn

BlockServices Class IBMTSSVC_MirrorExtentForVolume

BlockServices Class IBMTSSVC_PrimordialPoolComponent

BlockServices Class IBMTSSVC_PrimordialStoragePool

BlockServices Class IBMTSSVC_PrimordialStoragePoolCapabilities

BlockServices Class IBMTSSVC_StorageCapabilities

BlockServices Class IBMTSSVC_StorageConfigurationService

BlockServices Class IBMTSSVC_StorageConfigurationServiceCapabilities

BlockServices Class IBMTSSVC_StoragePoolComponent

BlockServices Class IBMTSSVC_StoragePoolSetting

BlockServices Class IBMTSSVC_StorageSettingsGeneratedFromCapabilities

BlockServices Class IBMTSSVC_StorageVolume

BlockServices Class IBMTSSVC_StorageVolumeElementSettingData

BlockServices Class IBMTSSVC_StorageVolumeOnCluster

BlockServices Class IBMTSSVC_StorageVolumeOnIOGroup

BlockServices Class IBMTSSVC_StorageVolumeSetting

BlockServices Class IBMTSSVC_VolumeBasedOn

Cascade Class IBMTSSVC_BackendController

Cascade Class IBMTSSVC_CandidateVolume

Cascade Class IBMTSSVC_ClusterScopeCandidateVolume

Cascade Class IBMTSSVC_MemberOfAllocatedResources
Cascade Class IBMTSSVC_RemoteAllocatedResources
Cascade Class IBMTSSVC_RemoteCluster
Cascade Class IBMTSSVC_BackendStorageVolume
Cascade Class IBMTSSVC_CascadingAllocationService
Cascade Class IBMTSSVC_CascadingElementCapabilities
Cascade Class IBMTSSVC_CascadingHostedService
Cascade Class IBMTSSVC_RemoteSystemVolume
Cascade Class IBMTSSVC_RemoteSystemCandidateVolume
Cascade Class IBMTSSVC_RemoteStorageVolume
Cascade Class IBMTSSVC_RemotePartnership
Cascade Class IBMTSSVC_RemoteBackendSystemDevice
Cascade Class IBMTSSVC_HostedAllocatedResources
Certificate Class IBMTSSVC_Certificate
CopyServices Class IBMTSSVC_AsyncCopyStorageSynchronizedSet
CopyServices Class IBMTSSVC_AuxRemoteStorageSynchronized
CopyServices Class IBMTSSVC_ClusterScopeAsyncCopySet
CopyServices Class IBMTSSVC_ClusterScopeCloneCopySet
CopyServices Class IBMTSSVC_ClusterScopeFlashCopySet
CopyServices Class IBMTSSVC_ClusterScopeSyncCopySet
CopyServices Class IBMTSSVC_CloneCopyStorageSynchronizedSet
CopyServices Class IBMTSSVC_CopyCandidate
CopyServices Class IBMTSSVC_FlashCopyStorageSynchronizedSet
CopyServices Class IBMTSSVC_LocalStorageSynchronized
CopyServices Class IBMTSSVC_MasterRemoteStorageSynchronized
CopyServices Class IBMTSSVC_RemoteStorageSynchronized
CopyServices Class IBMTSSVC_StorageSynchronized
CopyServices Class IBMTSSVC_StorageReplicationElementCapabilities
CopyServices Class IBMTSSVC_StorageReplicationCapabilities
CopyServices Class IBMTSSVC_SyncCopyStorageSynchronizedSet
CopyServices Class IBMTSSVC_SynchronizedSet
DeviceConfiguration Class
IBMTSSVC_DeviceConfigurationServiceAvailableToProfile
DeviceConfiguration Class IBMTSSVC_DeviceConfigurationService
DeviceConfiguration Class IBMTSSVC_DeviceConfiguration
DeviceConfiguration Class IBMTSSVC_HostedDeviceConfigurationService
DeviceConfiguration Class
IBMTSSVC_ConcreteDependencyDeviceConfiguration
DeviceConfiguration Class IBMTSSVC_DeviceSettingData
Fabric Class IBMTSSVC_FabricElementView
FCPort Class IBMTSSVC_InitiatorControllerForPort
FCPort Class IBMTSSVC_InitiatorControllerOnCluster
FCPort Class IBMTSSVC_InitiatorController
FCPort Class IBMTSSVC_IOGroupPort
FCPort Class IBMTSSVC_HostedSCSIProtocolEndpoint

FCPort Class IBMTSSVC_FCPort

FCPort Class IBMTSSVC_ClusterScopeStorageVolumeBackendVolumeView

FCPort Class IBMTSSVC_DeviceSAPImplementation

FCPort Class IBMTSSVC_BackendTargetSCSIProtocolEndpoint

FCPort Class IBMTSSVC_SystemFCPort

FCPort Class IBMTSSVC_SCSIProtocolEndpoint

FCPort Class IBMTSSVC_StorageVolumeBackendVolumeView

Indications Class IBMTSSVC_InstCreation

Indications Class IBMTSSVC_InstDeletion

Indications Class IBMTSSVC_InstModification

JobControl Class IBMTSSVC_FormatVolumeJob

JobControl Class IBMTSSVC_HostedJob

JobControl Class IBMTSSVC_HostedFlashCopyJob

JobControl Class IBMTSSVC_HostedFormatVolumeJob

JobControl Class IBMTSSVC_HostedMigrateVolumeJob

JobControl Class IBMTSSVC_HostedRepairVdiskCopyJob

JobControl Class IBMTSSVC_HostedSyncCopyJob

JobControl Class IBMTSSVC_HostedVdiskSyncJob

JobControl Class IBMTSSVC_Job

JobControl Class IBMTSSVC_MigrateVolumeJob

JobControl Class IBMTSSVC_RepairVdiskCopyJob

JobControl Class IBMTSSVC_SpaceEfficientRepairForCopyProgress

JobControl Class IBMTSSVC_SpaceEfficientRepairJob

JobControl Class IBMTSSVC_SyncCopyJob

JobControl Class IBMTSSVC_VdiskSyncJob

MaskingMapping Class IBMTSSVC_AuthorizedControllerPrivilege

MaskingMapping Class IBMTSSVC_AuthorizedStorageHardwareID

MaskingMapping Class IBMTSSVC_AvailableHardwareID

MaskingMapping Class IBMTSSVC_CandidateStorageHardwareIDPort

MaskingMapping Class IBMTSSVC_ClusterMaskingCapabilities

MaskingMapping Class
IBMTSSVC_ClusterScopeHardwareIdStorageVolumeView

MaskingMapping Class IBMTSSVC_ClusterScopePrivilege

MaskingMapping Class IBMTSSVC_ManagesHardwareID

MaskingMapping Class IBMTSSVC_ManagementServiceForPrivilege

MaskingMapping Class IBMTSSVC_ConfigurationServiceForController

MaskingMapping Class IBMTSSVC_ControllerConfigurationServiceForSystem

MaskingMapping Class
IBMTSSVC_ControllerConfigurationServiceMaskingCapabilities

MaskingMapping Class IBMTSSVC_SystemVolumeController

MaskingMapping Class IBMTSSVC_StorageHardwareID

MaskingMapping Class IBMTSSVC_StorageHardwareIDsForSystem

MaskingMapping Class IBMTSSVC_StorageHardwareIDManagementService

MaskingMapping Class IBMTSSVC_SAPAvailableForElement

MaskingMapping Class IBMTSSVC_HardwareIdStorageVolumeView

MaskingMapping Class IBMTSSVC_ProtocolControllerMaskingCapabilities
MaskingMapping Class IBMTSSVC_ProtocolController
MaskingMapping Class IBMTSSVC_ProtocolControllerForPort
MaskingMapping Class IBMTSSVC_PrivilegeServiceForSystem
MultipleComputerSystem Class IBMTSSVC_SystemVPD
MultipleComputerSystem Class IBMTSSVC_CandidateNode
MultipleComputerSystem Class IBMTSSVC_CandidateRemoteCluster
MultipleComputerSystem Class IBMTSSVC_ClusteringCandidate
MultipleComputerSystem Class IBMTSSVC_ClusterConcreteIdentity
MultipleComputerSystem Class IBMTSSVC_ClusterScopeNodeVPD
MultipleComputerSystem Class IBMTSSVC_PartnershipCandidate
MultipleComputerSystem Class IBMTSSVC_NodeComponentOfIOGroup
MultipleComputerSystem Class IBMTSSVC_NodeComponentOfCluster
MultipleComputerSystem Class IBMTSSVC_MemberOfIOGroupRedundancySet
MultipleComputerSystem Class IBMTSSVC_MemberOfClusterRedundancySet
MultipleComputerSystem Class IBMTSSVC_Cluster
MultipleComputerSystem Class IBMTSSVC_Features
MultipleComputerSystem Class IBMTSSVC_IOGroupRedundancySet
MultipleComputerSystem Class IBMTSSVC_Node
MultipleComputerSystem Class IBMTSSVC_NodeVPD
MultipleComputerSystem Class IBMTSSVC_IOGroup
MultipleComputerSystem Class IBMTSSVC_IOGroupComponentOfCluster
MultipleComputerSystem Class IBMTSSVC_ClusterRedundancySet
MultipleComputerSystem Class IBMTSSVC_IOGroupConcreteIdentity
MultipleComputerSystem Class IBMTSSVC_ElementConformsToProfile
PhysicalPackage Class IBMTSSVC_Chassis
PhysicalPackage Class IBMTSSVC_ComputerSystemPackage
PhysicalPackage Class IBMTSSVC_Product
PhysicalPackage Class IBMTSSVC_ProductPhysicalComponent
Server Class IBMTSSVC_ProviderSoftwareIdentity
Server Class IBMTSSVC_SubProfileRequiresProfile
Server Class IBMTSSVC_SubProfileConformstoSMIS
Server Class IBMTSSVC_RegisteredSubProfileSoftwareIdentity
Server Class IBMTSSVC_RegisteredProfileSoftwareIdentity
Server Class IBMTSSVC_RegisteredProfileConformsToSMIS
Server Class IBMTSSVC_ReferencedProfile
Server Class IBMTSSVC_HostedAccessPoint
Server Class IBMTSSVC_NamespaceInManager
Server Class IBMTSSVC_CIMXMLCommunicationMechanism
Server Class IBMTSSVC_CommMechanismForManager
Server Class IBMTSSVC_ObjectManagerConformsToProfile
Server Class IBMTSSVC_MasterConsole
Server Class IBMTSSVC_NameSpace
Server Class IBMTSSVC_ObjectManager
Server Class IBMTSSVC_HostedService

Chapter 7. Return codes

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

Common Information Model

Table 3 is a condensed list of possible CIM return codes.

Table 3. Common Information Model return codes

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

Table 3. 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 3. 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 3. 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 3. 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 3. 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 3. 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.
0x1000	Parameters checked – Job started		The CLI copy command was run and a job object was returned.
0x1000	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.
0x1000	LogicalDevice instance not valid	AttachDevice()	The device is not a volume of the RedundancyGroup of the controller.

Table 3. Common Information Model return codes (continued)

CIM return code	Description	Method	Explanation
0x1000	LogicalDevice not associated to Controller	DetachDevice()	The device has no Protocol ControllerFor Unit association to this controller.
0x1000	ID already created	CreateStorage HardwareID()	The WWPN is already assigned to an existing storage hardware ID.
0x1000	Specified instance not found	DeleteStorage HardwareID()	The storage hardware ID could not be found.
0x1000	HardwareID instance not valid	CreateGateway ID() AddHardwareIDs ToCollection()	The storage hardware ID could not be found or is already a member of another collection.
0x1001	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.
0x1001	Device Number Conflict	AttachDevice()	The specified device number is already occupied.
0x1001	Hardware implementation does not support specified IDType	CreateStorage HardwareID()	The type of ID is different from 2.
0x8000	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.
0x8000	Locale not valid	SetLocale()	The submitted Locale was greater than 9.

Table 3. Common Information Model return codes (continued)

CIM return code	Description	Method	Explanation
0*x*8000	Type not valid	Dump()	A type greater than 2 was passed in.
0*x*8000	Connection refused	GetDump()	We lost connection to the cluster or failed to connect to a node (CISCO only).
0*x*8000	Backup not found	Restore Configuration()	The specified backup was not found.
0*x*8000	Delete failed	Delete Configuration Backup()	The deletion of the backup directory failed. The failure might have been caused by a sharing violation.
0*x*8000	IOGroup must have Nodes aggregated	SetIOGroup()	The I/O group does not have any nodes.
0*x*8000	ID not valid	SetQuorum()	The quorum ID is a number greater than 2.
0*x*8000	Volume not valid	IncludeBackend Volume()	The volume is not expelled.
0*x*8000	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.
0*x*8000	Ports are from multiple IOGroups	CreateProtocol ControllerWith Ports()	All ports are required to belong to the same I/O group.
0*x*8000	HardwareID still bound to AuthorizationSubject. Force required	DeleteStorage HardwareID()	The hardware ID has access granted to a storage volume and Force was not specified.
0*x*8000	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."
0*x*8000	Record(s) not found	GetRecord() GetAllRecords()	No records were found.
0*x*8000	Cannot connect to cluster	Create2062 Cluster() Add2062 Cluster()	Unable to connect to the cluster.

Table 3. Common Information Model return codes (continued)

CIM return code	Description	Method	Explanation
0x8000	Connection to cluster refused	Add2145Cluster()	The connection to the cluster was refused.
0x8000	Connection to switch refused	Reset2062Node() Reload2062Node()	The connection to the switch was refused.
0x8000	Cluster IP not found	RemoveCluster()	The IP for the cluster cannot be found.
0x8001	Maximum number of Nodes for Cluster exceeded	AddNode()	All I/O groups already have two nodes assigned to them.
0x8001	Prefix not valid	Dump()	A file prefix and feature log type were passed in at the same time.
0x8001	File not found	GetDump()	The given file path was not found (CISCO).
0x8001	Backup script failed	Backup Configuration()	The backup script returned with an error.
0x8001	Restore script failed	Restore Configuration()	The backup script returned with an error.
0x8001	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.
0x8001	Operation not allowed for current SyncState	Modify Synchronized Set()	The operation is not allowed with the current SyncState of the set.
0x8001	Unsupported protocol	CreateProtocol ControllerWith Ports()	Protocol != 2.
0x8001	Syntax error in ClusterName	Create2062 Cluster() Add2062Cluster() Reset2062Node() Reload2062Node()	The cluster name is not valid because of a syntax error.
0x8002	ExtraCapacitySet not valid	AddNode()	The submitted ExtraCapacitySet was not a IBMTSSVC_ IOGroupSet.
0x8002	Secure copy failed	Backup Configuration()	The download of the backup file using secure copy failed.

Table 3. 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 4 is a condensed list of CIM return codes and their corresponding SAN Volume Controller Command-Line Interface (CLI) error codes.

Table 4. CIM return codes and corresponding CLI error codes

CIM return code	SAN Volume Controller CLI error code	Description
36865	CMMVC5700E	The parameter list is not valid.
36866	CMMVC5701E	No object ID was specified.
36867	CMMVC5702E	%1 is below the minimum level.
36868	CMMVC5703E	%1 is above the maximum level.
36869	CMMVC5704E	%1 is not divisible by the permitted step level.
36870	CMMVC5705E	A required parameter is missing.
36871	CMMVC5706E	%1 is not a valid argument for the -x parameter.
36872	CMMVC5707E	Required parameters are missing.
36873	CMMVC5708E	The %1 parameter is missing its associated arguments.
36874	CMMVC5709E	%1 is not a supported parameter.
36875	CMMVC5710E	No self-describing structure for identifier parameter [%1].
36876	CMMVC5711E	%1 is not valid data.
36877	CMMVC5712E	Required data is missing.
36878	CMMVC5713E	Some parameters cannot be used together.
36879	CMMVC5714E	There are no items in the parameter list.
36880	CMMVC5715E	There is no parameter list.
36881	CMMVC5716E	Nonnumeric data was entered for a numeric field (%1). Enter a numeric value.
36882	CMMVC5717E	No match was found for the specified unit.
36883	CMMVC5718E	An unexpected return code was received.
36884	CMMVC5719E	A value of %2 requires the parameter %1 to be specified.
36885	CMMVC5720E	%1 is not a valid argument for the -o parameter.
36886	CMMVC5721E	%1 is not a valid time-stamp format. The valid format is MMDDHHmmYY.
36887	CMMVC5722E	%1 is not a valid month.
36888	CMMVC5723E	%1 is not a valid day.
36889	CMMVC5724E	%1 is not a valid hour.
36890	CMMVC5725E	%1 is not a valid minute.
36891	CMMVC5726E	%1 are not valid seconds.
36892	CMMVC5727E	%1 is not a valid filter.

Table 4. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code	Description
36893	CMMVC5728E	%1 must be in the format minute:hour:day:month:weekday.
36894	CMMVC5729E	One or more components in the list are not valid.
36895	CMMVC5730E	%1 is only valid when %2 has a value of %3.
36896	CMMVC5731E	%1 can only be entered when %2 has been entered.
36897	CMMVC5732E	The shared memory interface (SMI) is not available.
36898	CMMVC5733E	Enter at least one parameter.
36899	CMMVC5734E	A combination of values was entered that is not valid.
36900	CMMVC5735E	The name entered is not valid.
36901	CMMVC5736E	-c is not a valid unit.
36902	CMMVC5737E	The parameter %1 has been entered multiple times. Enter the parameter once.
36903	CMMVC5738E	The argument %1 contains too many letters.
36904	CMMVC5739E	The argument %1 does not contain enough letters.
36905	CMMVC5740E	The filter flag %1 is not valid.
36906	CMMVC5741E	The filter value %1 is not valid.
36922	CMMVC5987E	%1 is not a valid command line option.
36923	CMMVC6007E	The two passwords that were entered do not match.
36924	CMMVC6009E	Unable to malloc a block of memory to copy the returned data.
37121	CMMVC5742E	AE_ParamOutOfRange. A parameter specified is out of range.
37122	CMMVC5743E	AE_ParamNotInStep. A parameter specified does not comply with the step value.
37123	CMMVC5744E	AE_TooManyCandidates. Too many objects were specified in the request.
37124	CMMVC5745E	AE_TooFewCandidates. Too few objects were specified in the request.
37125	CMMVC5746E	AE_InvalidObjectType. The requested operation cannot be applied to the object specified.
37126	CMMVC5747E	AE_InvalidRequestId. The action requested is not valid. This is an internal error.
37127	CMMVC5748E	AE_NotSupportedYet. The action requested is not valid. This is an internal error.

Table 4. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code	Description
37128	CMMVC5749E	AE_DumpFileExists. The specified dump file name already exists.
37129	CMMVC5750E	AE_DumpFileCreateError. Cannot create the dump file. The file system is probably full.
37130	CMMVC5751E	AE_DumpFileWriteError. Cannot write to the dump file.
37131	CMMVC5752E	AE_ObjectNotEmpty. The request failed. The object contains child objects. You must first delete the child objects.
37132	CMMVC5753E	AE_InvalidObject. The specified object does not exist or is not a suitable candidate.
37133	CMMVC5754E	AE_InvalidObjectName. The specified object does not exist, or the name that is supplied does not meet the naming rules.
37134	CMMVC5755E	AE_SizeMismatch. Cannot create because the sizes of the specified objects do not match.
37135	CMMVC5756E	AE_ObjectMapped. Cannot perform the request as the object is already mapped.
37136	CMMVC5757E	AE_NoSDSdefaults.SDS The defaults are not found. This is an internal error.
37137	CMMVC5758E	AE_NameExists. The object name already exists.
37138	CMMVC5759E	AE_MemoryAllocationFailed. Memory cannot be allocated. This is an internal error.
37139	CMMVC5760E	AE_AddNodeCallFailed. Failed to add the node to the cluster member list.
37140	CMMVC5761E	AE_DeleteNodeCallFailed. Failed to delete the node from the cluster member list.
37141	CMMVC5762E	AE_ClusterTimerExpired. The request did not complete before the timeout period has expired.
37142	CMMVC5763E	AE_NodeUnpendFailed. The node failed to go online.
37143	CMMVC5764E	AE_InvalidModeChange. The requested mode change is not valid. This is an internal error.
37144	CMMVC5765E	AE_NoMatchingCandidate. The selected object is no longer a candidate. A change occurred during the request.
37145	CMMVC5766E	AE_NoAssociations.
37146	CMMVC5767E	AE_InvalidParams. One or more of the parameters specified are not valid.
37147	CMMVC5768E	AE_UnfixedErrorsExist. Not used.

Table 4. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code	Description
37148	CMMVC5769E	AE_NotAllNodesOnline. The requested operation requires all nodes to be online. One or more nodes are not online.
37149	CMMVC5770E	AE_InvalidSSHKeyFile. The supplied ssh key file is not valid.
37150	CMMVC5771E	AE_ForceRequired. The requested operation did not complete. This usually occurs when a child object exists. To force the operation, specify the force flag.
37151	CMMVC5772E	AE_SoftwareUpgradeInProgress. The operation requested cannot be performed because a software upgrade is in progress.
37152	CMMVC5773E	AE_InvalidMode. The object selected is in the wrong mode to perform the requested operation.
37153	CMMVC5774E	AE_InvalidSSHUserId. The supplied user ID is not valid.
37154	CMMVC5775E	AE_InvalidDirectory. The specified directory attribute is not valid.
37155	CMMVC5776E	AE_DirectoryListingFailed. The directory listing cannot be retrieved.
37156	CMMVC5777E	AE_IncorrectPowerDomain. The node cannot be added to the I/O Group because the other node in the I/O Group is in the same power domain.
37157	CMMVC5778E	AE_ClusterAlreadyCreated. Cannot create another cluster because a cluster already exists.
37158	CMMVC5779E	AE_TooManyClustersExistAlready.
37159	CMMVC5780E	AE_ClusterIDCannotBeDeleted.
37160	CMMVC5781E	AE_InvalidClusterID. The cluster ID specified is not valid.
37161	CMMVC5782E	AE_ObjectOffline. The specified object is offline.
37162	CMMVC5783E	AE_InformationNotAvailable
37163	CMMVC5784E	AE_ClusterNameNotUniqueUseId. The specified cluster name is not unique. You must specify the cluster using the cluster ID.
37164	CMMVC5785E	AE_IllegalCharacterInFilename. The specified filename contains an illegal character.
37165	CMMVC6024E	The auxiliary virtual disk entered is not valid.
37166	CMMVC6025E	The consistency group master cluster is not the local cluster.

Table 4. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code	Description
37168	CMMVC6026E	The consistency group is not in the stopped state.
37169	CMMVC6027E	The consistency group is not the primary master.
37170	CMMVC6002E	This command can only be run on a node that is in service mode.
37171	CMMVC6003E	This command cannot be run on a node that is in service mode.
37172	CMMVC6008E	The key already exists.
37173	CMMVC6019E	The software upgrade failed because a node was added during the upgrade process.
37174	CMMVC6020E	The software upgrade failed because the system is not able to distribute the software to all of the nodes.
37175	CMMVC6021E	The system is currently busy performing another request.
37176	CMMVC6022E	The system is currently busy performing another request.
37177	CMMVC6023E	The system is currently busy performing another request.
37178	CMMVC5993E	The specified upgrade package does not exist.
37179	CMMVC5994E	An error occurred while verifying the signature of the upgrade package.
37180	CMMVC5995E	An error occurred while unpacking the upgrade package.
37181	CMMVC5996E	The specific upgrade package cannot be installed over the current version.
37182	CMMVC6028E	This upgrade package cannot be applied to the current software level because it contains changes to the cluster state and there are remote cluster partnerships defined.
37183	CMMVC6029E	All nodes must have identical code level before a concurrent code upgrade can be performed.
37184	CMMVC6200E	The action failed because of incompatible software.
37185	CMMVC6073E	The maximum number of files has been exceeded.
37186	CMMVC6079E	The meta data recovery cannot complete the operation because a parameter is not valid.
37188	CMMVC6081E	The meta data recovery is busy processing the previous operation.

Table 4. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code	Description
37189	CMMVC6082E	The attempt to stop the meta data recovery has failed because the previous operation has completed.
37190	CMMVC6083E	The meta data recovery cannot find a valid dump file that is required for the rebuild operation.
37191	CMMVC6084E	The meta data recovery cannot create, open, or write to the scan file. The disk might be full.
37192	CMMVC6085E	The meta data recovery cannot create, open, or write to the dump file. The disk might be full.
37193	CMMVC6086E	The meta data recovery cannot create, open, or write to the progress file. The disk might be full.
37194	CMMVC6087E	The meta data recovery cannot map the buffers that are necessary to complete the operation.
37195	CMMVC6088E	The LBA for which the meta data recovery was requested does not contain meta data.
37196	CMMVC6089E	The meta data at the requested LBA is flagged as not valid.
37197	CMMVC6090E	The meta data header check sum verification failed.
37198	CMMVC6091E	The meta data region check sum verification failed.
37199	CMMVC6092E	The meta data recovery operation has stopped.
37200	CMMVC6093E	Meta data recovery internal error - read only.
37202	CMMVC6095E	The meta data recovery encountered the end of the disk.
37203	CMMVC6096E	The meta data recovery encountered an error from a lower layer - vl no resource.
37204	CMMVC6097E	The meta data recovery encountered an error from a lower layer - vl failure.
37205	CMMVC6077E	All unfixed errors must be fixed before the software upgrade can be applied. Unfixed errors can cause the upgrade process to fail. If you cannot fix an error, contact an IBM support representative.
37206	CMMVC6201E	The node cannot be added because the software is not compatible.
37207	CMMVC6098E	The copy has failed because the specified node is the configuration node for the cluster.

Table 4. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code	Description
37208	CMMVC6203E	The action has failed because the directory that is specified is not one of the following directories: /dumps, /dumps/iostats /dumps/iotrace /dumps/feature /dumps/config /dumps/elogs /dumps/ec /dumps/pl
37209	CMMVC6204E	The action has failed because the resulting disk size is less than or equal to zero.
37210	CMMVC6205E	The meta data recovery cannot use the provided MDisk ID because the ID is not valid or destroyed.
37211	CMMVC6206E	The software upgrade failed because a file that contains the software for the specified MCP cannot be found.
37212	CMMVC6034E	The action failed because the maximum number of objects has been reached.
37213	CMMVC6207E	The action failed because the virtual disk is part of a Metro Mirror mapping.
37214	CMMVC6208E	The action failed because the virtual disk is part of a FlashCopy mapping.
37215	CMMVC6213E	You are trying to recover region data that is created by a code level that is different from the one that you are currently running on the node.
37216	CMMVC6214E	Failed to recreate the cluster that you are trying to build.
37217	CMMVC6215E	The action failed because the source an the destination VDisk are the same.
37218	CMMVC6216E	The action failed because the node hardware is incompatible with the current group member.
37219	CMMVC6227I	The package installed successfully.
37220	CMMVC6228E	The cluster has been recovered and the CLI functionality is limited until the cause of the failure has been determined and any corrective action taken. Contact your service representative.
37221	CMMVC6236E	The command has not completed. A limited availability parameter has been entered without the required environment setting being set.

Table 4. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code	Description
37261	CMMVC6347E	The specific upgrade package cannot be installed on this hardware.
37376	CMMVC5786E	The action failed because the cluster is not in a stable state.
37377	CMMVC5787E	The cluster was not created because a cluster already exists.
37378	CMMVC5788E	The service IP address is not valid.
37379	CMMVC5789E	The cluster cannot be modified because the IP address, subnet mask, service address, SNMP address or gateway address is not valid.
37380	CMMVC5790E	The node cannot be added to the cluster because the maximum number of nodes that are allowed in a cluster has been reached.
37381	CMMVC5791E	The action failed because an object that was specified in the command does not exist.
37382	CMMVC5792E	The action failed because the I/O group is used for recovery.
37383	CMMVC5793E	The node cannot be added to the cluster because the I/O group already has two nodes.
37384	CMMVC5794E	The action failed because the node is not a member of the cluster.
37385	CMMVC5795E	The node cannot be deleted because a software upgrade is in progress.
37386	CMMVC5796E	The action failed because the I/O group that the node belongs to is unstable.
37387	CMMVC5797E	The node cannot be deleted because this is the last node in the I/O group and there are VDisks associated with the I/O group.
37388	CMMVC5798E	The action failed because the node is offline.
37389	CMMVC5799E	The shut down was not successful because there is only one node that is online in the I/O group.
37390	CMMVC5800E	The action failed because the object that is specified in the command does not exist.
37391	CMMVC5801E	The cluster software upgrade cannot proceed because one or more nodes in the cluster are offline. You must delete the node or nodes that are offline or bring them online before you can reissue the command.

Table 4. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code	Description
37392	CMMVC5802E	The cluster software upgrade cannot proceed because one of the I/O groups in the cluster contains only one node. The software upgrade process requires a shutdown and restart of each node in an I/O group. If there is only one node in an I/O group, I/O operations can be lost if the I/O operations are nto stopped before the software upgrade is started. If you want to continue the cluster software upgrade, you must reissue the command and specify the force parameter.
37393	CMMVC5803E	The entry in the error log is not marked because the error has already been fixed or if unfixed, the sequence number cannot be found.
37394	CMMVC5804E	The action failed because an object that is specified in the command does not exist.
37395	CMMVC5805E	The progress information is not returned because the FlashCopy statistics are not ready.
37396	CMMVC6013E	The command failed because there is a consistency group mismatch on the auxiliary cluster.
37397	CMMVC6014E	The command failed because the requested object is either unavailable or does not exist.
37398	CMMVC6018E	The software upgrade preinstall process has failed.
37632	CMMVC5806E	The action failed because an object that was specified in the command does not exist.
37792	CMMVC5807E	The action failed because the MDisk cannot be changed to the mode that you have specified.
37793	CMMVC5808E	The action failed because the MDisk does not exist.
37794	CMMVC5809E	The tracing of I/O operations was not started because it is already in progress.
37795	CMMVC5810E	The quorum index number for the MDisk was not set because the MDisk is offline.
37796	CMMVC5811E	The quorum index number for the MDisk was not set because the quorum disk does not exist.
37797	CMMVC5812E	The quorum index number for the MDisk was not set because the MDisk is in the wrong mode.

Table 4. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code	Description
37798	CMMVC5813E	The quorum index number for the MDisk was not set because the MDisk has a sector that is not valid.
37799	CMMVC5814E	The quorum index number for the MDisk was not set because the unique identifier (UID) is not valid.
37800	CMMVC5808E	The action failed because the MDisk does not exist.
38858	CMMVC6006E	The MDisk was not deleted because the resource is busy.
37803	CMMVC6349E	The command failed because the virtual disk cache is lost. Use the force flag to acknowledge this and move the VDisk.
37804	CMMVC6364E	The command failed because the logical block address (LBA) requested is too large for the disk.
37805	CMMVC6365E	The command timed out.
37812	CMMVC6212E	The command failed because the data in the cache has not been committed to disk.
37817	CMMVC6217E	The maximum number of hosts for the cluster is already configured.
37818	CMMVC6218E	The maximum number of host I/O group pairs for the cluster is already configured.
37819	CMMVC6219E	The maximum number of WWPNs for the cluster is already configured.
37822	CMMVC6220E	The maximum number of hosts for one or more I/O groups is already configured.
37823	CMMVC6221E	The maximum number of WWPNs for one or more I/O groups is already configured.
37827	CMMVC6222E	The maximum number of WWPNs for the host is already configured.
37828	CMMVC6223E	The host object does not belong to one or more of the I/O groups that you have specified.
37829	CMMVC6224E	The host already belongs to one or more I/O groups that you have specified.
37830	CMMVC6225E	An I/O group cannot be removed from a host because of one or more of the associated VDisks.
37841	CMMVC6317E	The action failed as an attempt was made to use an I/O group that is not valid.

Table 4. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code	Description
37843	CMMVC6011E	The cluster is part of a remote cluster partnership. The upgrade changes the cluster state, so you must delete the remote cluster partnership before you can upgrade.
37844	CMMVC6033E	The action failed because an internal error has occurred.
37845	CMMVC6034E	The action failed because the maximum number of objects has been reached.
37846	CMMVC6035E	The action failed because the object already exists.
37847	CMMVC6036E	An action that is not valid has been requested.
37848	CMMVC6037E	The action failed because the object is not empty.
37849	CMMVC6038E	The action failed because the object is empty.
37850	CMMVC6039E	The action failed because object is not a member of a group.
37851	CMMVC6040E	The action failed because the object is not a parent.
37854	CMMVC6041E	The action failed because the cluster is full.
37855	CMMVC6042E	The action failed because the object is not a member of the cluster.
37856	CMMVC6043E	The action failed because the object is a member of a group.
37858	CMMVC6044E	The action failed because the object is a parent.
37857	CMMVC6045E	The action failed because force flag is not specified.
37859	CMMVC6046E	The action failed because too many candidates have been selected.
37860	CMMVC6047E	The action failed because not enough candidates have been selected.
37861	CMMVC6048E	The action failed because the object is busy.
37862	CMMVC6049E	The action failed because the object is not ready.
37863	CMMVC6050E	The action failed because the command is busy.
37864	CMMVC6051E	The action that is selected is not supported.
37865	CMMVC6052E	The action failed because the object is a member of a FlashCopy mapping.
37866	CMMVC6053E	A WWPN that is not valid was entered.

Table 4. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code	Description
37867	CMMVC6054E	The action failed because all nodes are not online.
37868	CMMVC6055E	The action failed because an upgrade is not in progress.
37869	CMMVC6056E	The action failed because the object is too small.
37870	CMMVC6057E	The action failed because the object is a target of a FlashCopy mapping.
37871	CMMVC6058E	The action failed because the object is in the recovery HWS.
37872	CMMVC6059E	The action failed because the object is in a mode that is not valid.
37873	CMMVC6060E	The action failed because the object is in the process of being deleted.
37874	CMMVC6061E	The action failed because the object is being resized.
37875	CMMVC6062E	The action failed because the object is being moved between HWS.
37876	CMMVC6063E	The action failed because there are no more disks in the group.
37877	CMMVC6064E	The action failed because the object has an name that is not valid.
37878	CMMVC6065E	The action failed because the object is not in a group.
37879	CMMVC6066E	The action failed because the system is running low on memory.
37880	CMMVC6067E	The action failed because the SSH key is not found.
37881	CMMVC6068E	The action failed because there are no free SSH keys.
37882	CMMVC6069E	The action failed because the SSH key is already registered.
37883	CMMVC6071E	The VDisk to host mapping cannot be created because the VDisk is already mapped to a host.
37888	CMMVC5815E	The MDisk group cannot be created because an object that is specified in the command does not exist.
37889	CMMVC5816E	The action failed because an object that is specified in the command does not exist.
37890	CMMVC5817E	The MDisk group that you specified is not valid.
37891	CMMVC5818E	The MDisk group cannot be deleted because there is at least one MDisk in the group.

Table 4. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code	Description
37892	CMMVC5819E	The MDisk cannot be added to the MDisk group because the MDisk is already a member of another MDisk group.
37893	CMMVC5820E	The MDisk cannot be added to the MDisk group because an object that is specified in the command does not exist.
37894	CMMVC5821E	The MDisk cannot be added to the MDisk group because not enough MDisks are included in the list.
37895	CMMVC5822E	The MDisk cannot be added to the MDisk group because too many MDisks are included in the list.
37896	CMMVC5823E	The MDisk cannot be deleted from the MDisk group because the MDisk is part of another MDisk group.
37897	CMMVC5824E	The MDisk cannot be deleted from the MDisk group because the MDisk does not belong to this MDisk group.
37898	CMMVC5825E	The MDisk cannot be deleted from the MDisk group because a VDisk is allocated from one or more of the specified MDisks. A force delete is required.
38144	CMMVC5826E	The VDisk cannot be created because an object that is specified in the command does not exist.
38145	CMMVC5827E	The command failed because there is an inconsistency between two or more parameters or there is an inconsistency between a parameter and the action that you have requested.
38146	CMMVC5828E	The VDisk cannot be created because the I/O group does not contain any nodes.
38147	CMMVC5829E	The VDisk cannot be created because more than one MDisk has been specified.
38148	CMMVC5830E	The VDisk cannot be created because no MDisks are specified in the command.
38150	CMMVC5831E	The VDisk cannot be created because the preferred node for I/O operations is not part of the I/O group.
38151	CMMVC5832E	The property of the VDisk cannot be modified because an object that is specified in the command does not exist.
38152	CMMVC5833E	The property of the VDisk cannot be modified because there are no nodes in the I/O group.

Table 4. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code	Description
38153	CMMVC5834E	The I/O group for the VDisk cannot be modified because the group is a recovery I/O group. Use the force option to modify the I/O group.
38154	CMMVC5835E	The VDisk cannot be expanded because the object that is specified does not exist.
38155	CMMVC5836E	The size of the VDisk has not changed because it is locked.
38156	CMMVC5837E	The action failed because the VDisk is part of a FlashCopy mapping.
38157	CMMVC5838E	The action failed because the VDisk is part of a Metro Mirror mapping.
38158	CMMVC5839E	The VDisk cannot be shrunk because an object that is specified does not exist.
38159	CMMVC5840E	The VDisk cannot be deleted because it is mapped to a host, is part of a FlashCopy or Metro Mirror mapping, or is part of an image mode migration.
38160	CMMVC5841E	The VDisk cannot be deleted because it does not exist.
38163	CMMVC5842	The action failed because an object that is specified does not exist.
38164	CMMVC5843E	The VDisk to host mapping cannot be created because the VDisk does not have the capacity greater than zero bytes.
38165	CMMVC5844E	The VDisk to host mapping cannot be created because the SCSI LUN ID is not valid.
38166	CMMVC5845E	The extent cannot be migrated because an object that is specified does not exist.
38167	CMMVC5846E	The VDisk cannot be migrated because an object that is specified does not exist.
38168	CMMVC5847E	The VDisk cannot be migrated because the associated MDisk is already in the MDisk group.
38169	CMMVC6348E	The command failed as there is not enough information provided to process successfully.
38170	CMMVC6319E	The command failed because a combination of IPv4 and IPv6 parameters were entered.
38171	CMMVC6320E	The command failed because the supplied IPv4 address is not valid.
38172	CMMVC6321E	The command failed because the supplied IPv4 subnet mask is not valid.
38173	CMMVC6322E	The command failed because the supplied IPv4 gateway address is not valid.

Table 4. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code	Description
39175	CMMVC6324E	The command failed because the supplied IPv6 prefix is not valid.
38176	CMMVC6325E	The command failed because the supplied IPv6 gateway address is not valid.
38177	CMMVC6326E	The command failed because the supplied IPv4 service mode address is not valid.
38178	CMMVC6327E	The command failed because the supplied IPv6 service mode address is not valid.
38179	CMMVC6328E	The command failed because the supplied console address is not valid.
38180	CMMVC6329E	The command failed because the supplied SNMP address is not valid.
38181	CMMVC6330E	The command failed because an IPv6 SNMP address was specified when the IPV6 protocol stack was not available.
38182	CMMVC6331E	The command failed because an IPv4 SNMP address was specified when the IPv4 protocol stack was not available.
38183	CMMVC6332E	The command failed because an IPv6 e-mail address was specified when the IPv6 protocol stack was not available.
38184	CMMVC6333E	The command failed because an IPv4 e-mail address was specified when the IPv4 protocol stack was not available.
38185	CMMVC6334E	The command failed because the e-mail port number supplied is not valid.
38186	CMMVC6335E	The command failed because the combination of parameters provided are either mutually incompatible or would leave the cluster without a functioning protocol stack.
38187	CMMVC6350E	The command failed because there is insufficient mirror bitmap space.
38188	CMMVC6351E	The command failed because the virtual disk (VDisk) is not mirrored.
38189	CMMVC6352E	The command failed because the number of copies of this virtual disk (VDisk) would exceed the limit.
38190	CMMVC6353E	The command failed because the copy that is specified does not exist.
38191	CMMVC6354E	The command failed because the copy is not synchronized.
38192	CMMVC6355E	The command failed because an image mode copy is not synchronized and -force is not specified.

Table 4. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code	Description
38193	CMMVC6356E	The command failed because a copy is not synchronized and -force is not specified.
38194	CMMVC6357E	The command failed because the copy that is specified is not synchronized and -force is not specified.
38195	CMMVC6358E	The command failed because the copy that is specified is the only synchronized copy.
38196	CMMVC6359E	The command failed because there are insufficient online synchronized copies.
38197	CMMVC6360E	The command failed because the virtual disk (VDisk) failed to pause operations in time (timeout).
38198	CMMVC6361E	The command failed because the virtual disk (VDisk) failed to flush in time (timeout).
38199	CMMVC6362E	The command failed because the virtual disk (VDisk) failed to flush (failed flush).
38200	CMMVC6363E	The command failed because the logical block address (LBA) that is specified is not valid for this virtual disk (VDisk).
38201	CMMVC6366E	One or more nodes in the cluster has hardware that is not supported by the new software package.
38202	CMMVC6367E	A remote cluster is running software that is not compatible with the new software package. Either upgrade the remote cluster first or stop all remote copy relationships between the clusters by deleting the cluster partnership.
38203	CMMVC6368E	The new software package might not be compatible with the remote cluster. However, this check cannot be performed because the remote cluster is not accessible. Either fix the link to the remote cluster or delete the cluster partnership before performing the upgrade.
38204	CMMVC6369E	The FlashCopy storage capacity is approaching the amount that is licensed.
38205	CMMVC6370E	The RemoteCopy storage capacity is approaching the amount that is licensed.
38206	CMMVC6371E	The command failed because there is no license to use space-efficient virtual disks.
38207	CMMVC6372E	The virtualized storage capacity is approaching the amount
38208	CMMVC6373E	The virtualized storage capacity used exceeds the amount that is licensed.

Table 4. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code	Description
38209	CMMVC6374E	The FlashCopy storage capacity used exceeds the amount that is licensed.
38210	CMMVC6375E	The RemoteCopy storage capacity used exceeds the amount that is licensed.
38211	CMMVC6376E	The command failed because the space-efficient license cannot be turned off when space-efficient VDisks exist.
38212	CMMVC6289E	The command failed because the virtual disk (VDisk) is pending synchronization.
38213	CMMVC6290E	The command failed because the virtual disk (VDisk) has image mode copies, the VDisk is pending synchronization, and -force has not been specified.
38214	CMMVC6291E	The command failed because the virtual disk (VDisk) is pending synchronization and -force has not been specified.
38215	CMMVC6292E	The command failed because a repair action is in progress for the virtual disk (VDisk).
38305	CMMVC6078E	The action failed because the object is in a mode that is not valid.
38306	CMMVC5848E	The action failed because the VDisk does not exist or is being deleted.
38307	CMMVC6010E	The command not complete because there are not enough free extents.
38308	CMMVC6015E	A delete request is already in progress for this object.
38309	CMMVC5849E	The migration failed because some or all of the extents are already being migrated.
38313	CMMVC5850E	The extent cannot be migrated because there is a problem with the source extent.
38314	CMMVC5851E	The extent cannot be migrated because there is a problem with the target extent.
38315	CMMVC5852E	The migration failed because there are too many migrations in progress.
38316	CMMVC5853E	The action failed because there is a problem with the group.
38324	CMMVC5854E	The extent information cannot be returned because the extent is not used or does not exist.
38325	CMMVC5855E	The extent information cannot be returned because the MDisk is not used by any VDisks.
38326	CMMVC5856E	The action failed because the VDisk does not belong to the specified MDisk group.
38327	CMMVC5857E	The action failed because the MDisk does not exist or is not a member of the MDisk group.

Table 4. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code	Description
38328	CMMVC5858E	The action failed because the VDisk, the MDisk, or both are in the wrong mode.
38329	CMMVC5859E	The migration did not complete because an error occurred while migrating the last extent on an image-mode VDisk.
38333	CMMVC5860E	The action failed because there were not enough extents in the MDisk group.
38334	CMMVC5861E	The action failed because there were not enough extents on the MDisk.
38335	CMMVC5862E	The action failed because the VDisk is being formatted.
38336	CMMVC5863E	The migration failed because there are not enough free extents on the target MDisk.
38337	CMMVC6074E	The command failed because the extents have already been assigned.
38338	CMMVC5864E	The extent information cannot be returned because the source extent is not used.
38339	CMMVC6075E	The expand failed because the last extent is not a complete extent.
38340	CMMVC5865E	The action failed because the extent is out of range for the MDisk or VDisk that is specified.
38341	CMMVC5866E	The action failed because the extent contains internal data.
38342	CMMVC5998W	The virtualized storage capacity exceeds the amount that you are licensed to use.
38343	CMMVC6012W	The virtualized storage capacity is approaching the amount that you are licensed to use.
38344	CMMVC6076E	The command failed because the virtual disk cache is not empty. Either wait for the cache to flush or use the force flag to discard the contents of the cache.
38345	CMMVC6210E	The command failed because an I/O medium error occurred on the migrated disk.
38346	CMMVC6211E	The command failed because a migration-to-image operation is in progress.
38347	CMMVC6226E	The action was not completed because the cluster has reached the maximum number of extents in MDisk groups.
38348	CMMVC6336E	The virtual disk (VDisk) copy was not created because the grain size must be 32, 64, 128, or 256.

Table 4. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code	Description
38349	CMMVC6337E	The action failed because the warning size must be a multiple of 512 bytes.
38350	CMMVC6338E	The action failed because the warning size cannot be larger than the virtual size.
38351	CMMVC6339E	The virtual disk (VDisk) copy was not created because the virtual size is not provided.
38352	CMMVC6340E	The action failed because the value supplied for real size is not a multiple of 512 bytes.
38353	CMMVC6341E	The action failed because the virtual disk (VDisk) copy is not space efficient.
38354	CMMVC6248E	The command failed because the authorization table is full.
38355	CMMVC6249E	The command failed because the authorization record is not found or is already set to the default role.
38356	CMMVC6250E	The command failed because the authorization record is not set to the default role. Use the rmauth command to set the default role.
38357	CMMVC6251E	The command failed because the role that is specified is not found.
38358	CMMVC6252E	The command failed because the session SSH key has either been deleted or is not valid.
38359	CMMVC6253E	The command failed authorization because the session SSH key does not have the requisite role.
38360	CMMVC6254E	The command failed because the specified SSH key is not found. You just specify an admin key.
38361	CMMVC6255E	The command cannot set the authorization record to the default role. Use the rmauth command to set the default role.
38362	CMMVC6263E	The command failed because the SSH key already exists or there is a duplicate SSH key.
38370	CMMVC6342E	The virtual disk (VDisk) copy was not shrunk because its real size cannot be less than its used size.
38371	CMMVC6343E	The virtual disk (VDisk) copy was not shrunk because its real size cannot be negative.
38372	CMMVC6344E	The repair operation cannot start because the space-efficient virtual disk (VDisk) copy is already being repaired.

Table 4. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code	Description
38373	CMMVC6345E	The repair operation cannot start because the space-efficient virtual disk (VDisk) copy was created using -import but the cluster could not recognize its format.
38400	CMMVC5867E	The action failed because the worldwide port name is already assigned or is not valid.
38401	CMMVC5868E	The action failed because the object that is specified does not exist.
38402	CMMVC5869E	The host object cannot be returned because the host ID or name is not valid.
38403	CMMVC5870E	The host object cannot be deleted because an object that is specified does not exist.
38404	CMMVC5871E	The host object cannot be deleted because there are VDisk to host mappings for this host. To delete the host, you must force deletion.
38405	CMMVC5872E	The port WWPN cannot be added to the host object because an object that is specified does not exist.
38406	CMMVC5873E	The WWPN is not found.
38560	CMMVC5874E	The action failed because the host does not exist.
38561	CMMVC5875E	The action failed because the VDisk does not exist.
38562	CMMVC5876E	The VDisk to host mapping cannot be created because the maximum number of mappings has been reached.
38563	CMMVC5877E	The VDisk to host mapping cannot be created because the maximum number of SCSI LUNs has been allocated.
38564	CMMVC5878E	The VDisk to host mapping cannot be created because the VDisk is already mapped to this host.
38565	CMMVC5879E	The VDisk to host mapping cannot be created because the VDisk is already mapped to this host with this SCSI LUN.
38566	CMMVC5880E	The VDisk cannot be created because a capacity of zero bytes is not allowed for image mode VDisks.
38569	CMMVC6346E	The repair operation cannot start because the space-efficient virtual disk (VDisk) copy was created using -import with a real size that is too small.
38611	CMMVC6016E	The action has failed because there are no more MDisks in the MDisk group.

Table 4. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code	Description
38656	CMMVC5881E	The FlashCopy mapping cannot be created because an object that is specified does not exist.
38657	CMMVC5882E	The FlashCopy mapping cannot be created because a mapping for the source or target VDisk already exists.
38658	CMMVC5883E	The FlashCopy mapping cannot be created because the recovery I/O group is associated with the source or target VDisk.
38659	CMMVC5884E	The FlashCopy mapping cannot be created because the source or target VDisk cannot be a member of a Metro Mirror mapping.
38660	CMMVC5885E	The FlashCopy mapping cannot be created because the source or target VDisk cannot be a member of a FlashCopy mapping.
38661	CMMVC5886E	The FlashCopy mapping cannot be created because the source or the target VDisk is associated with a recovery I/O group.
38662	CMMVC5887E	The FlashCopy mapping cannot be created because the source or target VDisk cannot be in router mode.
38663	CMMVC5888E	The action failed because an object that is specified does not exist.
38664	CMMVC5889E	The FlashCopy mapping cannot be deleted because an object that is specified does not exist.
38665	CMMVC5890E	The FlashCopy mapping cannot be prepared because preparing consistency group 0 (zero) is not a valid operation.
38666	CMMVC5891E	The FlashCopy consistency group cannot be created because the name is not valid.
38667	CMMVC5892E	The FlashCopy consistency group cannot be created because it already exists.
38668	CMMVC5893E	The action failed because an object that is specified does not exist.
38669	CMMVC5894E	The FlashCopy consistency group cannot be deleted because you are trying to delete consistency group 0 (zero) or the name of the consistency group is not valid.
38670	CMMVC5895E	The FlashCopy consistency group cannot be deleted because it contains mappings. You must force the deletion.

Table 4. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code	Description
38816	CMMVC5896E	The FlashCopy mapping cannot be deleted because the mapping or consistency group is in the preparing state. You must first stop the mapping or consistency group and reissue the command.
38817	CMMVC5897E	The FlashCopy mapping cannot be deleted because the mapping or consistency group is in the prepared state. You must first stop the mapping or consistency group and reissue the command.
38818	CMMVC5898E	The FlashCopy mapping cannot be deleted because the mapping or consistency group is in the copying state. You must first stop the mapping or consistency group and reissue the command.
38819	CMMVC5899E	The FlashCopy mapping cannot be deleted because the mapping or consistency group is in the active state. You must first stop the mapping or consistency group and reissue the command with the force parameter.
38820	CMMVC5900E	The FlashCopy mapping cannot be deleted because the mapping or consistency group is in the suspended state. You must first stop the mapping or consistency group and reissue the command.
38821	CMMVC5901E	The FlashCopy mapping cannot be prepared because the mapping or consistency group is already in the preparing state.
38822	CMMVC5902E	The FlashCopy mapping cannot be prepared because the mapping or consistency group is already in the prepared state.
38823	CMMVC5903E	The FlashCopy mapping cannot be prepared because the mapping or consistency group is already in the copying state.
38824	CMMVC5904E	The FlashCopy mapping cannot be prepared because the mapping or consistency group is already in the suspended state.
38825	CMMVC5905E	The FlashCopy mapping or the consistency group cannot be started because the mapping or consistency group is in the idle state. The mapping or consistency group must first be prepared.

Table 4. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code	Description
38826	CMMVC5906E	The FlashCopy mapping or the consistency group cannot be started because the mapping or consistency group is in the preparing state.
38827	CMMVC5907E	The FlashCopy mapping or the consistency group cannot be started because the mapping or consistency group is in the copying state.
38828	CMMVC5908E	The FlashCopy mapping or the consistency group cannot be started because the mapping or consistency group is in the stopped state. The mapping or consistency group must first be prepared.
38829	CMMVC5909E	The FlashCopy mapping or the consistency group cannot be started because the mapping or consistency group is in the suspended state.
38830	CMMVC5910E	The FlashCopy mapping or the consistency group cannot be stopped because the mapping or consistency group is in the idle state.
38831	CMMVC5911E	The FlashCopy mapping or the consistency group cannot be stopped because the mapping or consistency group is in the preparing state.
38832	CMMVC5912E	The FlashCopy mapping or the consistency group cannot be stopped because the mapping or consistency group is in the stopped state.
38833	CMMVC5913E	The properties of the FlashCopy mapping cannot be modified because the mapping or consistency group is in the preparing state.
38834	CMMVC5914E	The properties of the FlashCopy mapping cannot be modified because the mapping or consistency group is in the prepared state.
38835	CMMVC5915E	The properties of the FlashCopy mapping cannot be modified because the mapping or consistency group is in the copying state.
38836	CMMVC5916E	The properties of the FlashCopy mapping cannot be modified because the mapping or consistency group is in the suspended state.
38837	CMMVC5917E	The FlashCopy mapping cannot be created because there is no memory to create the bitmap.
38838	CMMVC5918E	The FlashCopy mapping cannot be prepared because the I/O group is offline.

Table 4. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code	Description
38839	CMMVC5919E	The FlashCopy mapping or consistency group cannot be started because the I/O group is offline.
38840	CMMVC5920E	The FlashCopy mapping cannot be created because the consistency group is not idle.
38841	CMMVC5921E	The properties of the FlashCopy mapping cannot be modified because the consistency group is not idle.
38842	CMMVC5922E	The FlashCopy mapping cannot be created because the destination VDisk is too small.
38843	CMMVC5923E	The FlashCopy mapping cannot be created because the I/O group is offline.
38844	CMMVC5924E	The FlashCopy mapping cannot be created because the source and target VDisks are different sizes.
38845	CMMVC5999W	Featurization for this facility has not been enabled.
38846	CMMVC6209	The FlashCopy mapping or consistency group cannot be started in a reasonable time. Instead, the mapping or consistency group is being prepared.
38849	CMMVC6215E	The FlashCopy mapping cannot be created or modified because the consistency group already contains the maximum number of mappings.
38850	CMMVC6316E	The FlashCopy mapping or consistency group could not be started because a source VDisk is the target of another FlashCopy mapping that is keeping the VDisk inaccessible.
38851	CMMVC6318E	The FlashCopy mapping could not be deleted because the source VDisk is required by other maps.
38855	CMMVC6288E	The command failed because the e-mail settings have not been configured.
38858	CMMVC6006E	The MDisk cannot be deleted because the resource is busy.
38859	CMMVC6001E	The FlashCopy consistency group cannot be started because there are no FlashCopy mappings in the consistency group.
38860	CMMVC5990E	The FlashCopy consistency group cannot be stopped because there are no FlashCopy mappings in the consistency group.
38861	CMMVC5991E	The Metro Mirror consistency group cannot be started because there are no Metro Mirror relationships in the group.

Table 4. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code	Description
38862	CMMVC5992E	The Metro Mirror consistency group cannot be stopped because there are no Metro Mirror relationships in the group.
38912	CMMVC5925E	The remote cluster partnership cannot be created because the partnership already exists.
38913	CMMVC5926E	The remote cluster partnership cannot be created because there are too many partnerships.
38914	CMMVC5927E	The action failed because the cluster ID is not valid.
38915	CMMVC5928E	The action failed because the cluster name already exists for another cluster.
38916	CMMVC5929E	The Metro Mirror partnership cannot be deleted because the partnership has already been deleted.
38917	CMMVC5930E	The Metro Mirror relationship cannot be created because an object that is specified does not exist.
38918	CMMVC5931E	The Metro Mirror relationship cannot be created because the master VDisk or the auxiliary VDisk is locked.
38919	CMMVC5932E	The Metro Mirror relationship cannot be created because the master VDisk or the auxiliary VDisk is a member of a FlashCopy mapping.
38920	CMMVC5933E	The Metro Mirror relationship cannot be created because the master VDisk or the auxiliary VDisk is in the recovery I/O group.
38921	CMMVC5934E	The Metro Mirror relationship cannot be created because the master VDisk or the auxiliary VDisk is in the router mode.
38922	CMMVC5935E	The action failed because an object that is specified does not exist.
38923	CMMVC5936E	The action failed because an object that is specified does not exist.
38924	CMMVC5937E	The action failed because an object that is specified does not exist.
38925	CMMVC5938E	The Metro Mirror consistency group cannot be deleted because the consistency group contains relationships. You just specify the force parameter.
38926	CMMVC6216E	The Metro Mirror relationship cannot be created because the master VDisk or the auxiliary VDisk is a member of a Metro Mirror mapping.
39072	CMMVC5939E	The action failed because the cluster is not in the stable state.

Table 4. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code	Description
39073	CMMVC5940E	The cluster that contains the auxiliary VDisk is unknown.
39074	CMMVC5941E	The cluster that contains the master VDisk has too many consistency groups.
39075	CMMVC5942E	The cluster that contains the auxiliary VDisk has to many consistency groups.
39076	CMMVC5943E	The relationship that is specific is not valid.
39077	CMMVC5944E	The consistency group that is specified is not valid.
39078	CMMVC5945E	The master cluster that is specified is not valid.
39079	CMMVC5946E	The auxiliary cluster that is specified is not valid.
39080	CMMVC5947E	The master VDisk that is specified is not valid.
39081	CMMVC5948E	The auxiliary VDisk that is specified is not valid.
39082	CMMVC5949E	The relationship that is specified is not known.
39083	CMMVC5950E	The consistency group that is specified is not known.
39084	CMMVC5951E	The operation cannot be performed because the relationship is not stand-alone.
39085	CMMVC5952E	The relationship and the consistency group have different master clusters.
39086	CMMVC5953E	The relationship and the consistency group have different auxiliary clusters.
39087	CMMVC5954E	The master and the auxiliary VDisks are different sizes.
39088	CMMVC5955E	The maximum number of relationships has been reached.
39089	CMMVC5956E	The maximum number of consistency groups has been reached.
39090	CMMVC5957E	The master VDisks is already in a relationship.
39091	CMMVC5958E	The auxiliary VDisk is already in a relationship.
39092	CMMVC5959E	There is a relationship that already uses this name on the master cluster.
39093	CMMVC5960E	There is a relationship that already uses this name on the auxiliary cluster.
39094	CMMVC5961E	There is a consistency group that already uses this name on the master cluster.
39095	CMMVC5962E	There is a consistency group that already uses this name on the auxiliary cluster.

Table 4. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code	Description
39096	CMMVC5963E	The direction is not defined.
39097	CMMVC5964E	The copy priority is not valid.
39098	CMMVC5965E	The VDisks are in different I/O groups on the local cluster.
39099	CMMVC5966E	The master VDisk is not known.
39100	CMMVC5967E	The auxiliary VDisk is not known.
39101	CMMVC5968E	The relationship cannot be added because the state of the relationship and the state of the consistency group do not match.
39102	CMMVC5969E	The Metro Mirror relationship cannot be created because the I/O group is offline.
39103	CMMVC5970E	The Metro Mirror relationship cannot be created because there is not enough memory.
39104	CMMVC5971E	The operation cannot be performed because the consistency group does not contain any relationships.
39105	CMMVC5972E	The operation cannot be performed because the consistency group contains relationships.
39106	CMMVC5973E	The operation cannot be performed because the consistency group is not synchronized.
39107	CMMVC5974E	The operation cannot be performed because the consistency group is offline.
39108	CMMVC5975E	The operation cannot be performed because the cluster partnership is not connected.
39109	CMMVC5976E	The operation cannot be performed because the consistency group is in the freezing state.
39110	CMMVC5977E	The operation cannot be performed because the operation is not valid in the current state of the consistency group.
39111	CMMVC5978E	The operation cannot be performed because the relationship is not synchronized.
39112	CMMVC5989E	The operation cannot be performed because the relationship is offline.
39113	CMMVC5980E	The operation cannot be performed because the master and the auxiliary clusters are not connected.
39114	CMMVC5981E	The operation cannot be performed because the relationship is in the freezing state.

Table 4. CIM return codes and corresponding CLI error codes (continued)

CIM return code	SAN Volume Controller CLI error code	Description
39115	CMMVC5982E	The operation cannot be performed because the operation is not valid in the current state of the relationship.
39118	CMMVC6202E	The cluster cannot be modified because the IP address is not valid.
39425	CMMVC5983E	The dump file cannot be created. The file system might be full.
39246	CMMVC5984E	The dump file cannot be written to disk. The file system might be full.
39427	CMMVC5985E	The directory that was specified was not one of the permitted directories.
39429	CMMVC5986E	The tracing of I/O operations cannot be started because the VDisk or MDisk failed to return any statistics.
39430	CMMVC6030E	The operation cannot be performed because the FlashCopy mapping is part of a consistency group. The action must be performed at the consistency group level.
39431	CMMVC6031E	The operation cannot be performed because the FlashCopy consistency group is empty.
39432	CMMVC6032E	The operation cannot be performed because one or more of the entered parameters is not valid for this operation.
39690	CMMVC5890E	The FlashCopy mapping or consistency group cannot be started because you cannot start consistency group 0 (zero).
39691	CMMVC6005E	The view request has filed because the specified object is not a member of an appropriate group.
39692	CMMVC5890E	The FlashCopy mapping or consistency group cannot be stopped because you cannot start consistency group 0 (zero).

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 readers have been tested: WebKing v5.5 and Window-Eyes v5.5.
- You can operate all features using the keyboard instead of the mouse.
- You can change the initial delay and repeat rate of the up and down buttons to two seconds when you use the front panel of the SAN Volume Controller to set or change an IPv4 address. This feature is documented in the applicable sections of the SAN Volume Controller publications.

Navigating by keyboard

You can use keys or key combinations to perform operations and initiate many menu actions that can also be done through mouse actions. You can navigate the SAN Volume Controller Console and help system from the keyboard by using the following key combinations:
- To traverse to the next link, button, or topic, press Tab inside a frame (page).
- To expand or collapse a tree node, press → or ←, respectively.
- To move to the next topic node, press V or Tab.
- To move to the previous topic node, press ^ or Shift+Tab.
- To scroll all the way up or down, press Home or End, respectively.
- To go back, press Alt+←.
- To go forward, press Alt+→.
- To go to the next frame, press Ctrl+Tab.
- To move to the previous frame, press Shift+Ctrl+Tab.
- To print the current page or active frame, press Ctrl+P.
- To select, press Enter.

Accessing the publications

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

http://www.ibm.com/storage/support/2145

Related reference

"SAN Volume Controller library and related publications" on page ix
A list of other publications that are related to this product are provided to you for your reference.

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Glossary

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

This glossary includes selected terms and definitions from A Dictionary of Storage Networking Terminology (http://www.snia.org/education/dictionary), copyrighted 2001 by the Storage Networking Industry Association, 2570 West El Camino Real, Suite 304, Mountain View, California 94040-1313. Definitions derived from this book have the symbol (S) after the definition.

The following cross-references are used in this glossary:

See   Refers the reader to one of two kinds of related information:
- A term that is the expanded form of an abbreviation or acronym. This expanded form of the term contains the full definition.
- A synonym or more preferred term.

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

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

Numerics

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

A

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

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

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

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

ARP   See *Address Resolution Protocol*.

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

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

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

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

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

B

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

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

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

block A unit of data storage on a disk drive.

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

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

C

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

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

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

CIM See *Common Information Model*.

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

CIMOM
See *CIM object manager*.

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

CLI See *command line interface*.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

D

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

DMP See *directed maintenance procedures*.

DMTF See *Distributed Management Task Force*.

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

DRAM See *dynamic random access memory*.

DWDM
See *dense wavelength division multiplexing*.

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

E

EC See *engineering change.*

EIA See *Electronic Industries Alliance*.

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

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

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

error code
A value that identifies an error condition.

ESS See *IBM TotalStorage Enterprise Storage Server®*.

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

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

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

F

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

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

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

FCIP See *Fibre Channel over IP*.

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

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

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

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

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

FlashCopy mapping
A relationship between two virtual disks.

FlashCopy relationship
See *FlashCopy mapping*.

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

F_port
See *fabric port*.

FRU See *field replaceable unit*.

G

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

GB See *gigabyte*.

GBIC See *gigabit interface converter*.

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

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

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

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

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

GUI See *graphical user interface*.

H

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

HBA See *host bus adapter*.

HLUN See *virtual disk*.

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

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

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

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

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

hub A fibre-channel device that connects nodes into a logical loop by using a physical star topology. Hubs will automatically recognize an active node and insert the node into the loop. A node that fails or is powered off is automatically removed from the loop.

A communications infrastructure device to which nodes on a multi-point bus or loop are physically connected. Commonly used in Ethernet and fibre-channel networks to improve the manageability of physical cables. Hubs maintain the logical loop topology of the network of which they are a part, while creating a "hub and spoke" physical star layout. Unlike switches,

hubs do not aggregate bandwidth. Hubs typically support the addition or removal of nodes from the bus while it is operating. (S) Contrast with *switch*.

I

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

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

ID See *identifier*.

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

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

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

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

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

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

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

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

IML See *initial microcode load*.

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

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

inconsistent-stopped state. This state also occurs when a **start** command is issued, with the force option, to a consistency group that is in the idling or consistent-stopped state.

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

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

indication
An object representation of an event.

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

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

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

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

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

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

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

I/O   See *input/output.*

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

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

IP See *Internet Protocol*.

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

ISL See *interswitch link*.

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

J

JBOD (just a bunch of disks)
> IBM definition: See *non-RAID*.
>
> HP definition: A group of single-device logical units not configured into any other container type.

L

LBA See *logical block address*.

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

line card
> See *blade*.

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

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

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

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

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

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

LRC See *longitudinal redundancy check*.

LRU See *least recently used*.

LU See *logical unit*.

LUN See *logical unit number*.

LUN masking

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

M

managed disk (MDisk)

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

managed disk group

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

managed space mode

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

Management Information Base (MIB)

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

mapping

See *FlashCopy mapping*.

master console

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

master virtual disk

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

MB See *megabyte*.

MDisk See *managed disk*.

megabyte (MB)

In decimal notation, 1 048 576 bytes.

mesh configuration

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

method

A way to implement a function on a class.

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

MIB See *Management Information Base*.

migration
> See *data migration*.

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

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

N

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

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

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

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

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

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

N_port
> See *node port*.

O

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

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

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

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

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

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

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

overallocated volume
See *space-efficient virtual disk*.

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

P

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

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

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

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

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

pend To cause to wait for an event.

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

PDU See *power distribution unit*.

PLUN See *managed disk*.

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

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

port ID
> An identifier associated with a port.

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

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

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

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

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

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

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

Q

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

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

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

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

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

R

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

RAID See *redundant array of independent disks*.

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

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

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

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

HP definition: See *mirrorset*.

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

IBM definition: See the SNIA definition.

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

RAID 10
A type of RAID that optimizes high performance while maintaining fault tolerance for up to two failed disk drives by striping volume data across several disk drives and mirroring the first set of disk drives on an identical set.

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

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

redundant array of independent disks (RAID)
A collection of two or more disk drives that present the image of a single

disk drive to the system. In the event of a single device failure, the data can be read or regenerated from the other disk drives in the array.

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

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

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

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

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

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

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

S

SAN See *storage area network.*

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

SATA See *Serial Advanced Technology Attachment.*

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

SCSI See *Small Computer Systems Interface.*

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

SCSI front-end layer
The layer in a Small Computer Systems Interface (SCSI) network that

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

SDD See *subsystem device driver (SDD)*.

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

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

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

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

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

Serial ATA
See *Serial Advanced Technology Attachment*.

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

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

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

Simple Mail Transfer Protocol (SMTP)
An Internet application protocol for transferring mail among users of the Internet. SMTP specifies the mail exchange sequences and message format. It assumes that the Transmission Control Protocol (TCP) is the underlying protocol.

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

SLP See *Service Location Protocol*.

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

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

SMI-S See *Storage Management Initiative Specification*.

SMTP See *Simple Mail Transfer Protocol*.

SNIA See *Storage Networking Industry Association*.

SNMP See *Simple Network Management Protocol*.

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

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

SSH See *Secure Shell*.

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

SSL See *Secure Sockets Layer*.

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

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

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

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

Storage Management Initiative Specification (SMI-S)
A design specification developed by the Storage Networking Industry Association (SNIA) that specifies a secure and reliable interface that allows storage management systems to identify, classify, monitor, and control physical and logical resources in a storage area network. The interface is intended as a solution that integrates the various devices to be managed in a storage area network (SAN) and the tools used to manage them.

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

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

stripeset
See *RAID 0*.

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

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

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

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

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

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

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

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

T

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

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

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

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

U

UID   See *unique identifier*.

unconfigured mode

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

uninterruptible power supply

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

unique identifier (UID)

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

unmanaged

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

V

valid configuration

A configuration that is supported.

VDisk See *virtual disk (VDisk)*.

VDisk copy

See *virtual disk copy*.

virtual capacity

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

virtual disk copy

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

virtual disk (VDisk)

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

virtualization

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

virtualized storage

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

virtual storage area network (VSAN)

A fabric within the SAN.

vital product data (VPD)

Information that uniquely defines system, hardware, software, and microcode elements of a processing system.

VLUN See *managed disk*.

VPD See *vital product data*.

VSAN See *virtual storage area network*.

W

WBEM
See *Web-Based Enterprise Management*.

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

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

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

WWNN
See *worldwide node name*.

WWPN
See *worldwide port name*.

Z

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

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