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Service Pack 4

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Preface	xi
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Chapter 1 EMC ControlCenter Introduction

What Is EMC ControlCenter?	1-2
Open Integration Components	1-3
Storage Resource Management Solutions	1-6
Supporting Multiple Vendors	1-8
Hosts.....	1-10
Storage Arrays.....	1-11
SAN Managed Objects	1-11
Standards	1-12
Frameworks.....	1-12

Chapter 2 ControlCenter Architecture

Introduction	2-2
User Interfaces	2-4
Console.....	2-4
Web Console	2-5
StorageScope	2-6
Performance Manager.....	2-7
ECC Server	2-10
Repository	2-11
How ControlCenter Models the Storage Environment.....	2-11
Store	2-13
Agents.....	2-14
What Do Agents Do?.....	2-14
Application Programming Interfaces	2-19
Enterprise Framework Environments	2-20

Implementing EMC ControlCenter.....	2-23
Installation	2-26
Scalability.....	2-26
Upgrade	2-27
Migration	2-27
Troubleshooting Help	2-28
Log Utility.....	2-29

Chapter 3 ControlCenter Common Services

Common Console Services.....	3-2
Administration Services	3-2
Console Views	3-2
Security Management	3-3
Logging In	3-3
User Administration	3-4
Initial User Groups and Rules	3-5
Permissions.....	3-5
Agent Configuration	3-8
Setting Up Data Collection Policies	3-9
Creating Alert Definitions	3-9
Common Console Views	3-10
Topology	3-10
Relationship.....	3-13
Properties	3-15
Performance	3-16
Alerts	3-17

Chapter 4 EMC ControlCenter Applications

ControlCenter Applications	4-2
Planning and Provisioning.....	4-3
SAN Manager.....	4-3
SAN Advisor	4-10
Automated Resource Manager.....	4-12
Monitoring and Reporting	4-22
StorageScope	4-22
StorageScope File Level Reporter.....	4-25
Performance Manager.....	4-27

Storage Device Management 4-29

 Array Managers 4-32

 Navisphere 4-34

 Symmetrix Manager 4-34

 Symmetrix Optimizer 4-43

Launching Open-Source Applications 4-45

What’s Next? 4-46

Index i-1

Figures

1-1	ControlCenter Console Relationship View	1-5
1-2	Connectivity Devices Folder	1-9
2-1	ControlCenter Architecture	2-3
2-2	Performance Manager in the ControlCenter Architecture	2-9
2-3	Integration Packages in the ControlCenter Architecture	2-21
2-4	Example Data Center Environment	2-25
3-1	At A Glance View	3-4
3-2	Properties View of Rules	3-6
3-3	Command History View	3-7
3-4	Agent Menu	3-8
3-5	Console Toolbar	3-10
3-6	Topology View of Fabrics	3-11
3-7	Relationship View of Hosts	3-14
3-8	Properties Views for Selected Objects	3-15
3-9	Performance View for Selected Storage Devices	3-16
3-10	At A Glance Notifications Information	3-18
4-1	Search for Connectivity Devices Dialog Box	4-4
4-2	Switch Identification Dialog Box	4-6
4-3	Path Details View for the Selected Storage Array Masking	4-9
4-4	Free Space View from a Host Perspective	4-15
4-5	Nested Storage Pools	4-16
4-6	Storage Provisioning Service Dialog Box	4-18
4-7	Monitoring Host Objects	4-21
4-8	Selecting a Report	4-23
4-9	StorageScope Home Page	4-24
4-10	StorageScope File Level Reporter	4-26
4-11	Performance Manager View	4-28
4-12	Visual Storage View of a CLARiiON System	4-33
4-13	Visual Storage View of a Symmetrix System	4-37

4-14 TimeFinder View 4-39

4-15 SRDF View 4-41

Tables

2-1	Data Collection Policies	2-15
2-2	Alert Metrics	2-17
4-1	Array Functionality	4-30
4-2	Storage Array Management	4-31

As part of an effort to improve and enhance the performance and capabilities of its product line, EMC from time to time releases revisions of its hardware and software. Therefore, some functions described in this guide may not be supported by all revisions of the software or hardware currently in use. For the most up-to-date information on product features, refer to your product release notes.

If a product does not function properly or does not function as described in this guide, please contact your EMC representative.

Audience

This guide is part of the EMC ControlCenter documentation set. It is intended to be read first and gives an introduction to EMC ControlCenter capabilities, gives an overview of the architecture, and describes the functionality.

Readers of this guide are expected to be familiar with these topics:

- ◆ Storage array operation
- ◆ Host operating environments

Organization

Here is an overview of where information is located in this guide.

Chapter 1, *EMC ControlCenter Introduction*, introduces EMC ControlCenter and the storage management solutions that it supports.

Chapter 2, *ControlCenter Architecture*, describes the architecture of EMC ControlCenter and how it could be deployed in your organization.

Chapter 3, *ControlCenter Common Services*, describes the common services provided by Open Integration Components.

Chapter 4, *EMC ControlCenter Applications*, describes the capabilities provided by applications available with ControlCenter.

Related Documentation

You can access ControlCenter publications from the:

- ◆ *Documentation /Help* CD (provided with your EMC ControlCenter installation kit)
- ◆ ControlCenter Documentation Library (available from the ControlCenter Console Help menu)
- ◆ EMC Powerlink Documentation Library (<http://powerlink.emc.com>)

Conventions Used in this Guide

EMC uses the following conventions for notes and cautions.

A note presents information that is important, but not hazard-related.

Typographical Conventions

EMC uses the following type style conventions in this guide:

AVANT GARDE	Keystrokes
Palatino, bold	◆ Dialog box, button, icon, and menu items in text ◆ Selections you can make from the user interface, including buttons, icons, options, and field names
<i>Palatino, italic</i>	◆ New terms or unique word usage in text ◆ Command line arguments when used in text ◆ Book titles
<i>Courier, italic</i>	Arguments used in examples of command line syntax.
Courier	System prompts and displays and specific filenames or complete paths. For example: c:\ecc
Courier, bold	◆ User entry. For example: mkdir /cdrom ◆ Options in command line syntax

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For additional information on the EMC products and services available to customers and partners, refer to the EMC Powerlink website at:

<http://powerlink.emc.com>

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EMC ControlCenter Introduction

This chapter introduces the EMC ControlCenter product and the storage management solutions that it supports.

- ◆ What Is EMC ControlCenter?.....1-2
- ◆ Open Integration Components1-3
- ◆ Storage Resource Management Solutions1-6
- ◆ Supporting Multiple Vendors1-8

What Is EMC ControlCenter?

Today, companies are storing ever-increasing amounts of information. As storage area networks (SANs) become more complex, and storage devices grow in number and size, companies are faced with the challenge of effectively managing their storage.

EMC ControlCenter™ is a family of products that provides you with an integrated approach to managing your multivendor storage environment, and automating many of your common storage management tasks.

The ControlCenter base product is comprised of Open Integration Components (OIC). Several other ControlCenter plug-in products are available. The ControlCenter products you choose depend on the Storage Resource Management (SRM) solutions you want to implement.

This chapter introduces you to ControlCenter OICs and SRM solutions.

This document contains many references to supporting publications, which can be accessed from any of the following:

Documentation /Help CD provided with your EMC ControlCenter installation kit

EMC Powerlink™ (<http://powerlink.emc.com>)

ControlCenter Documentation Library, which is available from the ControlCenter Console's help menu after installation.

Open Integration Components

At the heart of ControlCenter is a common foundation and infrastructure, which provides scalability, usability, and information sharing across all ControlCenter applications. An embedded database stores and shares information about each object being managed. Common services, part of OIC, discover, correlate, and map relationships between objects.

This design enables ControlCenter applications, such as Symmetrix® Manager and Performance Manager, to span storage array, storage network, and host management functions.

OIC components include:

- ◆ User interfaces
 - Console
 - Web Console
- ◆ Infrastructure
 - ECC Server
 - Repository
 - Store
- ◆ Agents
 - Host agents for Solaris, HP-UX, AIX, Linux, and Windows
 - Common Mapping Agent
 - Database Agent for Oracle
 - Database Agent for DB2
 - Integration Gateway Agent
 - Physical agent for z/OS
 - Storage Agent for SMI

- ◆ Common services

Common services span across all ControlCenter applications providing you with simple access to various tasks and to the various views of your SAN and the objects in it. These common services allow you to discover and monitor objects in your SAN. For example; you can map the relationship of storage structures from databases and file systems through to their logical and physical location within the storage array. Common services also provides you with information such as the status of your environment, high-level perspective on performance, capacity, and health.

Common services include:

- Administration services
 - Security management
 - Agent configuration
- Console views include:
 - Topology view
 - Relationship view
 - Properties view
 - Performance view
 - Alerts view
 - Command History

From a single console, you can discover, monitor, plan, provision, and report on networks, host resources, and storage resources across your entire SAN. Your resources appear as objects in the ControlCenter Console.

Figure 1-1 shows host information within a table and a pictorial rendering as it might appear in the Console Relationship view.

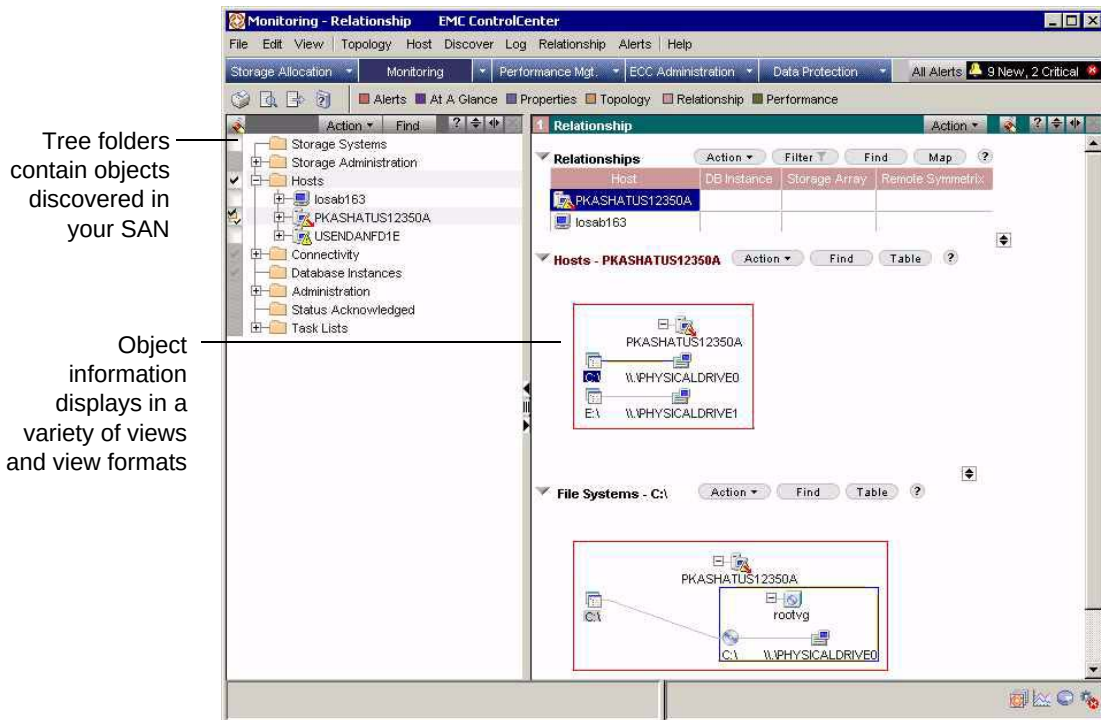


Figure 1-1 ControlCenter Console Relationship View

Chapter 2, *ControlCenter Architecture*, provides additional information on ControlCenter user interfaces, infrastructure components, and agents.

Storage Resource Management Solutions

In addition to the base functionality provided by OIC, several other ControlCenter products are available. ControlCenter product packaging is based on the storage resource management (SRM) solutions that follow.

SRM Planning and Provisioning

The planning and provisioning solution allows you to design, plan, and provision a multivendor storage infrastructure for the benefit of improving the utilization, performance, and cost effectiveness of your storage assets. It also allows you to quickly recognize, isolate, and respond to storage issues from a single console.

This solution is achieved using the following ControlCenter applications:

- ◆ SAN Manager™
- ◆ SAN Advisor™
- ◆ Automated Resource Manager™

SRM Monitoring and Reporting

The monitoring and reporting solution allows you to effectively utilize your storage assets, manage inventory, and assess how your storage is performing.

This solution is achieved using the following ControlCenter applications:

- ◆ Performance Manager
- ◆ StorageScope™
- ◆ StorageScope File Level Reporter

SRM Storage Device Management

The storage device management solution allows you to actively configure and optimize storage arrays.

This solution is achieved using the following ControlCenter applications:

- ◆ Navisphere® Manager
- ◆ Symmetrix Manager
- ◆ Symmetrix Optimizer

Refer to Chapter 4, *EMC ControlCenter Applications* for more SRM product information.

Supporting Multiple Vendors

ControlCenter is designed for use in a heterogeneous environment of multi-vendor storage networks, storage hosts, and storage resources. Information can reside on technologically disparate devices running a variety of operating systems, in geographically diverse locations.

After installing the ControlCenter infrastructure, Console, and required agents, objects that are discovered in your environment appear in Console tree folders. The main folders are organized as follows:

- ◆ Storage Systems
- ◆ Storage Administration
- ◆ Hosts
- ◆ Connectivity
- ◆ Database Instances
- ◆ Administration
- ◆ Zoning Policies
- ◆ Status Acknowledged
- ◆ Task Lists

Figure 1-2 shows how connectivity devices are organized in the Connectivity folder.

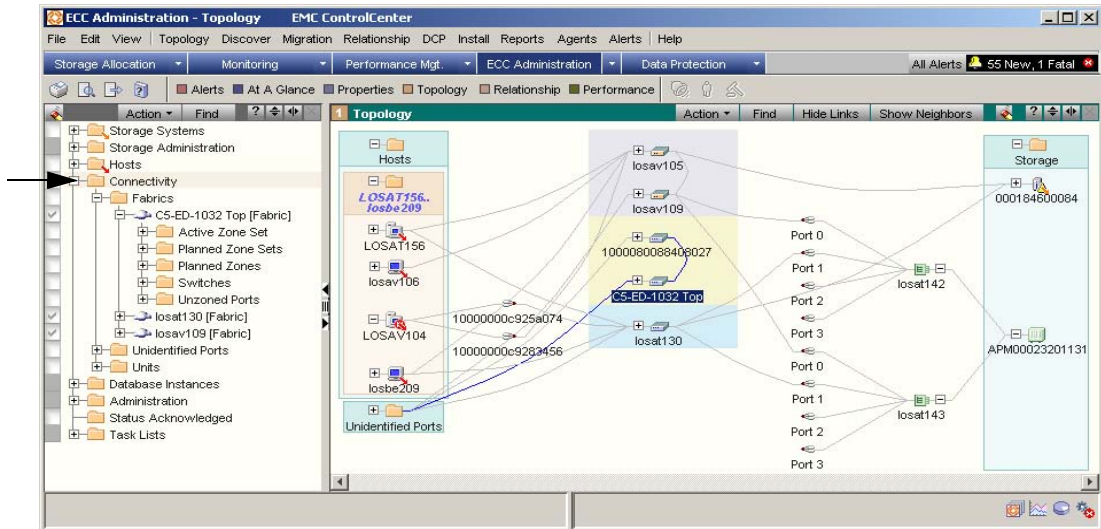


Figure 1-2 Connectivity Devices Folder

To learn more about folders in the Console tree panel, refer to the *EMC ControlCenter Online Help*, which is available from the Console Help menu.

This section identifies the objects that appear in the Console and are supported by ControlCenter.

Refer to the *EMC ControlCenter Support Matrix*, for all supported models and version numbers.

Hosts

The Hosts folder contains information relating to hosts discovered in your SAN.

ControlCenter supports the following host platforms:

- ◆ Windows 2000, Windows 2003 (.net)
- ◆ SUN Solaris, HP-UX, AIX, Tru64
- ◆ z/OS ¹
- ◆ Novell
- ◆ Linux

Host Applications

The following host applications are also supported:

- ◆ Solstice DiskSuite
- ◆ Databases:
 - Oracle
 - Informix
 - Sybase
 - SQL Server
 - DB2
- ◆ Backup applications
 - IBM Tivoli Storage Manager
 - VERITAS NetBackup
 - LEGATO® NetWorker backup applications
 - EMC EDM

1. z/OS is the naming convention used in this document to refer to the MVS, OS390, and z/OS operating systems.

Storage Arrays

The Storage Systems folder contains information about storage arrays discovered in your SAN.

ControlCenter supports the following storage arrays:

- ◆ EMC Symmetrix
- ◆ EMC CLARiiON®
- ◆ EMC Celerra
- ◆ EMC Centera
- ◆ HP StorageWorks HSG80
- ◆ HP XP (StorageWorks XP)
- ◆ HDS/SUN
- ◆ Other SMI Arrays
 - IBM Enterprise Storage Server (ESS)
 - Internal disks (JBOD)
 - Hitachi and OEM versions of HDS Storage Arrays

SAN Managed Objects

ControlCenter supports the following devices:

- ◆ SAN connectivity devices
 - Brocade
 - McDATA/Connectrix™
 - Cisco
 - Computer Network Technology Corp. (CNT)
- ◆ NAS devices
 - EMC Celerra

- ◆ Volume Managers
 - HP Tru64 LSM
 - HP LVM
 - HP/VERITAS VxVM
 - IBM AIX LVM
 - Solaris/VERITAS VxVM
- ◆ Windows 2000 LDM
- ◆ EMC PowerPath® VM

Refer to the *EMC ControlCenter Planning and Installation Guide, Volume 1 and Volume 2*, for details on installing the ControlCenter infrastructure, Console, agents, and discovery, and the *EMC ControlCenter Administration/User Guide*, for details on managing users and data collection.

Standards

ControlCenter supports Storage Management Initiative Standards (SMI-S 1.0.2).

Frameworks

ControlCenter supports the following open-source management frameworks applications:

- ◆ CA Unicenter
- ◆ HP Openview
- ◆ Micromuse
- ◆ Tivoli Netview
- ◆ Microsoft MOM
- ◆ Any SNMP-based application
- ◆ BMC Patrol

This chapter describes the architecture of EMC ControlCenter and how components are deployed in a real-life configuration.

◆ Introduction	2-2
◆ User Interfaces	2-4
◆ ECC Server	2-10
◆ Repository	2-11
◆ Store	2-13
◆ Agents	2-14
◆ Implementing EMC ControlCenter	2-23

Introduction

This chapter introduces you to the components in the ControlCenter architecture, as well as additional product components that you may choose to include in your ControlCenter implementation.

The ControlCenter architecture includes three basic tiers (Figure 2-1):

- ◆ User interfaces
- ◆ Infrastructure components
- ◆ Agents in your network

Figure 2-1 illustrates a single-host configuration and the ControlCenter components that reside in each tier.

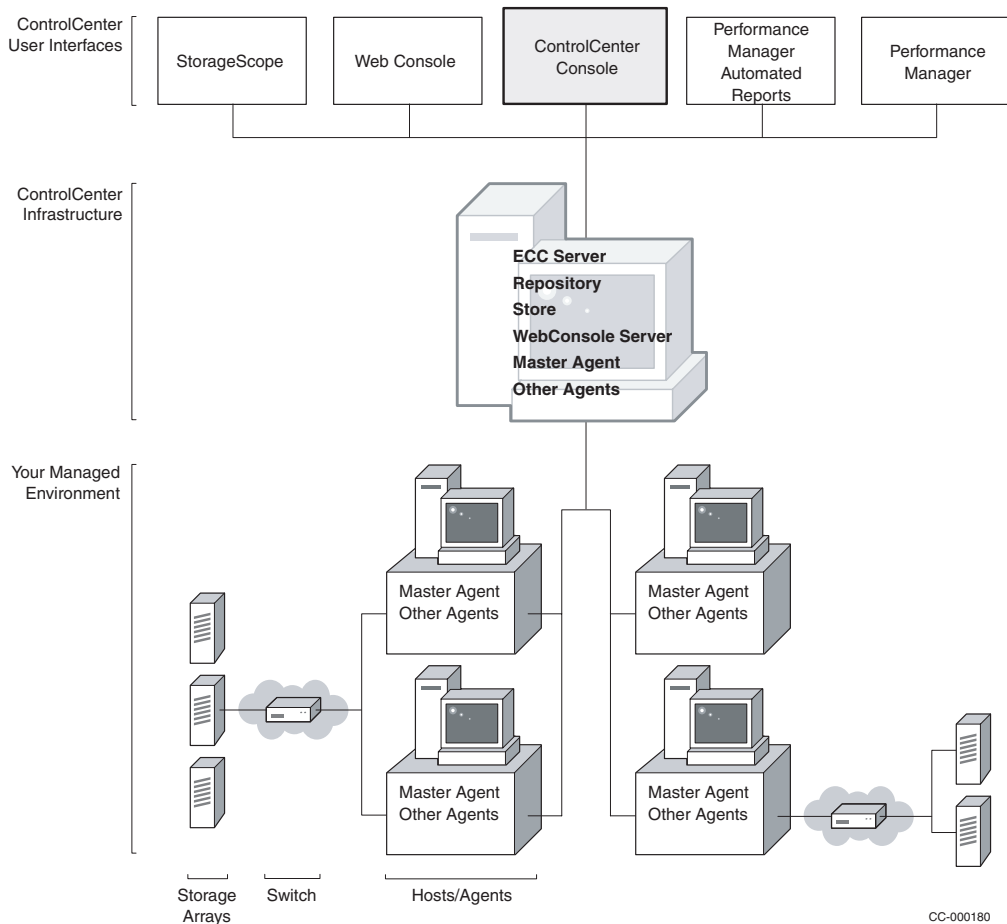


Figure 2-1 ControlCenter Architecture

For examples of additional ControlCenter configuration options, refer to the *EMC ControlCenter Planning and Installation Guide, Volume 1*.

User Interfaces

The following user interfaces can be used with ControlCenter:

- ◆ Console (primary interface)
- ◆ Web Console (local and remote access interface)
- ◆ StorageScope (reporting interface)
- ◆ Performance Manager (analysis interface)

Although the primary user interface to ControlCenter is through the Console application, an SNMP-based Integration Gateway allows framework applications such as CA Unicenter to retrieve details of ControlCenter alerts and events. Refer to *Enterprise Framework Environments* on page 2-20 for more information.

Console

The Console is the primary ControlCenter user interface. System and storage administrators use the Console to view, manage, configure, and report on storage area network components (managed objects).

Multiple Consoles can exist within a single ControlCenter implementation.

The Console is a Java-based application that is installed through either the Microsoft Internet Explorer or Netscape browser. It launches from a desktop icon or from the command line.

ControlCenter applications are implemented as plug-ins to the Console and use the common collection of services provided by the ECC Server.

For an object to be displayed in the Console, it must first be *discovered* by an agent. Once discovered, the object appears in the Console, grouped into its appropriate folder, such as Storage Systems, Hosts, or Connectivity.

Information about the object can be retrieved by the Console from the Repository or in real-time directly from the agent. Information about the object is presented in Console views.

Any Console command that is issued for an object is passed from the Console to the ECC Server, and then forwarded to the appropriate agent to act on.

When to Use the Console

Use the Console when you:

- ◆ Are working within the ControlCenter environment (although you can also access the Console using applications like Terminal Services or Citrix from outside the environment)
- ◆ Want to view, manage, provision, configure, or report on your SAN

Console Functions

You can perform all functions necessary for:

- ◆ Storage allocation
- ◆ Monitoring
- ◆ Performance management
- ◆ Administration maintenance
- ◆ Data protection
- ◆ Reporting (StorageScope is accessed directly from the Console for reporting)

Web Console

The Web Console is a Web-based interface that is provided with EMC ControlCenter. It allows you to conveniently monitor on your SAN remotely, or from within your network.

The Web Console uses a similar tree and view structures, and provides many of the same monitoring and alert management functions as the ControlCenter Console.

Because the Web Console does not require local installation, it requires fewer system resources and provides a more portable solution.

When to Use the Web Console

Use the Web Console when you:

- ◆ Do not want to install a ControlCenter Console on your host.
- ◆ Are using a host that does not support installation of the ControlCenter Console.
- ◆ Have bandwidth limitations on the network that prevent you from using the ControlCenter Console.
- ◆ Want quick access to the ControlCenter environment.
- ◆ Do not want to use the amount of memory required by the ControlCenter Console.
- ◆ Only need to monitor the environment.

Web Console Functions

- ◆ Want access to the ControlCenter environment through a single port.

You can perform the following ControlCenter functions using the Web Console:

- ◆ Monitoring
 - View the properties and relationships of a managed object
 - Monitor active alerts for managed objects
 - View the history of issued commands
 - Build a dynamic topology map of the SAN
 - Monitor the performance of Symmetrix storage arrays and Fibre Channel connectivity device ports
- ◆ Alert Management
 - Assign alerts
 - Acknowledge alerts
 - Clear alerts
 - View, add, or edit alert notes

StorageScope

StorageScope is packaged as part of the ControlCenter reporting SRM solution. StorageScope allows you to report on your SAN.

StorageScope, an integral part of the EMC ControlCenter family of storage management software, enables capacity planning, chargeback, and efficient asset management. With StorageScope's historical SRM reports, you can:

- ◆ Identify underutilized or inefficient utilization of storage assets
- ◆ Facilitate billing and chargeback operations by location, line of business, or application
- ◆ Plan capacity across your entire infrastructure
- ◆ Summarize your multi-vendor storage capacity and usage in application and business contexts
- ◆ Track historical metrics to predict growth

The StorageScope server is a Web server that operates as a component of the ControlCenter infrastructure tier. It can be installed on the same host as other ControlCenter components, or more typically, on a separate host as long as the server can communicate with the ControlCenter Server and Repository over TCP/IP.

StorageScope is designed for one installation per ControlCenter infrastructure. However, the optional Multisite reporting feature allows you to retrieve, consolidate, and view report data from multiple StorageScope sites on a single StorageScope site.

Once installed, StorageScope can be launched from the ControlCenter Console or independently in a browser.

Report Data Collection, Scheduling, and Retention

StorageScope queries the Repository at predefined intervals (once a day by default). The data is stored in a compressed, time-stamped XML file. By default, these XML files are kept indefinitely so the user can access previously collected data in order to compare metrics over time. The StorageScope administrator has the option of forcing a read of the Repository to provide “current” data and can also change the report retention policy.

When the user requests a report, StorageScope reads data from the latest XML file (by default), populates the report according to an associated report definition, and displays the report to the user.

Performance Manager

Performance Manager is packaged as part of the SRM monitoring and reporting offering. It is the ControlCenter performance analysis tool.

It can be launched from the Console and provides the ability to quickly generate performance and configuration data views based on performance data collected by ControlCenter agents.

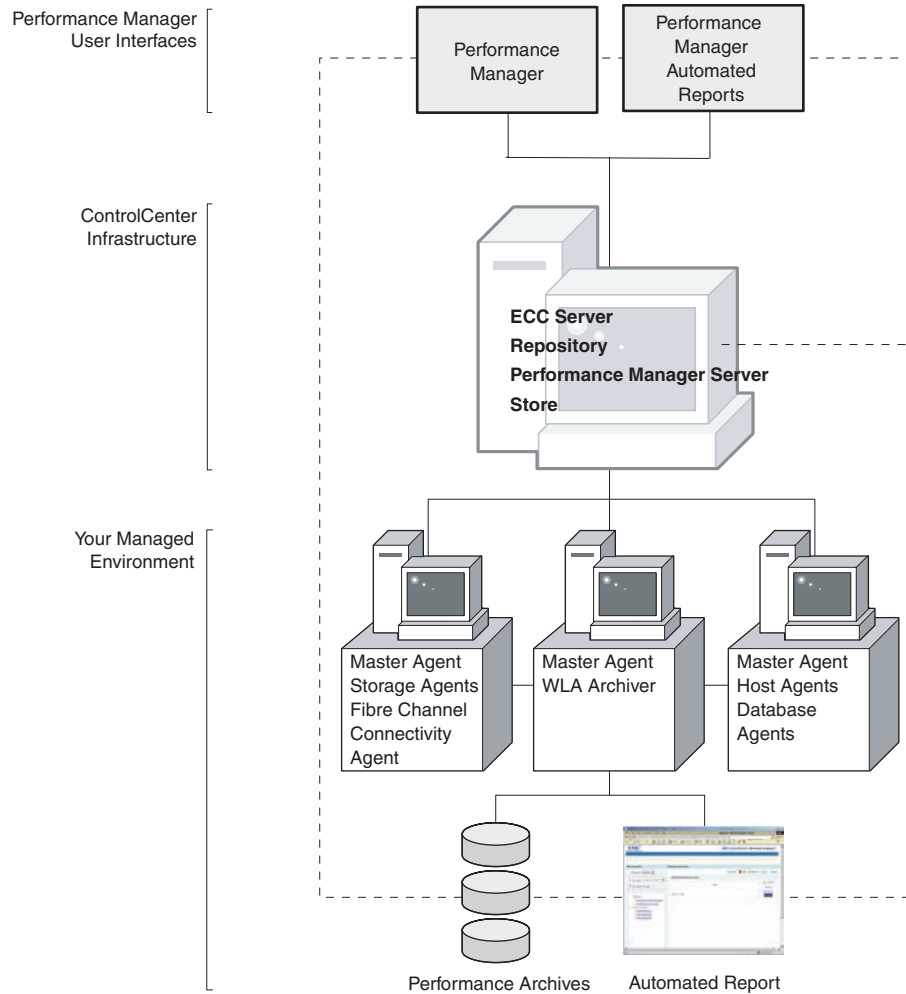
Performance Manager is comprised of the following components:

- ◆ **WLA data collection policies** are assigned to ControlCenter agents for managing the collection of historical, revolving, and analyst performance data and include the WLA Daily, WLA Revolving, and WLA Analyst policies.
- ◆ **Workload Analyzer Archiver** processes and stores the data collected by ControlCenter agents as performance archives, revolving collections, and analyst collections. The performance

archives and collections are then available for viewing through Performance Manager and Performance Manager Automated reports.

- ◆ **Performance Manager** is a Windows-based, post-processing tool that is invoked after data collection and processing is complete. From Performance Manager, you can create data views of system performance and configuration.
- ◆ **Performance Manager Automated Reports** are reports that are generated with the Performance archives and viewed in the Performance Manager Automated Reports interface. Automation reports are defined through automation jobs. The automation jobs are managed from the Automation Job Scheduler, which is accessed from Performance Manager.

Figure 2-2 illustrates Performance Manager within a ControlCenter configuration.



CC-000183

Figure 2-2 Performance Manager in the ControlCenter Architecture

ECC Server

The ECC Server is the primary interface between the Console and the ControlCenter infrastructure. The ECC Server is a collection of services created for use by ControlCenter. It encompasses diverse areas including:

- ◆ Web server, used to download the Console
- ◆ Security and access management, such as licensing, login, authentication, and authorization
- ◆ Communication with the Console
- ◆ SNMP data collection
- ◆ Alert and event management
- ◆ Real-time statistics
- ◆ Object management to maintain a list of managed objects
- ◆ Agent management to maintain a list of available agents

The ECC Server retrieves data from the Repository for display by the Console. It can also request real-time data directly from some agents, but the Console user must initiate the request and the information collected is transient (not stored).

Repository

The Repository contains a relational database. Installation and maintenance of the database is fully embedded into ControlCenter.

The Repository holds the current and historical data of both the storage environment and ControlCenter itself, with the exception of performance data. The ECC Server processes transactions from the Console for Repository data, such as checking user group permissions.

How ControlCenter Models the Storage Environment

ControlCenter models the storage environment as objects of different types, characteristics, and relationships. Because ControlCenter is designed specifically for the purpose of storage management, it includes many predefined categories of storage-related objects, such as "Storage Array", each with a particular set of characteristics.

ControlCenter views objects in a hierarchical form. The characteristics of abstract objects in the `Storage Array` category are inherited, for example, by a specific instance of a `Symmetrix` object. The specific `Symmetrix` object would in turn contain objects representing directors for the `Symmetrix` instance, ports for the `Symmetrix` instance, and devices for the `Symmetrix` instance.

The complete hierarchy of objects is called the *object model*. Information on object instances, called the *data model*, is stored in the Repository. A managed object is an object instance, such as a file system about which information is stored in the Repository.

ControlCenter passes information about these managed objects between its components.

The Repository is designed to hold data about managed objects such as:

- ◆ Storage systems, for example, `Symmetrix` systems, ports, directors, and devices.
- ◆ Host systems, for example, logical volume managers, file systems, and databases.
- ◆ Connectivity devices and their topology, for example, switches and associated fabrics and zones, as well as hubs, host bus adapters (HBAs), and fibre adapters (FAs).

This data includes configuration details, statistical data, alerts, and status information about any given device. It also contains general information about links, groups, metadata, alert definitions, components, and the data dictionary.

Data stored in the Repository allows applications to perform sophisticated management and problem tracking of changes within the storage environment. The Repository preserves a history of changes to a managed object. A Configuration Change log contains an audit trail of configuration changes with their time stamp.

Some historical data is stored externally to the Repository:

- ◆ StorageScope report data is maintained separately in XML files on the host where the StorageScope server manages storage and retrieval. For more information, refer to *StorageScope* on page 2-6.
- ◆ Performance Manager statistics files are maintained separately in Archives. The Workload Analyzer Archiver manages the storage and retrieval of data in this archive. For more information, refer to *Performance Manager* on page 2-7.

Store

The Store is a process that populates the Repository with persistent data from the agents. It provides a store-and-retrieve interface between the agents and the Repository.

For transaction load balancing, you may choose to install more than one Store in your ControlCenter implementation. In a single-host configuration, you can only have one Store. In a distributed-host configuration, you can have one Store per host.

For information on installation and performance and scalability, refer to the *EMC ControlCenter Planning and Installation Guide, Volume 1*.

Agents

ControlCenter manages every physical and logical element using intelligent agents. Agents collect data and monitor the health of objects. In addition, it can run user commands for configuring disk groups, volumes, and file systems, and for real-time explore.

There are many types of agents for managing diverse domains, from storage arrays through to host applications. A different agent manages different types of object. For example, there is a Storage Agent for Symmetrix, a Host Agent for Windows, and a Database Agent for Oracle.

There can be more than one agent on a host. A single Master Agent controls all the agents on a host, starts and stops the agents, and facilitates remote installation and upgrade.

Some ControlCenter applications or operations require multiple agents. For example, in the Console's Topology view, the storage data comes from a storage agent; the switch, fabric, and zoning data from the Fibre Channel Connectivity Agent; and host data from a host agent.

What Do Agents Do?

Each agent type has a predefined set of actions it can perform, specific to the object type it manages.

Agents work autonomously in the background according to user-defined management policies or in response to Console commands by you or by ControlCenter applications. They are the primary means by which ControlCenter management is effected on your behalf.

Typically, agents watch for events; gather, organize, analyze, and interpret information; send out alerts when a monitored event occurs; and manage themselves and their corresponding objects. They not only collect data from the object, but also transmit commands to the object.

ControlCenter periodically (as defined by that agent's policy) polls every agent to retrieve updated information.

In a limited capacity, agents can operate independently of the infrastructure; they communicate with the infrastructure only when requested or when they find anything to report. If the network is unavailable, the agents continue to operate as normal, saving the data until the network becomes available again.

Data Collection Policies

Each agent has a set of predefined data collection policies (DCPs). You can modify the existing data collection policies or define new policies based on templates available through the Console.

Agents can collect five types of data about managed objects:

Table 2-1 Data Collection Policies

Data Type	Description
Discovery	High-level information such as the newly discovered object's name and type. Agents perform discovery when they start and periodically afterwards, based on their policy. Discovery information is written to the Repository.
Configuration	The managed object's configuration, including the hierarchy of the managed object and its subcomponents.
Status	The status of one or more components of a managed group. Status data can indicate OK, Error, Offline, or another condition, with a reason.
Performance Statistics	The values of specific information such as bandwidth, disk space, memory, CPU, and so forth. The data archiving mechanism saves these metrics and converts them to performance statistics at the time specified by a data collection policy. In addition, agents can deliver raw data straight through to the ECC Server on request, without processing it.
Logs	System data.

Data Collection Processing

Agents process the collected data as follows:

- ◆ Snapshot data (discovery, configuration, and status) is sent to the Store to be archived in the Repository. The ECC Server reads data from the Repository for display on the Console.
- ◆ Performance statistics are saved in local collections.

Once data collection is enabled, the agent polls the object for statistical data. Daily and Analyst statistics are sent to the WLA Archiver as collected. Revolving data is stored on the agent host until requested by the user. The Workload Analyzer Archiver archives collections from the agents based upon the WLA Daily, WLA Analyst, and WLA Revolving data collection policies. The summarized data is saved to a data archive, separate from the Repository. The contents of the data archive are viewed through the Performance Manager application.

The WLA Retention policy provides parameters defining how long to save the archived data collections.

Discovery

A major agent function is querying and reporting on the existence of and health of the object(s) it manages. ControlCenter does not recognize an object until it is discovered. Once discovered, the objects appear in the relevant folders in the Console tree panel.

ControlCenter provides the following types of discovery operations:

- ◆ **Automatic discovery** — Performed automatically by some ControlCenter agents after they are installed and started.

When an agent is installed, the host or Symmetrix storage subsystem connected to the host is automatically *discovered* by the agent. For example, when you install a Host Agent for Windows, it automatically discovers the host on which it is installed. When you install a Storage Agent for Symmetrix, it automatically discovers Symmetrix systems, ports, directors, devices, and so on, for any connected Symmetrix system.

- ◆ **Assisted discovery** — User-initiated through the Console. This discovery method enables you to find Centera™, CLARiiON, and a wide range of storage arrays and database objects, by entering access information for the object.
- ◆ **Connectivity device discovery** — User-initiated through the Console. This discovery method finds switches, hubs, bridges, extenders, patch panels, and gateways at the specified network address in the SAN, and discovers topology information for the switches it finds. At the same time, or in a later discovery operation, you can discover the fabrics to which the switches belong, and import zoning configurations from those fabrics. Following discovery, information about the discovered objects is updated periodically according to the Fibre Channel Connectivity Agent's data collection policy settings.

Alerts Each agent has numerous predefined alerts to help monitor various aspects of your distributed storage environment, such as:

- ◆ Space availability of volumes or disks
- ◆ Performance of hosts and storage subsystems
- ◆ Status of backup operations
- ◆ Availability and status of ControlCenter components

Agents monitor metrics, that is, the value of a particular variable in a managed object, such as file size, file system occupancy, storage array status, and so on.

Alerts can monitor four types of metrics:

Table 2-2 Alert Metrics

Metric	Description
Rate	Triggers an alert using percentages to indicate whether the value of a metric has exceeded its threshold. For example, a file size change of 50%.
Interval	Triggers an alert if the difference between two values exceeds a specified amount. For example, a file size change by number of bytes.
State	Triggers an alert if a Boolean value of TRUE or FALSE is returned. For example, is the service running?
Count	Triggers an alert by comparing the value of a metric against the threshold value. For example, memory usage has exceeded a predefined absolute threshold value, such as 256 MB.

The definition of an alert tells the agent:

- ◆ Which metrics to monitor
- ◆ Which objects to monitor
- ◆ How often to check
- ◆ What threshold values trigger an alert
- ◆ What action to take when an alert is triggered

Each agent monitors its assigned metrics in the managed objects for configuration changes and alertable conditions. When a condition occurs, the agent automatically triggers an alert.

When an alert is triggered, the agent checks whether there is an *autofix* attached to the alert. An autofix is a user-specified action that is run when the alert is triggered, enabling the agent to autonomously respond to alertable conditions independently of the rest of ControlCenter.

The agent then sends the alert to the ControlCenter infrastructure, where the alert's management policy is checked to determine what action should be taken. Typical actions are:

- ◆ Display on the Console.
- ◆ E-mail or issue a page to notify a user.
- ◆ Forward an SNMP trap to the Integration Gateway for onward transmission to a open-source management framework, such as IBM Tivoli Enterprise Console.

You can customize the supplied alerts or define new alerts using a supplied template and assign them to specific agents.

Host Management

You can manage host storage resources (file systems, devices, databases) by issuing commands directly to the host or database agent using Console right-click menus. These commands allow you to:

- ◆ Create, extend, or mount file systems
- ◆ Manage volume groups
- ◆ Explore files, host logical volumes, or physical devices
- ◆ Control disk consumption, disk quotas, or file size on hosts
- ◆ Monitor host security
- ◆ Monitor host memory, disk, or processor performance
- ◆ Manage Oracle, Informix, Sybase, SQL Server, or DB2 database applications
- ◆ Manage Tivoli Storage Manager, VERITAS NetBackup, or LEGATO NetWorker backup applications

Disk Management

You can manage disk resources through the storage agents. To manage a Symmetrix storage array, you use the tasks and menus available through the Console window. To manage other storage arrays, you issue commands using Console right-click menus.

Console commands allow you to:

- ◆ Explore host and physical devices in disk subsystems
- ◆ Manage host connections to disk subsystems
- ◆ View configuration and performance data

Application Programming Interfaces

EMC's application programming interfaces (APIs) provide a common interface that isolates ControlCenter agents from the underlying differences of the storage structures (databases, file systems, volume managers) and the actual storage devices. The agents can access APIs locally or remotely, thus extending the platforms supported.

EMC Solutions Enabler

In order to retrieve data from a Symmetrix system and information about databases and file systems that are to be monitored by certain ControlCenter agents, such as Common Mapping Agent, you must install the EMC Solutions Enabler on the host managing the Symmetrix system (either the host running the Storage Agent for Symmetrix or a proxy host: refer to *Proxy Agent Configuration* on page 2-20).

Solutions Enabler provides low-level SCSI commands that communicate with Symmetrix systems to retrieve configuration, status, and performance information.

When you install Solutions Enabler, you are installing these components:

- ◆ **SYMAPI** — The Symmetrix Application Programming Interface and runtime libraries.
- ◆ **SYMCLI** — An open systems application, written using the SYMAPI, that manages Symmetrix systems.
- ◆ **SYMAPI Server** — A process that retrieves status and performance information by polling the Symmetrix systems and processing client commands. The SYMAPI Server process is called *symapisrv*.

Proxy Agent Configuration

Usually, you run a storage agent on a host that is connected to the storage array it is managing. However it is possible to run *middleware* software, such as Solutions Enabler, on a host connected to the storage array and run the storage agent elsewhere on the network.

The most common example of a proxy configuration is to run a SYMAPI Server on the host connected to the Symmetrix, run a Storage Agent for Symmetrix elsewhere on the network, and have the SYMAPI Server proxy agent pass the data it collects to the Storage Agent for Symmetrix. You might choose this configuration because the SYMAPI Server is supported on more platforms than the Storage Agent for Symmetrix. For example, if the host connected to the Symmetrix system is running z/OS or a version of UNIX for which the SYMAPI Server is supported but the Storage Agent for Symmetrix is not, then the SYMAPI Server host can collect data from the Symmetrix array and transmit it to a Storage Agent for Symmetrix running as a proxy agent.

Other examples of proxy agent middleware are the Navisphere Agent, as the interface between a Storage Agent for CLARiiON and an EMC CLARiiON array, and the StorageWorks Enterprise Array Manager Agent, as the interface between a Storage Agent for StorageWorks and an HP StorageWorks array.

Enterprise Framework Environments

Most users will use ControlCenter through the Console application. However, if you already use a management framework application such as CA Unicenter, you can display ControlCenter information through that open-source management framework.

EMC ControlCenter can be integrated into a number of enterprise management frameworks.

SNMP trap-based integration:

- ◆ BMC Patrol Enterprise Manager
- ◆ HP OpenView NNM VPO (ITO)
- ◆ IBM Tivoli Enterprise Console
- ◆ MicroMuse Netcool OMNibus
- ◆ MicroSoft Operations Manager (MOM)

API-based integration:

- ◆ Computer Associates Unicenter
- ◆ HP OpenView Network Node Manager
- ◆ IBM Tivoli NetView

If you currently use one of these monitoring systems to control your IT environment from a central command console, you can integrate ControlCenter into the enterprise management framework.

Integration Gateway

The information is passed from the ECC Server to the Integration Gateway agent as ControlCenter alert data, and from the Integration Gateway agent to the Integration Packages module installed with the open-source management framework as SNMP traps. The SNMP interface on the Integration Gateway includes an SNMP MIB (Management Information Base) for discovery information and SNMP traps for the events.

Figure 2-3 illustrates how Integration Gateway and Integration Packages components fit into the ControlCenter architecture.

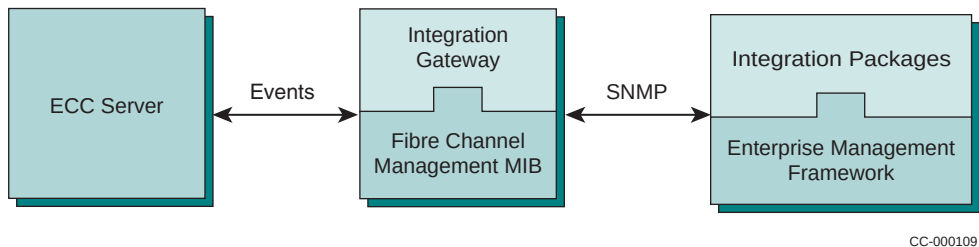


Figure 2-3 Integration Packages in the ControlCenter Architecture

Integration Packages

Integration Packages files are provided to help you integrate ControlCenter into the management framework display. Each framework is slightly different and requires its own icons, configuration, and registration files.

The Integration Packages provides two modes of integration: active and passive.

Active Integration

Active integration works with network (SNMP) management products that use a centralized Console or server to collect information from SNMP agents. The Console provides the intelligent processing. The Integration Package provides an application that resides with the open-source framework Console to interpret the SNMP traps issued by ControlCenter.

Passive Integration

Passive integration converts SNMP traps issued by ControlCenter into framework (existing open-source enterprise software) messages. Use passive integration with systems management products that rely on intelligent agents to send messages to a central server or Console. Integration Packages provide the files you need to configure agents to interpret the SNMP traps issued by ControlCenter. These agents then forward the traps as framework-specific messages to the framework Console.

For more information, refer to the *EMC ControlCenter Integration Packages Product Guide*.

SNMP Interface

Although the Integration Gateway is used primarily by the Integration Packages, any application can obtain ControlCenter data through the SNMP-based Integration Gateway interface to ControlCenter.

Implementing EMC ControlCenter

There are many aspects to planning your ControlCenter configuration, ranging from high-level strategic decisions about high availability, performance, scalability, or security, to low-level implementation checks such as whether a host has the right prerequisite software installed.

Each implementation of ControlCenter is different from site to site. A ControlCenter configuration spans the whole storage network, with different components on different hosts, each serving a particular purpose.

Implementing ControlCenter involves:

1. Planning and evaluating your storage environment, including gathering and documenting information, and determining your installation size.
2. Planning the implementation of the ControlCenter infrastructure within your storage environment.
3. Planning where and how to use ControlCenter features and applications within your storage environment.
4. Planning the deployment of ControlCenter agents and the data to collect, within your storage environment.
5. Preparing for the ControlCenter installation.
6. Installing the ControlCenter infrastructure.
7. Installing ControlCenter Console interfaces and any additional Controlling applications.
8. Deploying ControlCenter agents within your storage environment.
9. Performing initial discovery of objects that you want ControlCenter to manage.

The following list of publications support the implementation of ControlCenter:

- ◆ *EMC ControlCenter Planning and Installation Guide, Volume 1*, guides you step-by-step through planning and installation of ControlCenter.
- ◆ *EMC ControlCenter Planning and Installation Guide, Volume 2 (MVS Agents)* describes how to plan and install ControlCenter MVS agents.
- ◆ *Configuration and Control: Manage What You Have (Playbook)* is a case study that shows how a fictional small company plans and implements ControlCenter.
- ◆ *Quick Start Tutorial: Ensuring Installation Success* is a tutorial that describes how to plan an optimal ControlCenter configuration.
- ◆ *Quick Start Tutorial: Completing Installation and Configuration* is a tutorial that describes how to complete the installation by installing and configuring agents (Windows only).

Figure 2-4 on page 2-25 illustrates a data center environment with a ControlCenter implementation.

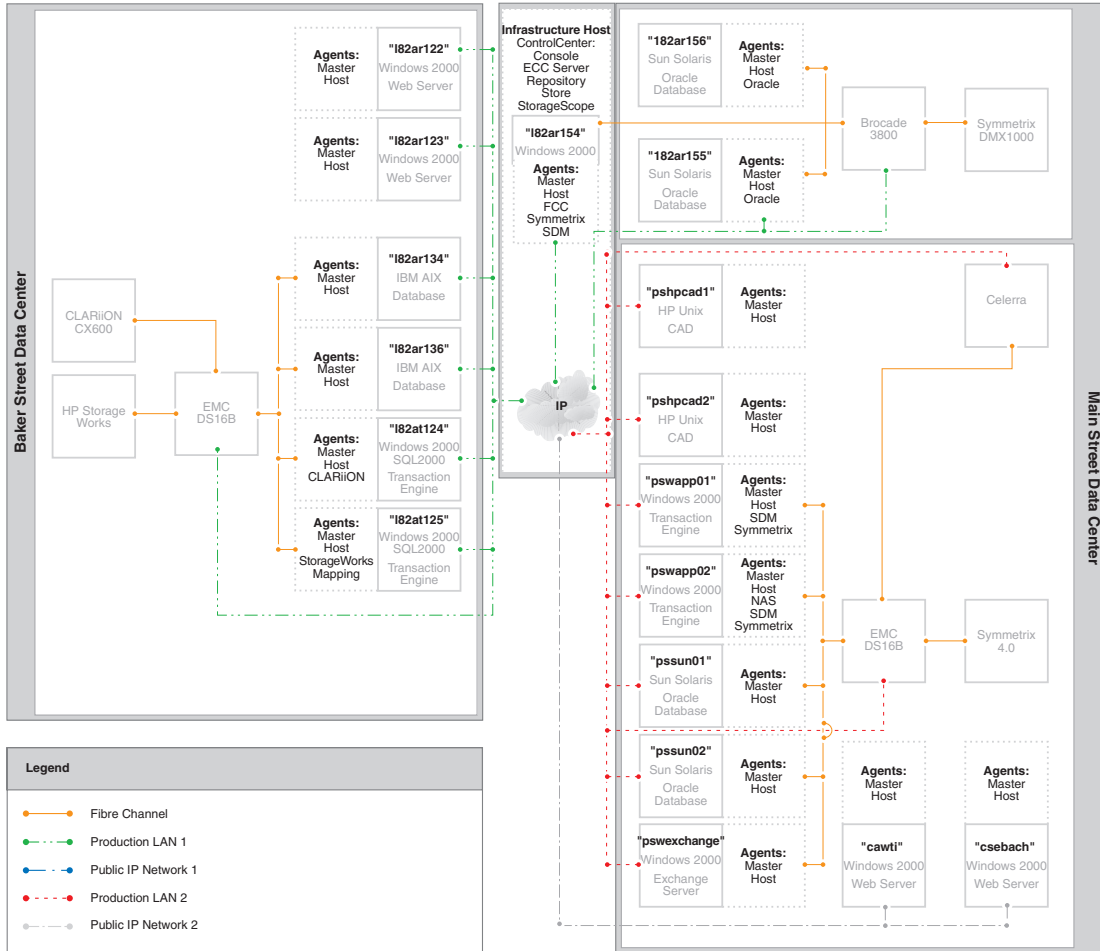


Figure 2-4 Example Data Center Environment

Installation

The installation process itself involves three broad steps:

1. Install the infrastructure components from CD-ROM using an Installation wizard.
2. Install the Console through your Web browser from the ECC Server.
3. Install the agents from the Console using the Agent Administration Wizard.

Refer to the *EMC ControlCenter Planning and Installation Guide, Volume 1* for more information about the installation process.

Scalability

ControlCenter is easily scalable, making it well-suited to large data warehouse environments. Scalability features include:

- ◆ Intelligent agents that send changed data only, because data is processed locally. Their activity is policy-based and user-defined.
- ◆ Ability to add multiple Stores to provide load balancing for a large number of agents.
- ◆ A Repository based on a commercial database.
- ◆ A Console that can display many thousands of managed objects through the use of:
 - Predefined groups
Built-in groups such as Hosts, and Storage Systems, provide a logical hierarchy. Within the hierarchy, an Arrange By feature provides flexible groupings. For example, you can list objects by name, type, or vendor.
 - Site-defined groups
These allow you to logically group hosts, storage arrays, and other objects that ControlCenter manages. You can create groups that correspond to particular geographic locations or to departments and manage that group as an entity. Creating object groups also simplifies how you perform reporting, and how you manage object permissions. For example, you can create an object group that includes all your UNIX hosts, and then grant your UNIX administrators permissions to perform actions on those hosts.
 - Filtering
Allows you to exclude objects from the display.

It is important to consider scalability when planning your ControlCenter implementation. Medium to large installations should refer to the following publication for assistance with sizing:

- ◆ *EMC ControlCenter Performance and Scalability Guidelines*, available through the EMC Powerlink Web site (<http://powerlink.emc.com>.)

Upgrade

If you are an existing ControlCenter site, an upgrade capability is provided allowing you to upgrade existing ControlCenter 5.1.1 and higher version components to the current version.

For information on what's new in EMC ControlCenter, refer to the:

- ◆ *EMC ControlCenter Upgrade Guide*
- ◆ *EMC ControlCenter Release Notes*

Migration

Migration wizards, utilities, and scripts are available to help you migrate data from earlier ControlCenter applications into the 5.2 release of ControlCenter:

- ◆ ESN Manager 2.x
- ◆ Symmetrix Manager 4.x
- ◆ Workload Analyzer 4.x
- ◆ Resource View 4.x

For more information on migration, refer to the:

- ◆ *EMC ControlCenter Migration Guidelines*, available through the EMC Powerlink Web site (<http://powerlink.emc.com>.)
- ◆ Console Online Help; then select **Installing ControlCenter components**, and then **Migrating data to ControlCenter**

Troubleshooting Help

The troubleshooting help system provides troubleshooting information for resolving problems encountered in EMC ControlCenter.

Troubleshooting involves the diagnosis and usually the simultaneous repair of a system malfunction. A wide range of behaviors, from undesirable (for example, poor performance from traffic bottlenecks) to nonperformance (for example, functional errors, data inaccessibility, or corruption) might prompt you to perform troubleshooting.

EMC ControlCenter aids in troubleshooting and fixing the storage environment it oversees, including some of the problems mentioned above. These capabilities are described throughout the installation and operations-related documentation, especially within the online Console Help system.

The Troubleshooting online help system, however, refers to the troubleshooting of ControlCenter software itself. Given the complexity of ControlCenter distributed systems and their interfaces, there are practical limits to the range of troubleshooting that should be performed without the aid of EMC technical personnel. This help system gives both pointers and contact information for handling unexpected behavior that could disable normal operation.

The symptoms and procedures described are primarily, but not entirely, installation-related. These include such events as unexpected pop-up windows, apparently frozen installation screens, and other unusual or unexpected software interface behavior.

Log Utility

EMC ControlCenter Log Utility is a Windows-based standalone utility that provides centralized logical access to EMC ControlCenter log files, and other files related to monitoring ControlCenter operations.

The Log Utility works with the following files:

- ◆ ControlCenter log files on the ECC Server, Store, and Console hosts
- ◆ ControlCenter log files on host machines running agents
- ◆ ControlCenter Repository log files and Repository backup logs
- ◆ StorageScope configuration application and logs
- ◆ SYMAPI logs
- ◆ ESNAPI logs
- ◆ Host information files
- ◆ Installation log files
- ◆ Agent log files
- ◆ Performance Archiver log files

With the Log Utility, you can also generate host information (on Windows) and collect host information generated outside of the Log Utility. Additionally, you can execute remote predefined commands for EMC Solutions Enabler and PowerPath.

The Log Utility provides:

- ◆ An easy-to-use ZIP and Ship Wizard for packaging and shipping ControlCenter logs via FTP to your EMC Customer Support Representative for troubleshooting.
- ◆ An Expert Mode facility where you can:
 - Package and ship via FTP manually selected files log files for desired ControlCenter application instances.
 - View and analyze managed files.
 - Parse and display log content.
 - Clearly view and easily select log file content.

- Search log file content.
- Filter on a predefined set of filters for severity, category, header and thread.
- Externalize logs to send a selected part of log file content to a printer, file, E-mail, or clipboard, or FTP them to EMC.
- Generate Host information on a local machine, including Msinfo32 output and a copy of event logs.
- Execute remote predefined commands for EMC Solutions Enabler and PowerPath applications.

For additional information, refer to the *EMC ControlCenter Log Utility* online help.

ControlCenter Common Services

This chapter describes the common views and services provided by OIC.

- ◆ Common Console Services3-2
- ◆ Security Management.....3-3
- ◆ Agent Configuration.....3-8
- ◆ Common Console Views.....3-10

Common Console Services

Through the Console, ControlCenter uses a common infrastructure and services to achieve uniform usability and information sharing across each of the ControlCenter applications. The result is a tightly integrated suite of applications that span storage network, host, and array management.

Administration Services

ControlCenter helps you simplify the management of all of your storage assets through common administration tasks that span specific applications. These administration tasks include:

- ◆ **Security management** — User administration, access control, and command history.
- ◆ **Agent configuration** — Remote installation, upgrade, and configuration of agents.

The benefits of sharing these administration tasks across your entire configuration include the ability to share common policies across access-control rules or alerts. You can standardize on schedules for data collection or reporting.

By creating user-defined groups to reflect the geographic or organizational structure of your business, you can then use the group as your basis for security, policies, reporting, or monitoring.

For more information about creating user-defined groups, refer to the *Console Online Help*, which is available from the Console Help menu.

Console Views

In addition to administration tasks, ControlCenter also provides common commands and views that span applications. For example, it doesn't matter whether you are managing a SAN and want to view switch properties, managing a Solaris host and want to view file system properties, or managing a storage array and want to view device properties, the procedure is the same. You select the object or group of objects and select Properties. Similarly, if you want to view the performance of a Fibre Channel switch or a UNIX host or a Symmetrix device group, you select the object or group of objects, and select Performance.

Security Management

A security management system controls the authorization for performing ControlCenter actions. The system manages permissions based on authorization rules. The permissions determine what actions (commands) a user or group may perform on any given object or group of objects.

Logging In

Access to the ControlCenter Console is controlled by the ECC Server either through the standard Windows authentication mechanism or through LDAP (Lightweight Directory Access Protocol):

- ◆ If controlled through the standard Windows authentication mechanisms, then a user must have a valid Windows account on the system where the ECC Server resides.
- ◆ If controlled through LDAP, an LDAP administrator must properly configure the ECC Server to access the appropriate LDAP-compliant directory in which ControlCenter users' usernames and passwords are stored, optionally over a secure connection such as Secure Sockets Layer (SSL).

The ControlCenter administrator adds each user's account to ControlCenter. An entry for that user is then included in the ECC Users folder. Users log in to use ControlCenter using their Windows or LDAP account and password. Their username and password is authenticated using Windows or through LDAP, depending on which mechanism is configured.

If the Console is running on Solaris, the administrator maps the UNIX login and password to an equivalent Windows account on the ECC Server. On login, the user has whatever user or user group access privileges are defined for that account.

User Administration

A ControlCenter administrator can query which users are logged in and from which host.

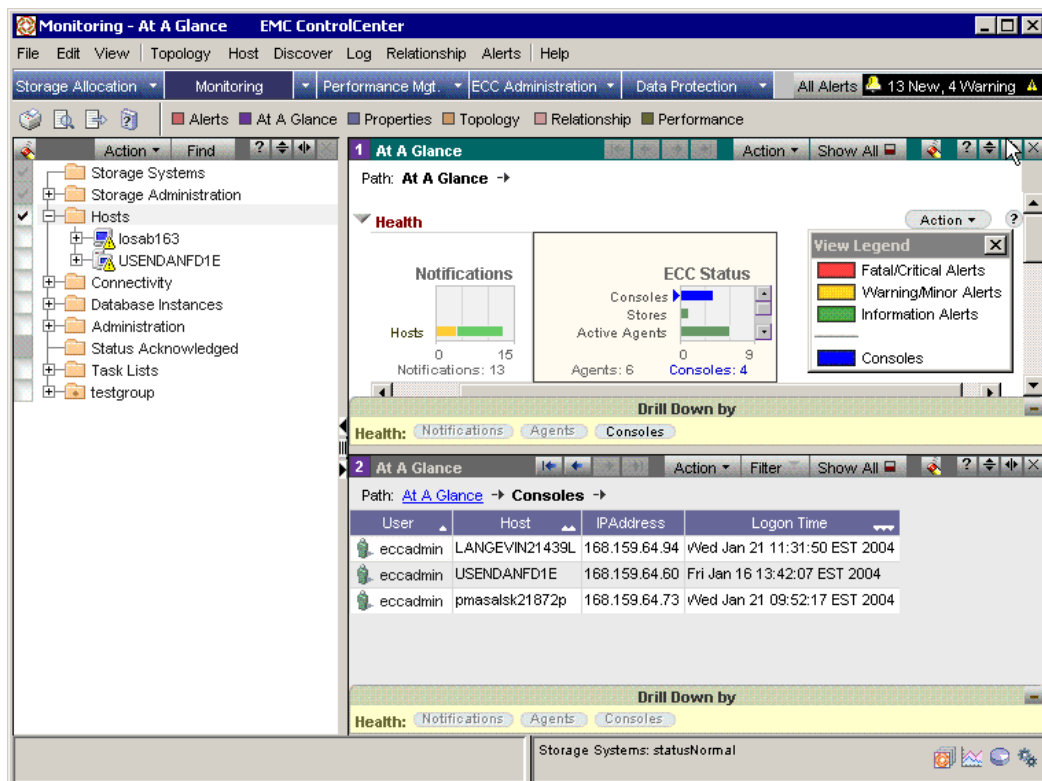


Figure 3-1 At A Glance View

Users or user groups can be restricted to perform only certain operations or manage specific devices. If users attempt to perform a command for which they are not authorized, ControlCenter issues a message and prevents the command from executing.

A ControlCenter administrator creates authorization rules and adds users and objects to the rule. For example, the TimeFinder rule could grant the backup manager (user) permission to use the TimeFinder application (action) on a named Symmetrix array (object).

Initial User Groups and Rules

When you start the ECC Server for the first time, ControlCenter creates several default user groups, object groups, and rules to help you set up ControlCenter security. As you create users within your organization, you add them to these user groups to grant them sets of permissions.

Permissions

The user groups and rules are organized according to typical job responsibilities. The rules grant permissions based on object types, such as storage arrays, switches, or hosts. Granularity for most objects is at the storage element (array, switch, host, database) level. The exception is a Symmetrix array where access control can be specified down to the volume level. For example, you can grant the TimeFinder permission at the Symmetrix level, allowing these commands for all devices on the Symmetrix system. Or, you can grant the TimeFinder permission at the individual device level.

You can view security management information in two ways:

- ◆ View the basic properties of authorization rules, users, and user groups, such as names and descriptions for users and groups and the permissions granted by a rule.
- ◆ View which rules apply to which users, groups, and objects.

Figure 3-2 shows a Properties view of the default authorization rules.

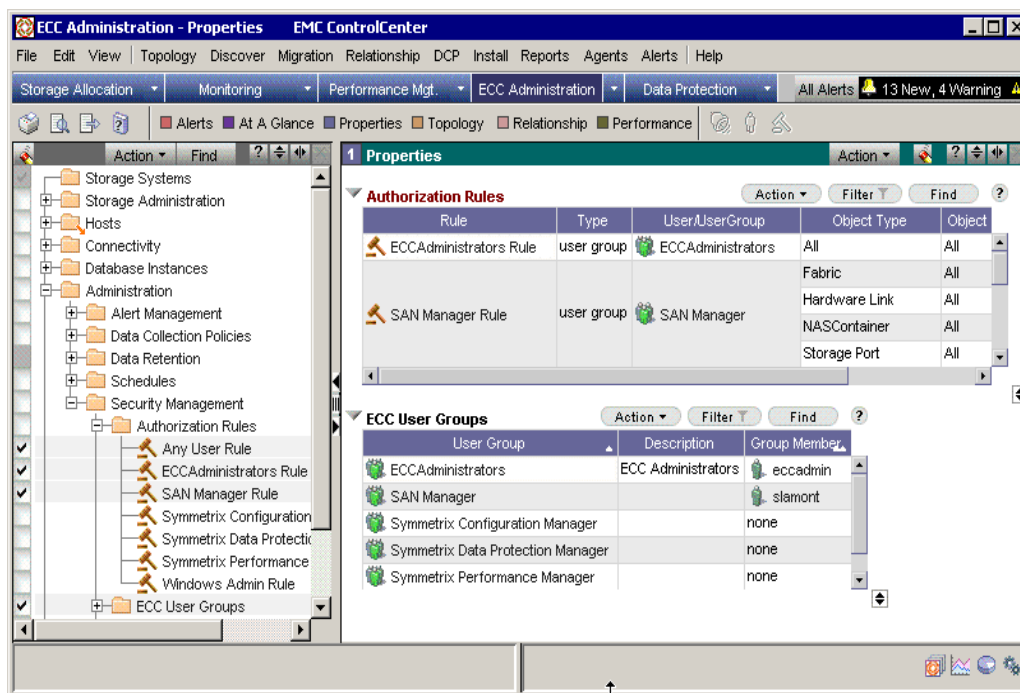


Figure 3-2 Properties View of Rules

For more information on security management, refer to the *EMC ControlCenter Administrator/User Guide*, which is available from <http://powerlink.emc.com> or, from the Console Online Help, which is available from the Console Help menu.

Command History View

ControlCenter maintains both a log of user activity (stored in a log file) and a command history of actions taken by a user (stored in the Repository). The log files and command history are crucial sources of information, particularly if there is a suspected intrusion or suspicious management activity.

The Command History view shows in table form, a cumulative list of commands performed. It shows the commands issued by a user, together with their associated object, outcome, status, and start and end dates for each active session.

Figure 3-3 shows an example Command History view.

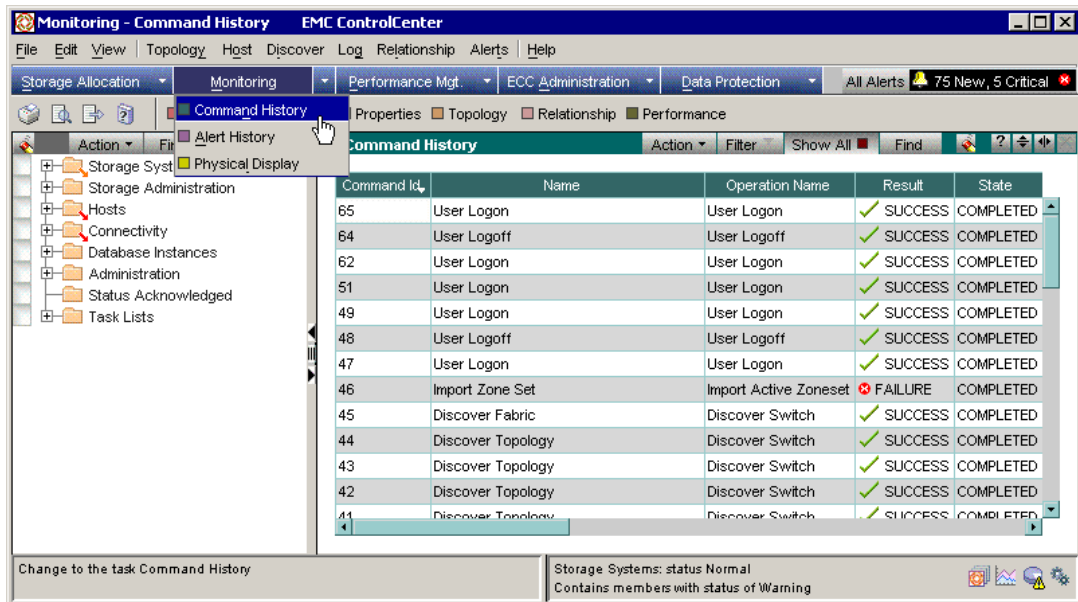


Figure 3-3 Command History View

Agent Configuration

The Console Agents menu allows you to configure agents and perform remote actions such as installing, upgrading, starting, stopping, and uninstalling agents.

Figure 3-4 shows the Agents menu and the Agents view.

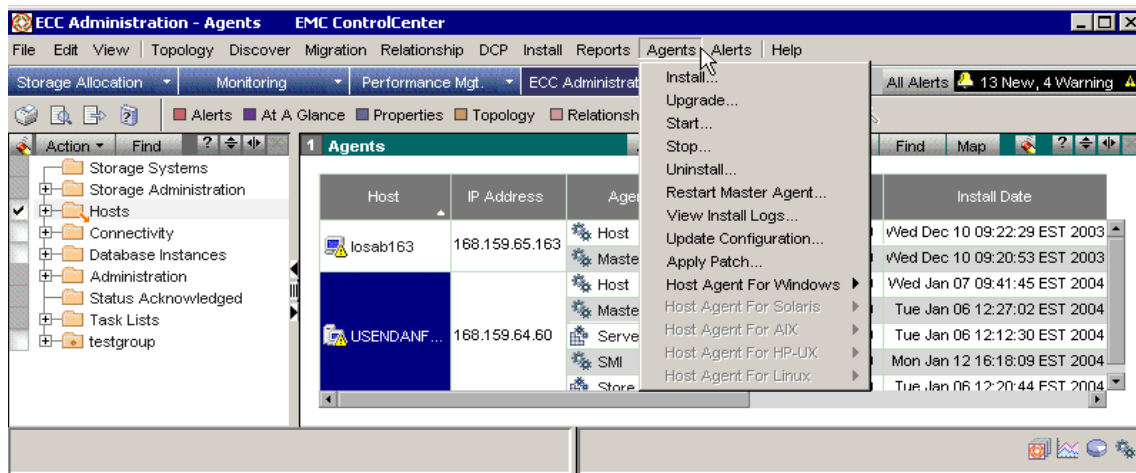


Figure 3-4 Agent Menu

After you install an agent, you need to configure it with information about the objects the agent is to manage, set up data collection policies, and set up alert definitions for the agent.

Once installed and configured, you can monitor the health of agents through the Agents view.

Setting Up Data Collection Policies

Most agents have associated predefined DCPs and DCP templates that are managed through the Console. DCP templates provide default values for the creation of new collection policies. You can define your own policies by editing the DCP templates.

An agent's data collection policy defines:

- ◆ Whether collection is enabled
- ◆ Which managed objects the agent should monitor
- ◆ Collection interval
- ◆ Duration
- ◆ Cycle time
- ◆ Numbers to keep
- ◆ Collection name

Creating Alert Definitions

You can create alerts from the templates ControlCenter provides or by copying existing alerts. You control:

- ◆ Which resources are monitored.
- ◆ The values that cause an alert to trigger.
- ◆ How often ControlCenter evaluates the alert. You specify this by attaching a schedule that determines how often the agent evaluates the alert definition. ControlCenter provides several predefined schedules and you can define additional ones.
- ◆ What happens when the alert triggers. You specify this by attaching:
 - An autofix that runs when the alert triggers.
 - A management policy to the alert definition to define who will be notified when an alert triggers and how the notification will occur, whether through the Console, by e-mail, by page, or by another method.

Common Console Views

ControlCenter provides common views that are available to all applications. Common views are located on the Console toolbar, as Figure 3-5 shows, while views specific to tasks and applications can be selected from task drop-down menus.



Figure 3-5 Console Toolbar

This section introduces views that are available to applications.

Topology

The Topology view provides a single view of your SAN network across many topologies and protocols, and across SCSI and Fibre Channel.

The Topology view is used to create a pictorial rendering, or map, of the physical and logical elements in the SAN, including hosts, storage arrays, connectivity devices, adapters, ports, fabrics, zones and zone sets, and the relationships among them. You can view the topology at a high level or in detail. You can expand objects to display their subelements, such as storage logical devices, host bus adapters (HBAs), etc.

Topology view requires a SAN Manager license. SAN Manager is part of the ControlCenter Planning and Provisioning SRM solution.

Figure 3-6 shows an example Topology view.

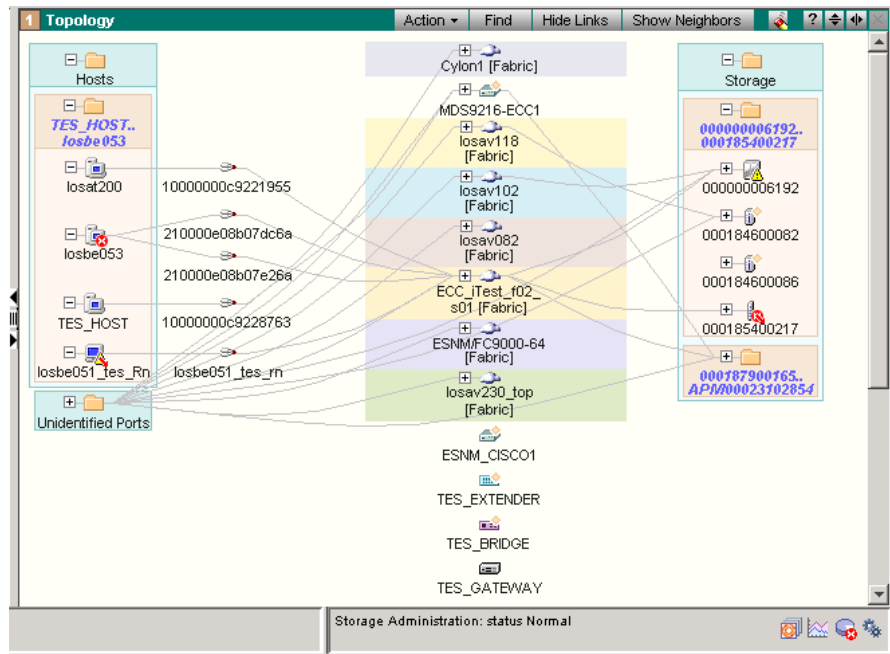


Figure 3-6 Topology View of Fabrics

After you install ControlCenter, you can *discover* the topology of the SAN (refer to *Discovery* on page 2-16). Topology discovery is the process of identifying the various elements in the SAN and their relationships to each other. Objects discovered by ControlCenter are listed in the tree panel, shown in the topology map, and their information is updated by the agents that discovered them.

The Fibre Channel Connectivity Agent collects most of the information required to develop the overall storage network topology. This agent delivers objects in two stages, which may be performed simultaneously or separately:

- ◆ Initial discovery of connectivity devices, including discovery of topology information for switches.
- ◆ Full discovery of the fabrics to which discovered switches belong, including import of zoning configurations from those fabrics if desired.

Storage arrays and tape units are discovered and correlated by their respective storage agents, which communicate with each array through its native device interface.

Host elements are discovered and correlated by the respective host agent.

If host or storage agents are not present, the HBA-to-host or FA-port-to-array mapping information can be manually entered. This allows you to correlate discovered end points (such as HBAs on hosts) without an agent and create new devices in the topology. Through automated discovery and manual editing, the topology view represents a complete view of the storage environment.

Relationship

Another common view, the Relationship view, provides a single view of how an application maps to its storage, across databases, file systems, and hosts.

The Relationship view shows the logical mapping of file systems and databases to their logical and physical location in the storage arrays. End-to-end mapping is one of the most important views for helping you understand your storage environment. Viewing the entire storage chain on a single screen can help you understand the effects of performance tuning and capacity planning from a database, host, and storage perspective.

The Relationship view is especially useful when used in combination with other ControlCenter applications. For example, for a particular database, you can create a user-defined group of all the objects associated with it (the database, the host, the storage array) and you can create a device group of the logical volumes mapped to the database. Monitoring the group, rather than individual objects, makes it easier to manage performance monitoring or alert tracking on database related objects.

The degree to which you can drill down through any particular object depends on which data is available to the agent managing that object. For example, at the storage end, for Symmetrix arrays, you can map host objects through the storage logical volumes to the physical devices—and back again—providing a complete, top-to-bottom view from the host through the specific devices. For CLARiiON, NAS (network-attached storage), HDS, StorageWorks, or ESS arrays, the host object is mapped through to the logical unit number (LUN) on the storage array.

Figure 3-7 on page 3-14 shows the Relationship view for the selected hosts.

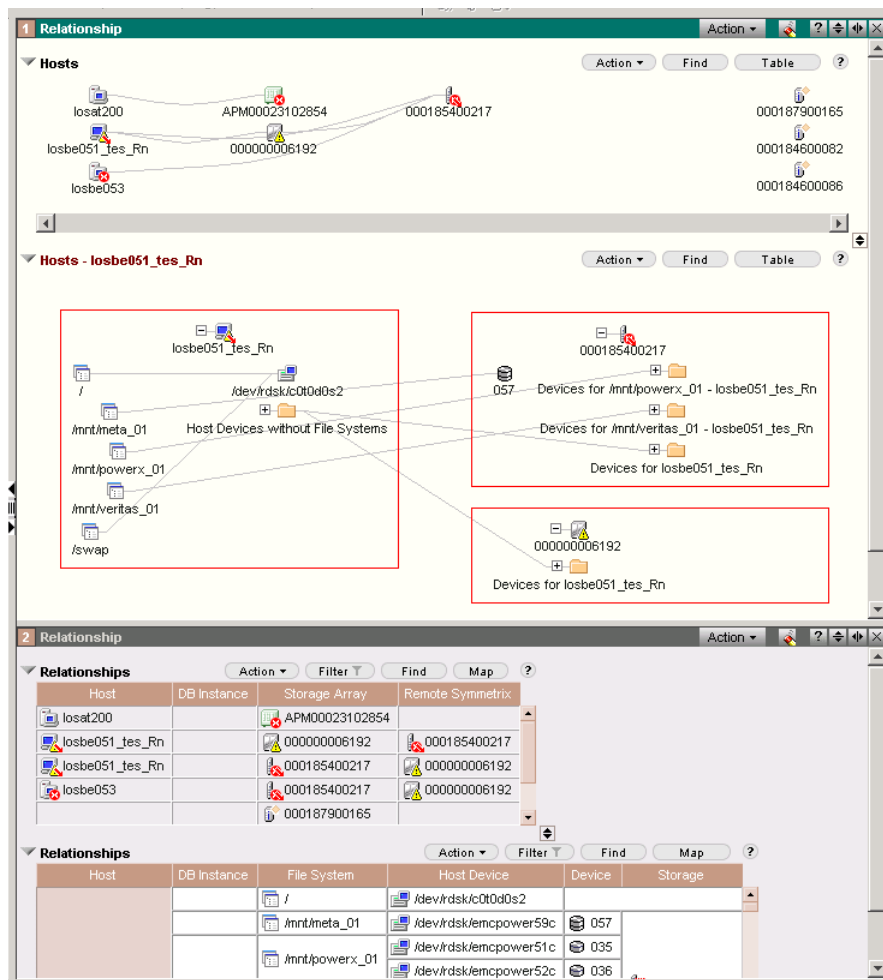


Figure 3-7 Relationship View of Hosts

Properties

From anywhere in ControlCenter, at any time, you can display the properties of an object. The Properties view displays the most common attributes for the selected objects. If appropriate, the view may also list the selected object's configuration. Figure 3-8 shows Properties views for a variety of selected objects.

The screenshot displays the 'Properties' window in ControlCenter, which is organized into five expandable sections. Each section has a title bar with 'Action', 'Filter', and 'Find' buttons. The sections and their data are as follows:

- Symmetrix Arrays:** A table with columns: Symmetrix, S/N, Managed, Model, Configured Capacity, Unconfigured Capacity, Total Standard, and Total BCV. It shows one entry for a Symmetrix Agent with a total capacity of 1,081.08 GB.
- Unix Hosts:** A table with columns: Host, Host Name, Operating System, OS Version, OS Level, # CPUs, Memory, and CPU Type. It shows one entry for 'losbe051_jes_Rn' running Solaris 2.8 with 2 CPUs and 1.50 GB of memory.
- Fabrics:** A table with columns: Name, Principal, Last Update, Switches, and Data Source. It shows one entry for '1000080088a0880d [Fabric]' with 1 switch and data source FCC.
- Connectivity Devices - Switches:** A table with columns: Name, Type, Vendor, Node WWN, Ports, User Given Name, Firmware Revision, Model, and Fabric. It shows one entry for 'losav113' switch with 16 ports and model ED-1032.
- Unidentified Hardware Ports:** A table with columns: Port, Vendor, and WWN. It lists five ports from Emulex Corporation with various WWN identifiers.

Figure 3-8 Properties Views for Selected Objects

Performance

A complex system like a storage network has multiple levels at which performance problems can occur: on the network, within particular storage devices, or within individual hosts. Ongoing performance measurement and management can provide early warning signals that a particular link in the chain is reaching full capacity.

The Console Performance view displays performance statistics for storage objects, host objects, and connectivity objects.

For the selected object(s), you can display:

- ◆ A table (displayed by default) showing the real-time performance statistics updated in real time for the object. The statistics are collected directly from the agent monitoring that object, not the Repository. Data obtained in this way is transient.
- ◆ A chart, showing historical performance data for the period since the Performance view was selected.

Figure 3-9 shows the Performance view chart displaying (in real time), the historical performance data from the selected time until now for the selected devices.

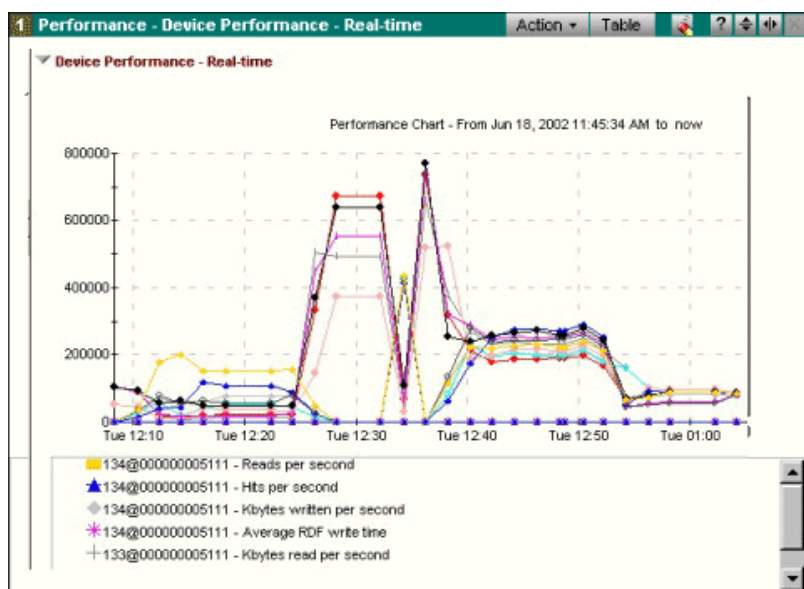


Figure 3-9 Performance View for Selected Storage Devices

Alerts

ControlCenter provides numerous metrics to help monitor various aspects of your distributed storage environment, such as:

- ◆ Space availability of volumes or disks
- ◆ Size of files
- ◆ Performance of hosts and storage systems
- ◆ Status of backup operations
- ◆ Availability and status of ControlCenter components

You configure these metrics into alert definitions that tell ControlCenter how you want to be alerted when a resource meets a value that you define. Many alert definitions are enabled by default when you install ControlCenter agents.

Viewing Alerts

If a Console object (such as a storage system or host) has an active alert, an icon indicating the severity of the condition appears next to the object: 

In the tree panel, a small downward arrow on a folder indicates that an object within the folder has an active alert: 

ControlCenter provides several methods for monitoring these metrics:

- ◆ **All Alerts button** — Shows you the total number of new alerts, the level of the highest severity alert, and the total number of alerts at that severity. Click the **All Alerts** button to display the Active Alerts view.
- ◆ **Active Alerts view**
 - In Table Mode, provides a color-coded table showing triggered alerts for the selected object(s) or all alerts, and tools for tracking alerts to resolution.
 - In Chart Mode, displays charts of triggered alerts for specific storage systems, hosts, or other objects or groups of objects.
- ◆ **At A Glance view** — Allows you to categorize metrics into charts, such as Host Capacity and Storage System Performance, and view metrics based on groups of systems, such as an application or business-unit group. The At A Glance view is the view displayed by default when you start the Console.
- ◆ **Alert History view** — Shows a history of all triggered alerts that have since been resolved or cleared. This enables you to trace the state and severity transitions.

In any of these views, you can filter the view to reduce the number of alerts shown, you can switch between a chart or table format, and you can sort or rearrange columns.

In the At A Glance view, the filter feature is only available when you drill down.

Notification Options

You have great flexibility in how ControlCenter notifies you about alerts. Notification options include:

- ◆ Displaying color-coded messages in the ControlCenter Console.
- ◆ Sending e-mail messages.
- ◆ Sending messages as SNMP traps to a open-source framework like HP OpenView or the IBM Tivoli Enterprise Console.

Figure 3-10 shows Notifications in table format reached from an At A Glance view.

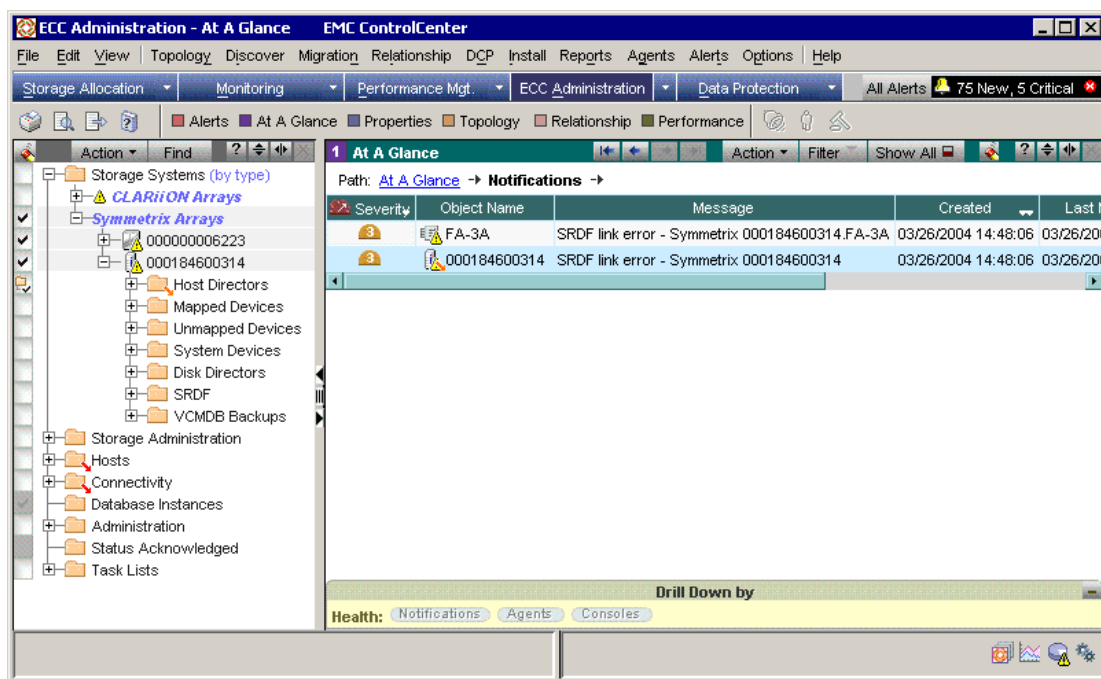


Figure 3-10 At A Glance Notifications Information

Responding to Alerts

You can respond to a triggered alert in several ways. Manual responses include:

- ◆ Displaying further details about the alert
- ◆ Acknowledging the alert
- ◆ Assigning the alert to a user or user group
- ◆ Attaching a note to the alert to indicate that corrective action is in progress, or searching for related notes
- ◆ Viewing the state and severity transitions that the alert has gone through
- ◆ Viewing the history to examine previously cleared alerts
- ◆ Editing the alert definition directly from the alert instance
- ◆ Disabling an alert
- ◆ Clear alert option

For more information, refer to the Console Online Help, which provides recommendations for how to respond to each alert.

This chapter describes the capabilities provided by applications available with ControlCenter.

◆ ControlCenter Applications	4-2
◆ Planning and Provisioning	4-3
◆ Monitoring and Reporting	4-22
◆ Storage Device Management.....	4-29
◆ Launching Open-Source Applications.....	4-45
◆ What's Next?	4-46

ControlCenter Applications

The tasks for managing your data center are provided by a number of closely integrated applications. These applications fall into three SRM categories:

Planning and Provisioning

- ◆ SAN Manager
- ◆ SAN Advisor
- ◆ Automated Resource Manager

Monitoring and Reporting

- ◆ Performance Manager
- ◆ StorageScope
- ◆ StorageScope File Level Reporter

Storage Device Management

- ◆ Navisphere Manager
- ◆ Symmetrix Manager
- ◆ Symmetrix Optimizer

Each application includes the common services described in Chapter 3, together with application-specific views and menu actions.

You may not have all the applications demonstrated in this chapter installed in your data center. This chapter provides a brief overview of each of these application. For full details, refer to the *EMC ControlCenter Administration/User Guide* or the *Console Online Help*.

This book describes Console features and interactions assuming that all applications that are part of ControlCenter are present. Most interactions apply to all applications, but some are specific to a particular application and screen displays may vary depending on which applications you have licensed. You may not have all the applications demonstrated in this book licensed in your data center.

Planning and Provisioning

The Storage Resource Management (SRM) Planning and Provisioning solution allows you to design, plan, and provision a multivendor storage infrastructure for the benefit of improving the utilization, performance, and the cost effectiveness of your storage assets. This solution is achieved using ControlCenter planning and provisioning applications, which allow you to quickly recognize, isolate, and respond to storage issues.

The applications included in the planning and provisioning solution include:

- ◆ SAN Manager
- ◆ SAN Advisor
- ◆ Automated Resource Manager

SAN Manager

A storage area network (SAN) is the collection of end ports and connectivity elements in a network of interconnected hosts and storage devices. A SAN typically consists of many components including hosts, HBAs, switches, hubs, bridges, and storage devices, all potentially from different vendors.

SAN Manager supports the entire switched fabric infrastructure, providing integrated network discovery, topology, and alert capabilities, and actively controlling SAN management functions such as zoning and LUN masking.

SAN Manager enables you to:

- ◆ Perform discovery of the logical and physical view of the SAN through agents.
- ◆ Monitor the health of connectivity devices and their ports to detect potential error conditions and to remedy or respond to any errors that occur.
- ◆ Monitor the connectivity device ports in your SAN by collecting statistical information. Alerts are triggered when thresholds are met or exceeded.
- ◆ Perform zoning operations for switches and mixed fabrics, including the ability to import active/inactive zoning, to create zones and zonesets, and to configure changes.

Discovery and Topology

- ◆ Perform masking operations on various arrays including Symmetrix, CLARiiON, HP StorageWorks HSG-80 and HP StorageWorks, HDS, and SUN arrays. A command line interface is available.
- ◆ Monitor and troubleshoot paths from hosts to storage.

ControlCenter discovers a wide range of Fibre Alliance-compliant connectivity devices in the topology and renders them accessible in both the Console tree and the topology map. When ControlCenter encounters a fully supported switch during discovery, it attempts to discover topology information for that switch, optionally prompting for connection settings, and optionally fabric information, as needed. Figure 4-1 illustrates the Search for Connectivity dialog box, used for discovering a Connectivity device.

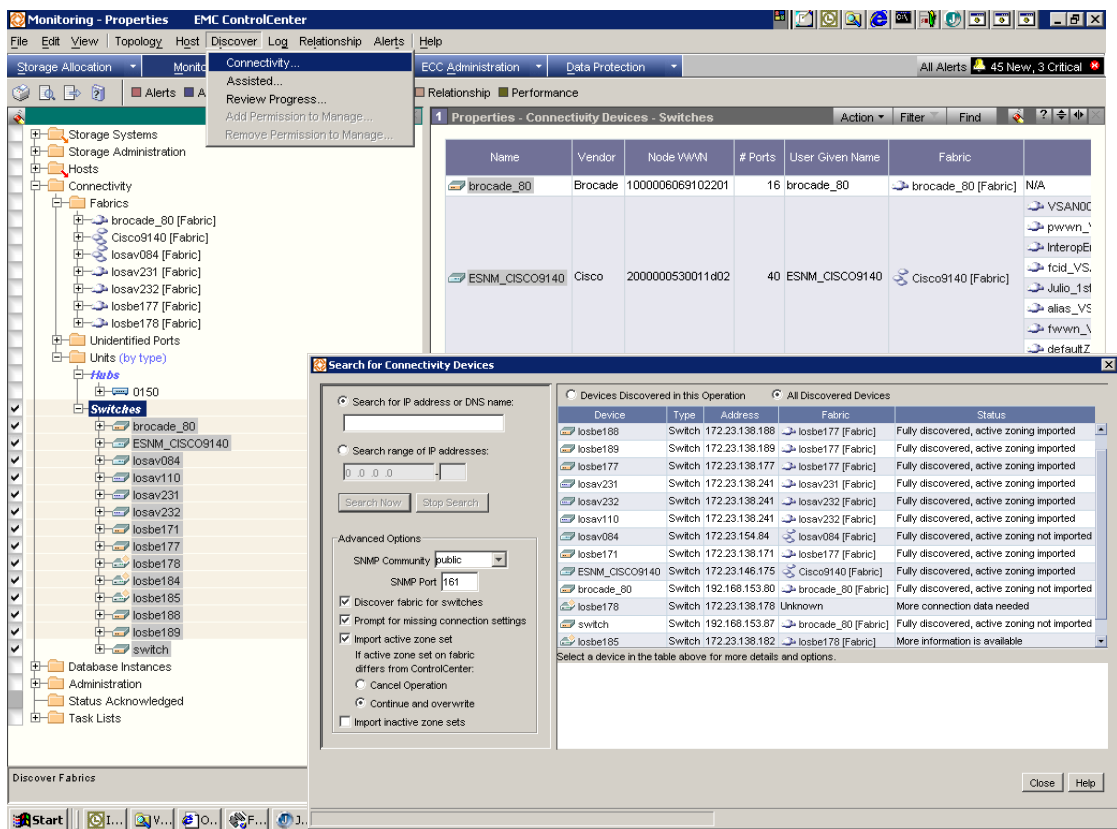


Figure 4-1 Search for Connectivity Devices Dialog Box

Topology Edit Service

Topology Edit Service (TES) allows the storage administrator to manually depict undiscoverable objects in the Console, and to associate unidentified ports with parent containers. For example, some objects do not have software-based management interfaces and are wholly hardware entities. You can depict these undiscoverable objects in the topology by providing some basic object properties. User-defined objects and their information are entered into the Repository and persist just like discovered information.

User-defined objects may be created and later discovered to have properties that do not match those that a user had defined earlier. If a user-defined object exists with the same properties as a discovered object, ControlCenter overwrites the user-defined properties and notifies the user by means of an alert.

Unassociated ports can be treated in the same way as undiscoverable objects. You can manually correlate unidentified ports with user-defined objects. Figure 4-2 on page 4-6 illustrates the Switch Identification dialog box.

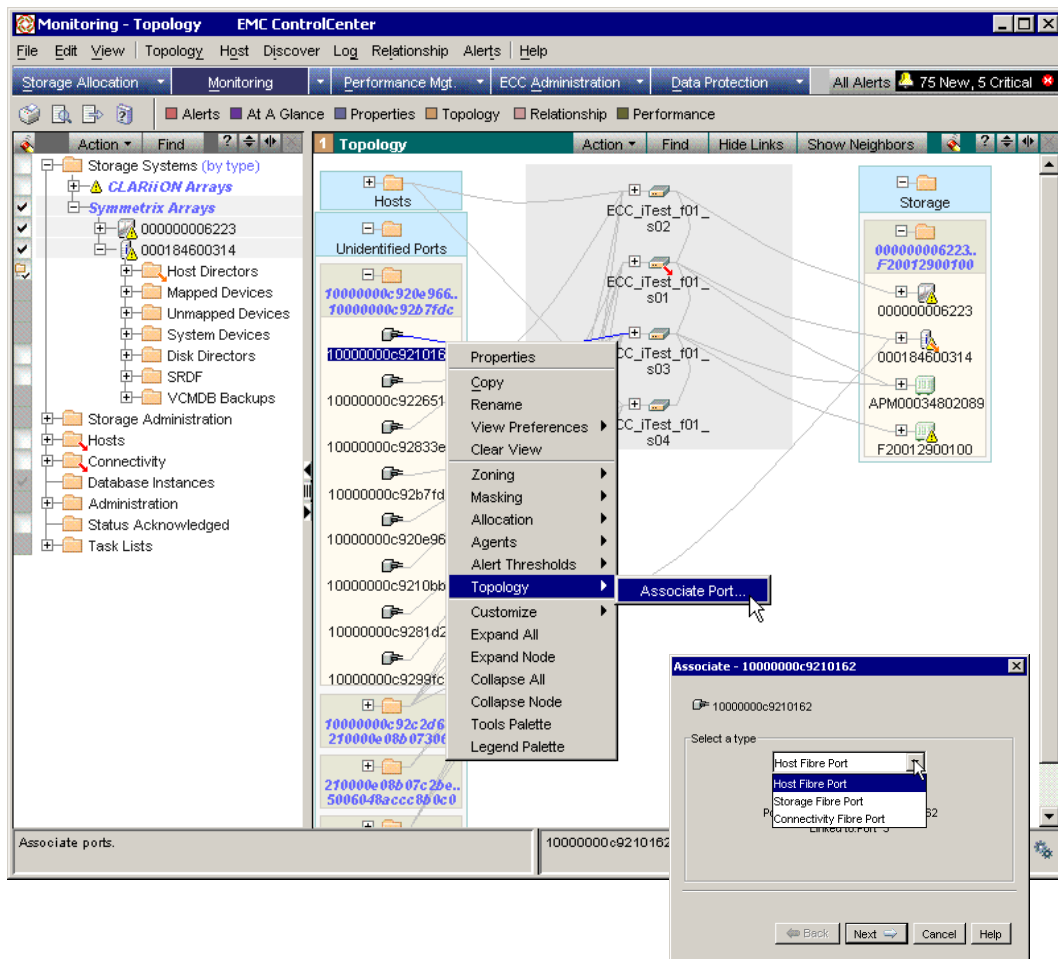


Figure 4-2 Switch Identification Dialog Box

Zoning Zoning enables a set of devices connected to a switched Fibre Channel fabric to communicate with each other; for example, a host and a storage array. Each zone groups the end ports of the devices involved, or the switch ports physically connected to those end ports. Using multiple zones, a single host can communicate with multiple storage devices, and vice versa.

A zone set is a collection of zones that can be activated together, partitioning a fabric into zones. Only one of the zone sets associated with a fabric can be active at any time. It is this active zone set that determines which of the devices connected to the fabric can communicate with each other.

Zones and zone sets can be created, modified, renamed, and deleted. A fabric's active zone set cannot be modified, but the active zone set can be changed by activating a different zone set.

Each fabric's zoning configurations are stored in the following folders in the Console tree panel, under the fabric's folder within the parent Connectivity folder:

Active Zone Set folder - Contains the current active zone set.

Planned Zone Sets folder - Stores inactive zone sets that have been created or modified by users, including a copy of the active zone set and a copy of the previous active zone set. Inactive zone sets imported from the fabric are also copied to this folder. Zone sets in this folder can be modified and activated.

Planned Zones folder - Stores inactive zone sets that have been created or modified by users. Inactive zones imported from the fabric are also copied to this folder. Zones in this folder can be modified.

Zone Sets and Zones folders - Located under each switch in the Switches folder. Inactive zoning configurations imported from the fabric are placed in these folders, then copied to the Planned Zone Sets and Planned Zones folder where they can be modified.

If zoning has not yet been imported from the fabric, all zoning folders are empty.

Virtual SAN

Most fabrics within ControlCenter are physical fabrics, meaning that the fabric must contain all of the switches that are physically connected together, and that these switches can represent one and only one fabric. A group of physically connected Cisco switches, however can represent a logical fabric, called a VSAN. Because a logical fabric is created by specifying the switch ports to be included, rather than switches themselves, a group of physically connected Cisco switches can represent more than one logical fabric; each logical fabric includes only a subset of the switch ports in the physical fabric.

Switches in a Cisco physical fabric can have different ports in different logical fabrics, and a special kind of switch port called a trunking E_Port can belong to more than one logical fabric. Whatever end port is connected to a physical switch port becomes a member of that port's VSAN.

Troubleshooting Paths

SAN Manager lets you view what paths exist (the mapping or I/O path) between a host device and a storage logical volume across a SAN. The information in the Path Details view correlates data received from host agents. Only ports and fabrics that have viable connectivity appear in the Path Details view.

The Path Details view displays host-to-storage path information in both tabular and graphic form. It is a diagnostic tool used to:

- ◆ Troubleshoot paths.
- ◆ Identify the host and storage devices at the endpoints of paths.
- ◆ View the host, connectivity, and storage elements in a path.
- ◆ View the zoning status of a path.

In order for a path to appear in Path Details view, host access to a storage array must have been granted through the ControlCenter's masking utility.

Figure 4-3 shows a Path Details view for the selected HBA.

Monitoring - Path Details EMC ControlCenter

File Edit View Topology Host Discover Log Relationship Alerts Help

Storage Allocation Monitoring Performance Mgt. ECC Administration Data Protection All Alerts 75 New, 5 Critical

Path Details Alerts At A Glance Properties Topology Relationship Performance

Free Space Visual Storage Masking

Path Details - APM00034802089

By Storage For CLARiiON

Storage Array	Storage Group	Volume	Is Connected?	Is Mapped?	Is Zoned?	Has Access Rights?
APM00034802089	losbe147	LUN 40	ECC	Yes	Yes	Yes
APM00034802089	losbe068	LUN 36	ECC	Yes	Yes	No
APM00034802089	losbe147	LUN 22	ECC	Yes	Yes	Yes
APM00034802089	losbe147	LUN 23	ECC	Yes	Yes	Yes
APM00034802089	losbe068	LUN 49	ECC	Yes	Yes	No
APM00034802089	losbe068	LUN 19	ECC	Yes	Yes	No
APM00034802089	losbe147	LUN 6	ECC	Yes	Yes	Yes
APM00034802089	losbe147	LUN 50	ECC	Yes	Yes	Yes

Diagram showing storage array APM00034802089 connected to LUN 36, which is mapped to Port 1 of the ECC_Test_f01 s01 [Fabric] storage system.

Figure 4-3 Path Details View for the Selected Storage Array Masking

Masking

Masking is the management of host access to logical devices (LUNs) in storage arrays. Masking provides a measure of efficiency and security by restricting host access to a defined set of logical devices on a given storage array. Masking is also referred to as LUN masking, LUN security, and storage device masking.

ControlCenter supports masking for the following vendor storage arrays:

- ◆ EMC Symmetrix
- ◆ EMC CLARiiON
- ◆ HP StorageWorks HSG-80
- ◆ HP StorageWorks XP 48/512
- ◆ HP StorageWorks XP 128/1024
- ◆ HDS 9500V Series and 9900V series
- ◆ SUN StoreEdge 9900V series

Masking must be enabled on a storage array or storage port before masking operations can be performed.

If masking is not enabled on a storage array/port, a host can see all the logical devices (LUNs) mapped to a storage port to which it is physically connected. After masking has been enabled on a storage array/port, you can configure host access to select logical devices through ControlCenter's masking functionality.

SAN Advisor

EMC SAN Advisor is a Web-based solution for the design, modeling, and validation of automated networked storage based on EMC's interoperability guidelines and best practices.

Generate Multiple Templates

SAN Advisor uses template solutions to networked storage design and validation. It is based on user and application storage requirements and generates a valid, comprehensive, networked storage blueprint with downloadable Microsoft Visio diagrams and Excel spreadsheets.

SAN Advisor allows you to use or modify pre-existing templates or to build your own array configurations. SAN Advisor generates descriptions for each template, showing performance, capacity, and scalability parameters and trade-offs for each configuration.

After the user defines an array configuration, SAN Advisor generates multiple topology configuration templates consisting of switch model, switch firmware, and all physical connections in the environment. Intelligent algorithms determine the connectivity requirements and the supported switches and topology configurations to meet these requirements. SAN Advisor accounts for required ISL ports and spare ports.

Perform Change Analysis

The initial design process is completed once you have defined a fabric topology. SAN Advisor then generates a diagram and spreadsheet that highlights the key configuration details including:

- ◆ Blueprints of all physical SAN connections
- ◆ Host, array, and topology configuration details
- ◆ Grouping of hosts by front-end port-sharing privileges
- ◆ Interoperability tables
- ◆ Cabling gridlines

After creating a configuration with SAN Advisor, you conduct modeling and "what-if" scenario analysis to assess the impact of proposed configuration changes. If you modify your configuration, your modifications are validated against the SAN Advisor rules base and you are updated with any informational, warning, or error messages related to these modifications. In addition, SAN Advisor tracks and displays the state of the configuration throughout the design process.

Go to <http://powerlink.emc.com>, for more information about SAN Advisor or contact your EMC sales representative.

Automated Resource Manager

Automated Resource Manager (ARM), which includes the application formerly known as Resource Availability, provides the storage provisioning, active host configuration, and automated alert fixes you need to respond to changing conditions in the data center.

ARM helps you manage storage from a host's perspective and brings many storage technologies into the same user interface, allowing you to monitor and manage products offered by numerous vendors. ARM can be used to locate available free space and actively provision storage capacity by performing host, SAN, and array configuration operations. It also provides real-time reporting, thresholds, alerts, and autofixes to facilitate either manual or automated policy-based management of host storage resources.

With Automated Resource Manager, you can:

- ◆ **Automate storage provisioning**
 - Allocate storage to a host.
 - Extend volume groups and logical volumes as well as file systems on a host.
 - Classify storage devices using pools and policies.
 - View available capacity accross your enterprise in Free Space views.
- ◆ **Simplify manual storage provisioning** by using GUI-based Console commands instead of command line interfaces
 - Add capacity to EMC PowerVolume™ file systems, VERITAS file systems, native file systems, volumes, and disk groups without remembering the commands and syntax.
 - Initialize multiple z/OS volumes at a time.
- ◆ **Improve performance**
 - Troubleshoot Windows disk and memory bottlenecks using snapshots of real-time performance conditions and recordings of performance conditions over time.
 - Troubleshoot UNIX host alerts by adding swap space and killing processes with too many threads.
 - Troubleshoot z/OS performance problems by mapping z/OS volumes to the Symmetrix physical disks on which they reside.

◆ **Ensure resource availability**

- Automate alert responses and add storage to file systems automatically when out-of-space conditions threaten.
- Manage Windows, UNIX, and Novell hosts with active commands.
- Monitor and manage z/OS hosts, including logical volumes, SMS-managed storage, and hierarchical storage.
- Monitor DB2 databases.
- Monitor and manage backup servers for Windows, and UNIX, including IBM Tivoli Storage Manager, VERITAS NetBackup, and LEGATO NetWorker.
- Automate alert responses with autofixes for Windows, UNIX, Novell, and z/OS hosts.

Viewing Free Space

When you are deploying a new application, adding a server to the network, or responding to space alerts, you can locate free space quickly across different types of storage arrays:

- ◆ Symmetrix
- ◆ CLARiiON
- ◆ HP StorageWorks
- ◆ HDS
- ◆ HP XP
- ◆ ESS arrays

Automated Resource Manager performs the work of identifying and consolidating information about the free space in your environment. You can locate available space across the spectrum of accessibility; from unallocated storage on a Symmetrix, to configured storage mapped to a host and ready to use with a file system.

The Free Space View shows free space and allocated space for storage arrays related to a selected host or host cluster with options to get detailed information for HBAs, ports, devices, and pools.

The Storage Summary chart displays the following information:

- ◆ **Not Available** — Amount of storage designated for use within a storage array. This includes host accessible capacity, replicas, and system resource storage.
- ◆ **Available mapped** — Devices or capacity that have been mapped to the front-end ports in the storage array.
- ◆ **Available unmapped** — Devices or capacity that have been configured but not been mapped to one or more front-end ports.

From consolidated views of free space at the highest level, drill down into the hosts and arrays themselves, locating space with the requirements you have to satisfy.

Figure 4-4 on page 4-15 shows an example Free Space view from the perspective of a Symmetrix storage array.

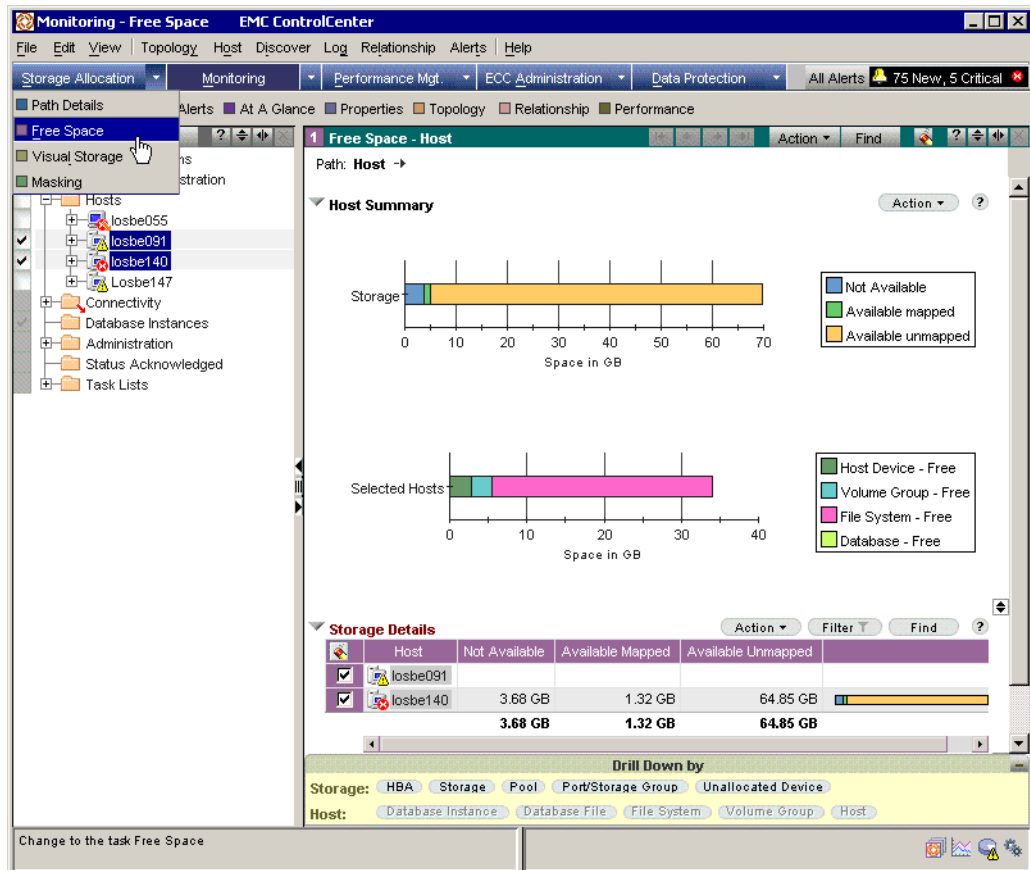


Figure 4-4 Free Space View from a Host Perspective

Reserved Devices

Devices that have been set aside for use by pending SPS tasks are considered *reserved*. Reservations are removed after the logical devices are allocated during task list execution or if a task list is deleted. If a task list fails, including a host rescan failure, reservations are not removed. Delete these task lists to ensure that devices in the task list are no longer reserved.

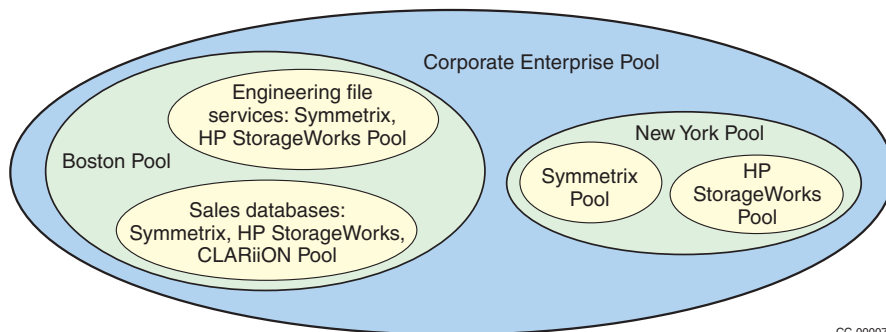
Storage Provisioning Services

ARM's Storage Provisioning Services (SPS) simplifies the way you allocate capacity for new hosts and applications or extend the capacity for existing ones. It enables you to request storage in terms of business needs such as performance, availability, and protection levels, using the concepts of storage pools and storage classes. SPS reduces the complexity of the provisioning process by allowing capacity to be configured based upon predefined policies.

Storage Pools

Storage pools are collections of heterogeneous storage elements from which the Storage Provisioning Services select storage for a particular host or application. You create each storage pool to reflect your organization. For example, in the following diagram, the Boston facility has created separate pools for the Engineering and Sales organizations. Each pool contains heterogeneous storage elements. The New York facility has storage pools that span the organization but are split according to storage array.

Refer to the EMC ControlCenter Storage Provisioning Glossary in the EMC ControlCenter Console Online Help for more information about these concepts.



CC-000076

Figure 4-5 Nested Storage Pools

Storage Provisioning Service Wizard

The actual host, SAN, and array configuration operations are linked together in a simple Storage Provisioning Services wizard that uses functionality available from Symmetrix Manager, Navisphere, common services for storage operations, SAN Manager for path configuration and SAN operations, and Automated Resource Manager for host operations.

This automated approach to storage provisioning lets you:

- ◆ Search for available free space through Free Space views or automatically through the wizard.
- ◆ Perform only the necessary number of steps, depending on where the free space is and where you want it to end up: a file system, volume group, logical volume, or host.
- ◆ Define policies to define how the new storage should be protected, depending on the storage type.
- ◆ Use storage pools to search for free space. These are user-defined, can be defined by customer, by application, or by type (best performance, high availability), and can span one or more arrays.
- ◆ Search across currently accessible versus all possible storage.
- ◆ Consider the number of paths (multipathing).
- ◆ Use built-in EMC best practices.

The Storage Provisioning Services guide you through the main steps in allocating storage. Figure 4-6 on page 4-18 shows a dialog box.

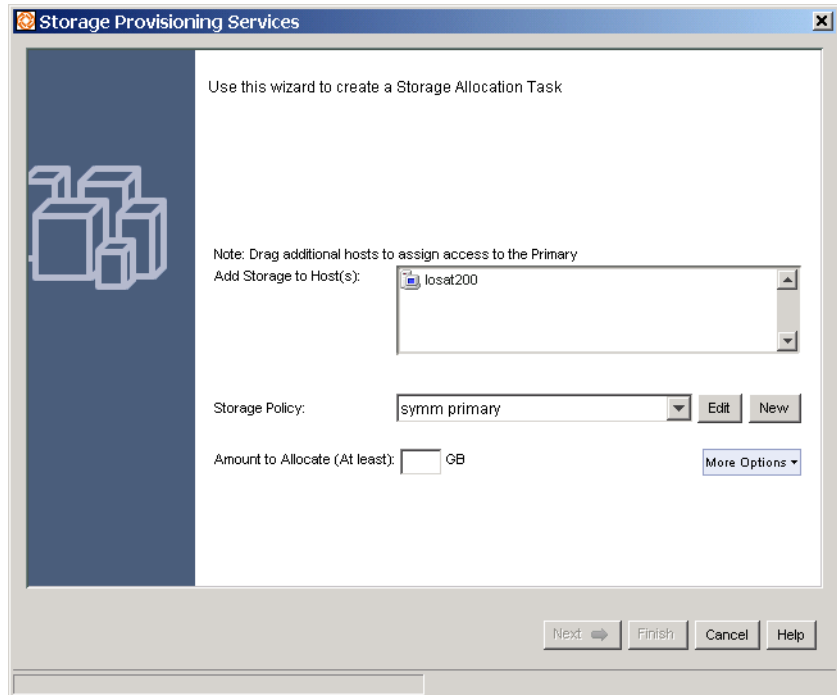


Figure 4-6 Storage Provisioning Service Dialog Box

The Storage Deallocation wizard helps you deallocate storage from hosts. You might deallocate storage to:

- ◆ Reclaim storage that was temporarily allocated to an application or department.
- ◆ Remove storage from a host that is being decommissioned.
- ◆ Migrate an application between hosts.
- ◆ Consolidate storage resources for increased efficiency.

Storage Provisioning Services assists you in deallocating storage by:

- ◆ Verifying that host file systems, logical volumes, or volume groups are no longer in use before devices that they use are deallocated.
- ◆ Performing tasks that are often overlooked or forgotten when deallocating storage, such as removing masking access rights, removing Symmetrix devices from device groups, and deallocating replica devices when a primary device is deallocated (in your deallocation policy, you can choose which of these tasks is performed).

Deallocating storage with the Storage Provision Service removes the relationship between hosts or unidentified ports and the storage array devices to which they have access. Refer to *EMC ControlCenter 5.2 Storage Provisioning Services* for more information.

Host Management

Each host agent contains the functionality to perform the daily SRM tasks and problem analysis required to ensure the best utilization of resources on that host.

Using the Explore function of each host agent, you can navigate the data structures on the agent host to search for files anywhere in the enterprise. Agents provide:

- ◆ Active commands for Windows, UNIX, Novell, and z/OS hosts.
- ◆ Discovery, monitoring, and active commands for z/OS logical storage. Among the many benefits is enhanced Relationship view data showing z/OS storage from the volume serial to the back-end Symmetrix physical disks.
- ◆ Discovery, monitoring, and active commands for backup applications, including IBM Tivoli Storage Manager, LEGATO NetWorker, and VERITAS NetBackup.
- ◆ Utilities and reports for DB2 databases on z/OS. ControlCenter can now manage up to 500 DB2 subsystems per host.
- ◆ Additional management functions for Oracle databases on Windows and UNIX.

Right-click menus for each host listed in the tree panel or displayed in the target panel enable you to make changes at the file, system, or database level on the selected host. Figure 4-7 shows several host objects selected in the tree panel and their corresponding properties displayed in the target panel.

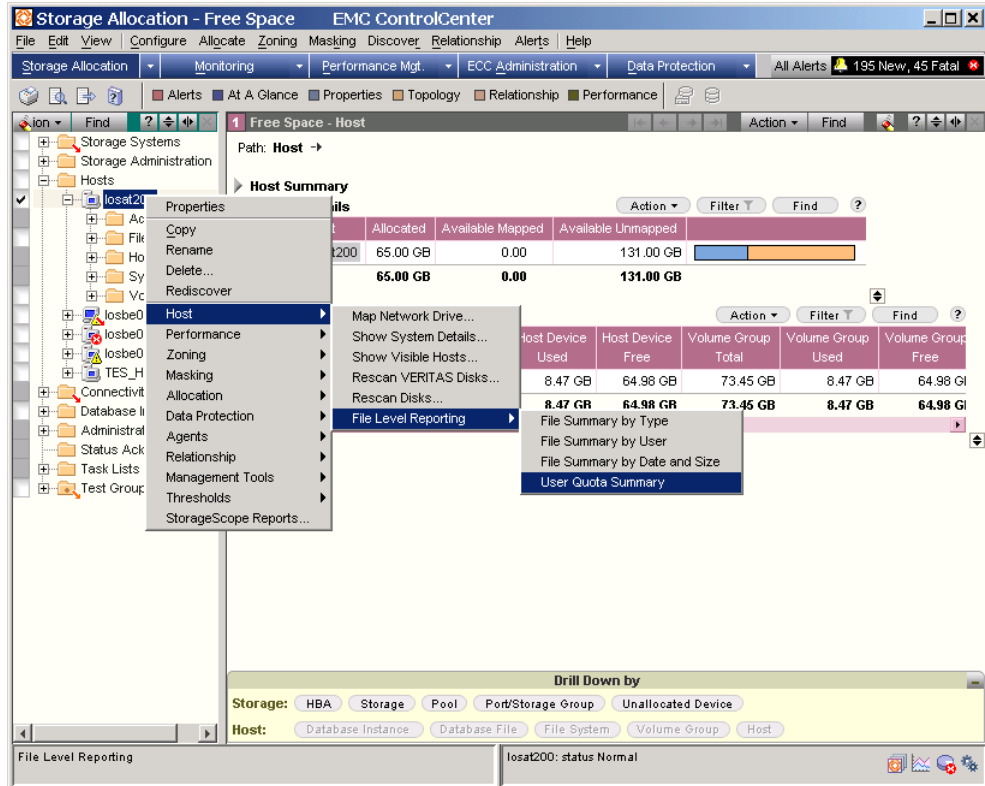


Figure 4-7 Monitoring Host Objects

Autofixes

To help streamline your storage management activities, ControlCenter provides automatic responses, called autofixes, that you can attach to alerts.

An autofix specifies user-defined action(s) to take when an alert triggers. This can be any command or script that is valid on the system(s) to which the autofix applies.

There are some predefined autofixes. For example, ControlCenter provides an alert that triggers when a Windows event log reaches a certain size. You can attach an autofix to this alert, which automatically backs up and clears the event log. You can create your own autofixes as well. To create your own autofix, specify the name of a shell script, Perl script, or an executable that should run when an alert triggers. You then attach this autofix to one or multiple alerts.

Monitoring and Reporting

The SRM Monitoring and Reporting solution allows you to effectively utilize your storage assets, manage your inventory, and assess how your storage is performing.

The applications included in the Monitoring and Reporting solution include:

- ◆ StorageScope
- ◆ Performance Manager
- ◆ StorageScope File Level Reporter

StorageScope

StorageScope is an EMC ControlCenter product that provides a variety of SRM reports to help customers assess their current storage environment, determine future storage requirements, and provides capacity utilization reporting.

For detailed information about StorageScope reports, refer to the *EMC ControlCenter StorageScope Reference Guide*.

Because StorageScope is fully integrated with ControlCenter, it uses many common ControlCenter components and services. For example, StorageScope:

- ◆ Populates its reports with data that has been gathered by ControlCenter agents and stored in the Repository.
- ◆ Collects and correlates metrics across:
 - host databases, file systems, and volume managers
 - switches
 - arrays
 - backup applications
- ◆ Uses ControlCenter security and access management services to grant users access to StorageScope.
- ◆ Provides file-level summaries by age and size distribution.

- ◆ Employs ControlCenter object management services for grouping storage assets by line of business, location, application, billing center, or other concept. This allows users to customize StorageScope's reporting capabilities to meet specific business needs.

Report Types

For increased flexibility, users can create custom report layouts and can also export reports into CSV, PDF, or XML format. Integration with open-source applications (for example, billing or customer care) is enabled through standard SQL views into the ControlCenter Repository and direct access to StorageScope XML files.

For more information about using the StorageScope API to access Repository data, refer to the *EMC ControlCenter StorageScope API* document.

Figure 4-8 demonstrates how StorageScope reports can be accessed from the Console tree panel.

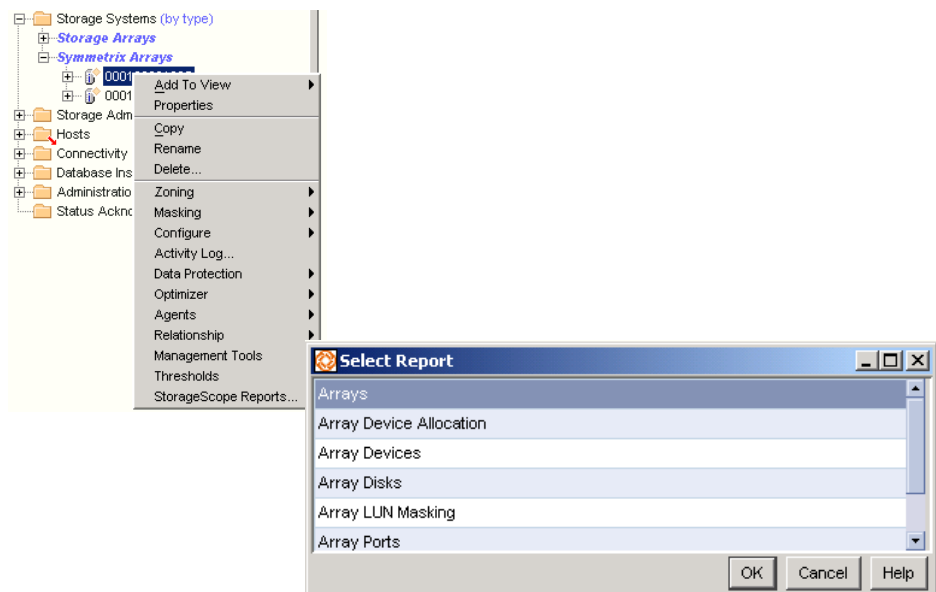


Figure 4-8 Selecting a Report

Figure 4-9 shows the StorageScope Reports Home page.

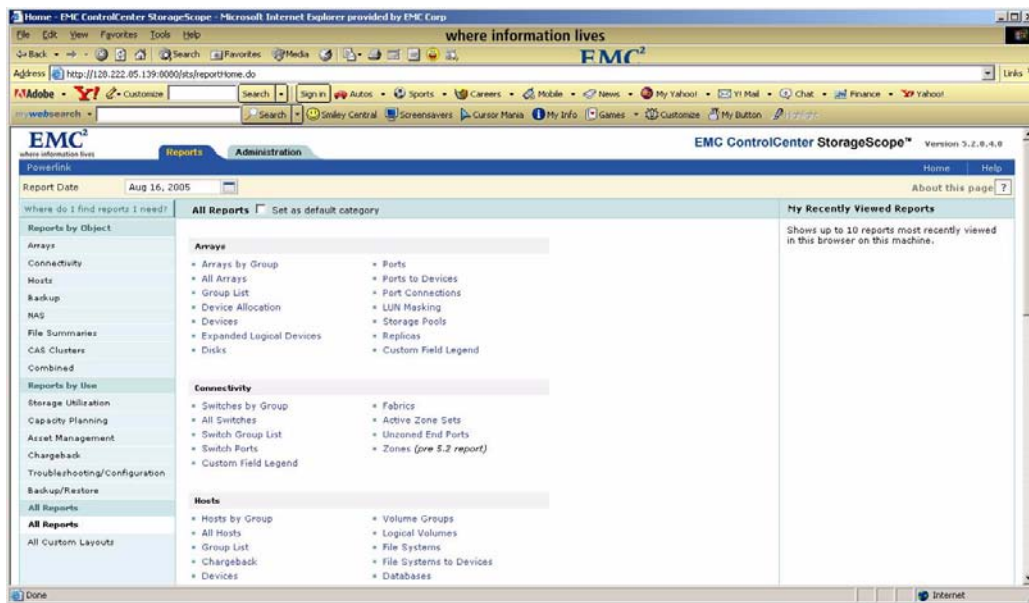


Figure 4-9 StorageScope Home Page

For more information on StorageScope, refer to the EMC StorageScope Online Help, which is available from the StorageScope Help menu, the *EMC ControlCenter StorageScope Reference Guide*, or *EMC ControlCenter StorageScope API* document.

StorageScope File Level Reporter

The StorageScope File Level Reporter (FLR) allows you to manage file-related storage activity and capacity. Once the file-level detail information is collected and reports are run, you can define policies that then take action based on that detail.

File-level actions include:

- ◆ Staging data to less-expensive storage, and then automatically deleting it after a set period of time.
- ◆ Moving or copying data to a new SAN or NAS.
- ◆ Running open-source applications natively on the system that the agent is on, such as TAR or a LEGATO backup process.
- ◆ Compressing the data into a local zip file that allows users to access the data at a later time.
- ◆ Deleting unwanted, non-business related files or stale files.

Once the actions are defined as policies, they can be:

- ◆ Scheduled to run on a weekly, daily, or monthly schedule.
- ◆ Run interactively as needed.
- ◆ Run based on a threshold or an event alert.

Basically, what was once a manual process or script, can now be converted to policies using StorageScope FLR.

Figure 4-10 on page 4-26 shows a StorageScope FLR view.

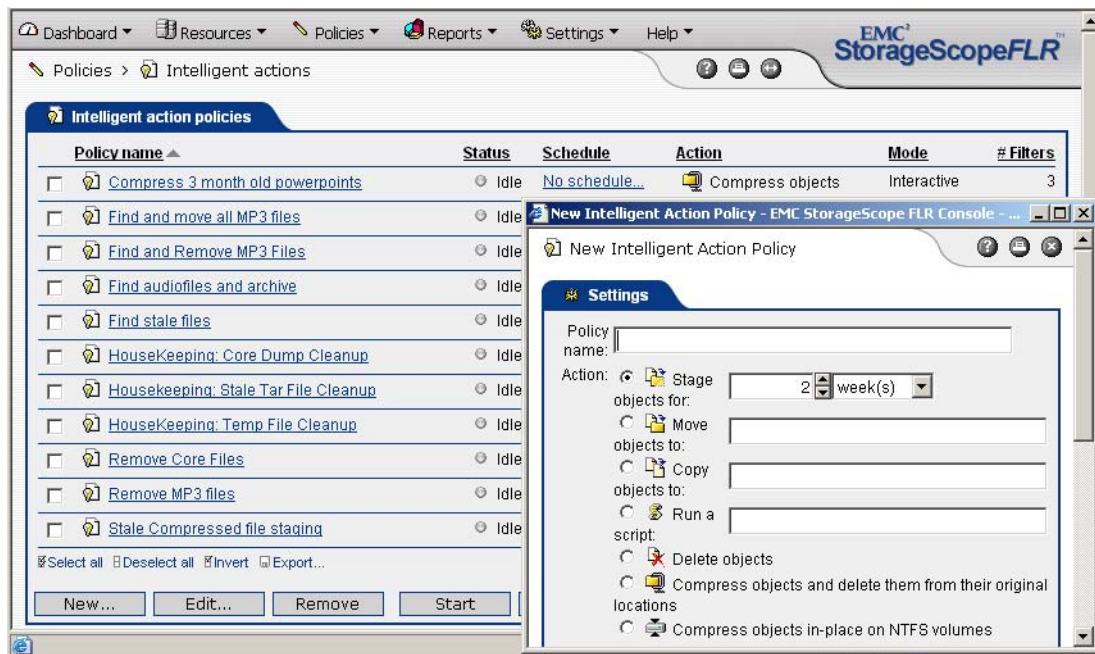


Figure 4-10 StorageScope File Level Reporter

Performance Manager

Performance Manager supplements the real-time performance and statistical data displayed in the Console Performance view through a feature-rich performance analysis engine. It helps you answer questions such as:

- ◆ Are my backups running successfully?
- ◆ Are they running fast?
- ◆ Which hosts are performing poorly and when?
- ◆ How active are my servers today compared with six months ago?

Performance Manager provides both historical reporting and real-time event polling. By analyzing historical trends, you can predict future capacity. You can also measure the impact of any changes you make to the configuration.

Performance Manager collects, archives, and displays performance information for:

- ◆ Hosts (Windows, UNIX, and z/OS)
- ◆ File systems
- ◆ Oracle databases
- ◆ SAN elements
- ◆ EMC Symmetrix and CLARiiON storage arrays

Workload Analyzer Archiver

The Workload Analyzer Archiver processes and stores the data in a collection file as Performance Archives, Revolving data, and Analyst data (known collectively as WLA Archives). The amount of data that is stored by the Workload Analyzer Archiver is determined by the WLA Retention policy.

Performance Manager

Performance Manager presents data on specified managed objects in a tabular or graphical format. The data can be performance or configuration data—archived or real-time—filtered by user-specified criteria. Figure 4-11 on page 4-28 shows a sample view.

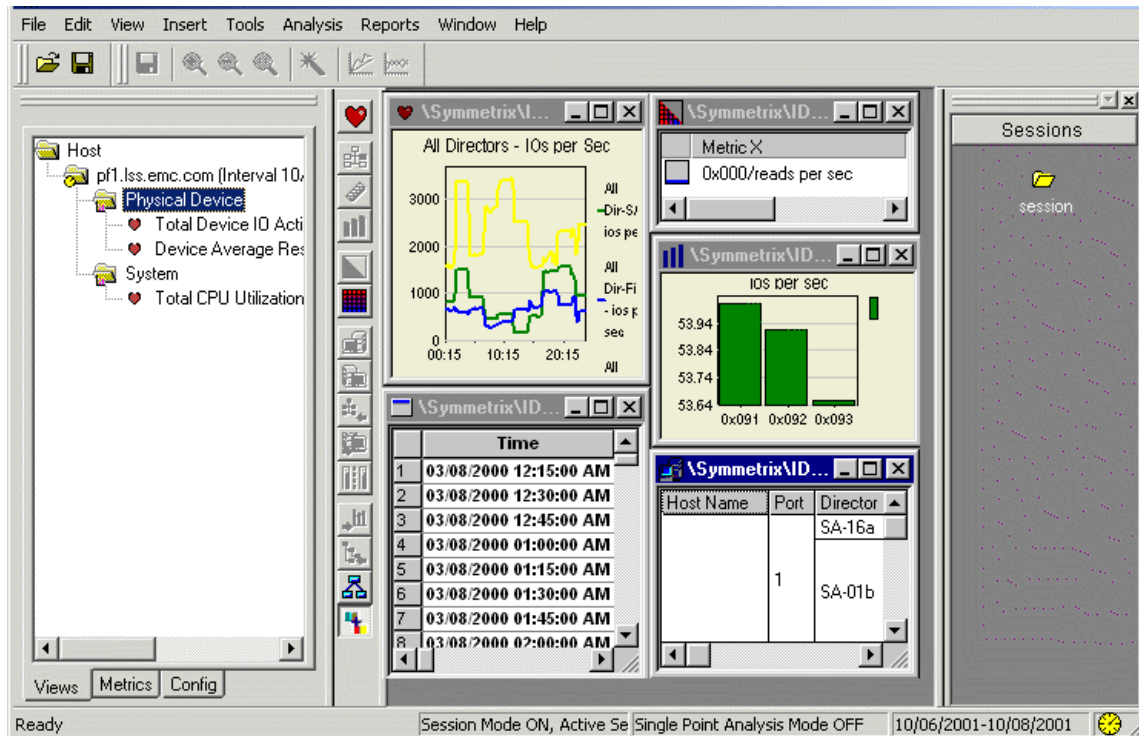


Figure 4-11 Performance Manager View

Performance Manager allows users to create their own graphs from specified managed objects. It can also display performance and configuration data in tables with behavior similar to Microsoft Excel tables. Every graph and table derives its statistics from the collections. The user can view historical reports side by side for multiple data providers.

You must install and start the Performance Manager application separately from the ControlCenter Console. However, Performance Manager does use ControlCenter to gather and retain its data.

Storage Device Management

The SRM Storage Device Management solution allows you to manage your storage environment including Symmetrix, CLARiiON, non-EMC storage arrays, network-attached storage (NAS), and CAS.

Storage Device Management includes the following products:

- ◆ Navisphere Manager
- ◆ Symmetrix Manager
- ◆ Symmetrix Optimizer

Storage agents contain the functionality to perform the daily storage management tasks and problem analysis required to ensure the best utilization of resources.

Different functionality is available for different storage arrays.
Table 4-1 details which information is available for each array.

Table 4-1 Array Functionality

	EMC Symmetrix	EMC CLARiiON	HP StorageWorks	HDS	Celerra/NetApps	IBM ESS
Health	Yes	Yes	Yes	Yes	Yes	Yes
Properties	Yes, through physical disk	Yes, through LUN	Yes, through LUN	Yes, through LUN	Celerra through LUN; NAS through physical disk	Yes
Real-time explore through agent	No	Yes	Yes	Yes	No	No
Relationship view	to physical disk	to LUN				
SAN topology	Yes, includes front-end director and port			Yes	Yes	Yes
Visual Storage						
- Front-End	Yes	Yes	Yes	Yes	No	No
- Back-End	Yes	No	No	No	No	No
Performance data (volume)	Yes	No	No	No	No	No
Physical configuration of array	Yes	Yes	Yes	No	No	Yes
Storage provisioning	Yes	Yes	Yes	No	No	No
LUN masking	Yes	Yes	Yes	No	No	No

ControlCenter provides several different products that enable you to discover, monitor, and collect data for the following storage arrays. Table 4-2 summarizes these products.

Table 4-2 **Storage Array Management**

Product	Storage Array
Symmetrix Manager	EMC Symmetrix, including DMX/800/1000/2000, DMX-3
CLARiiON Manager	EMC CLARiiON FC4700, FC4500, FC5300, CX200, CX300, CX400, CX500, CX600, CX700
Celerra Manager	EMC Celerra NS600
OIC	HDS 9900, 9900V HP XP48, XP128, XP512, XP1024
	HP StorageWorks HSG-80
	IBM ESS F10, F20, 800, 800 Turbo IBM RAMAC Virtual Array and StorageTek Shared Virtual Array

Array Managers

Using array agents you can discover, explore, report, and view configuration attributes and status. Some agents also enable you to:

- ◆ View the topology, relationships, properties, and alerts for a storage array. For more information, refer to *Common Console Views* on page 3-10.
- ◆ Display the configuration of the storage array through the Visual Storage view (CLARiiON, HDS, and HP StorageWorks).
- ◆ Automatically allocate storage on a CLARiiON or HP StorageWorks array through Storage Provisioning Services.

You use the native array management tools, such as Navisphere, for additional active management capabilities.

Figure 4-12 shows the Visual Storage view of a CLARiiON array. Compare it with Figure 4-13, *Visual Storage View of a Symmetrix System*, on page 4-37.

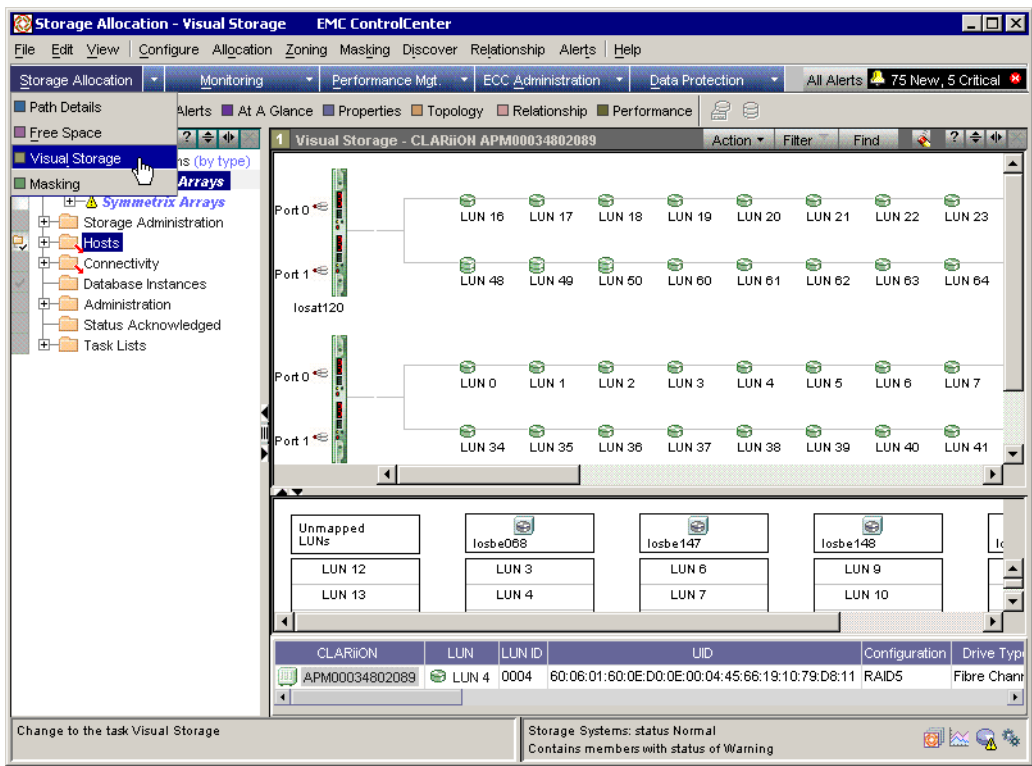


Figure 4-12 Visual Storage View of a CLARiiON System

Navisphere

Navisphere is a stand-alone CLARiiON monitoring and configuration management tool. CLARiiON alerts are propagated to the Alerts views and Navisphere can be launched to perform detailed monitoring and configuration. The Storage Agent for CLARiiON collects CLARiiON configuration, performance, and status information and stores it in the Repository for use in other ControlCenter functions such as topology and relationship mapping.

Symmetrix Manager

Symmetrix Manager provides real-time monitoring, configuration, and control of Symmetrix storage arrays. Symmetrix Manager enables you to:

- ◆ View the topology, relationships, properties, performance, and alerts for a Symmetrix storage array. For more information, refer to *Common Console Views* on page 3-10. Display Symmetrix configuration (Visual Storage view).
- ◆ Display the physical layout of a Symmetrix array (Physical Display view).
- ◆ Change Symmetrix configuration.
- ◆ Log all activity with connected hosts.

For information on automatically allocating storage on a Symmetrix array, refer to *Storage Provisioning Services* on page 4-16.

Symmetrix Configuration

Typically, you allocate storage to hosts using the Storage Provisioning Services and related functionality. This is described more fully in *Storage Provisioning Services* on page 4-16.

However, if you want to configure Symmetrix storage devices manually, a number of functions are available (depending on the supported Enginuity™ Operating Environment):

- ◆ **SDR** — Controls mapping of devices to Symmetrix front end ports. This option lets you bring previously unallocated devices online to a specific port or directory to provide extra storage, and lets you redistribute devices between ports to balance workloads.
- ◆ **Logical Device Configuration** — Configures additional storage capacity from unused physical disks within a Symmetrix.
- ◆ **Meta Device Configuration** — Creates new and configures existing members of meta devices.
- ◆ **Port Flag Settings** — Configures the flag settings on Symmetrix Fibre Channel and SCSI front-end ports used to communicate with a host.
- ◆ **Device Type Definition** — Converts between DRV, BCV, STD, VCM, WORM, and so on devices.
- ◆ **Device Attribute Definition** — Specifies attributes such as RDB Checksum and Dynamic RDF.
- ◆ **Device Protection Definition** — Defines the level of protection for a logical device.
- ◆ **SRDF Device Definition** — Defines a local device and a remote device as an SRDF pair.

EMC SNAP

Using EMC Snap to perform virtual copying operations provides a space-saving method of creating instant, point-in-time copies of logical volumes. Snapping to a virtual device (VDEV) creates the appearance of copying volumes by simply copying the original data from changed tracks and the pointers to that data.

The EMC Snap operation uses two types of devices: VDEV and SAVE. A VDEV device contains pointers to the changed data, while a SAVE device holds the actual data that has been changed.

This technique also provides you with considerable flexibility in managing data on volumes that can change daily. Snapping to virtual devices is a space-efficient way to capture one or many point-in-time copies of a logical volume with a low change rate (for example, 20 percent or less).

Snapping to virtual devices uses a copy-on-first-write technique as a way to conserve disk space when making copies. Only writes to tracks on the source device or target virtual device cause any incremental storage to be consumed. The space savings using virtual devices can be significant when you consider that most applications change only a small percentage of data on a volume. However, you can expect performance degradation that varies according to application characteristics and I/O profile.

EMC Snap operations allow you to copy data from a single source device to as many as 16 target devices. The target of a copy operation is a Symmetrix virtual device, and the copy operation (also referred to as a virtual snap) performs a copy of those tracks identified by track pointers on a virtual device. Copying occurs only when there are writes to the source or target devices. The snap pair state remains CopyOnWrite until you terminate the copy session or all tracks have been written to.

Although you can create VDEVs with the Logical Device Configuration dialog box (with eccadmin rights), EMC recommends you do this with guidance from EMC. Creating VDEVs consumes additional system cache and storage resources utilized for other key system operations. Also, proper SAVE device sizing needs to be assessed to ensure sufficient space for the additional VDEV operation. You should work with the EMC Regional Technical Specialist when creating VDEV and SAVE devices.

Visual Storage View

The Visual Storage view allows you to view a highly configurable graphical display of the storage array. In the case of a Symmetrix storage array, the configuration details include all directors, channels, cache, ports, and volumes, as well as the links between them.

Visual Storage has three panels:

- ◆ The upper panel displays the storage devices from the host perspective.
- ◆ The middle panel displays the storage devices from the disk drive director perspective.
- ◆ Depending upon the specific device covered by the mouse pointer at each point in time, the lower panel is a table that shows dynamically changing information.

By comparing the upper and middle panels, you can easily see the relationships between the front-end and back-end directors and devices.

Figure 4-13 shows an example Visual Storage view for a Symmetrix array. Figure 4-12 on page 4-33 shows a Visual Storage view for a CLARiiON array for comparison.

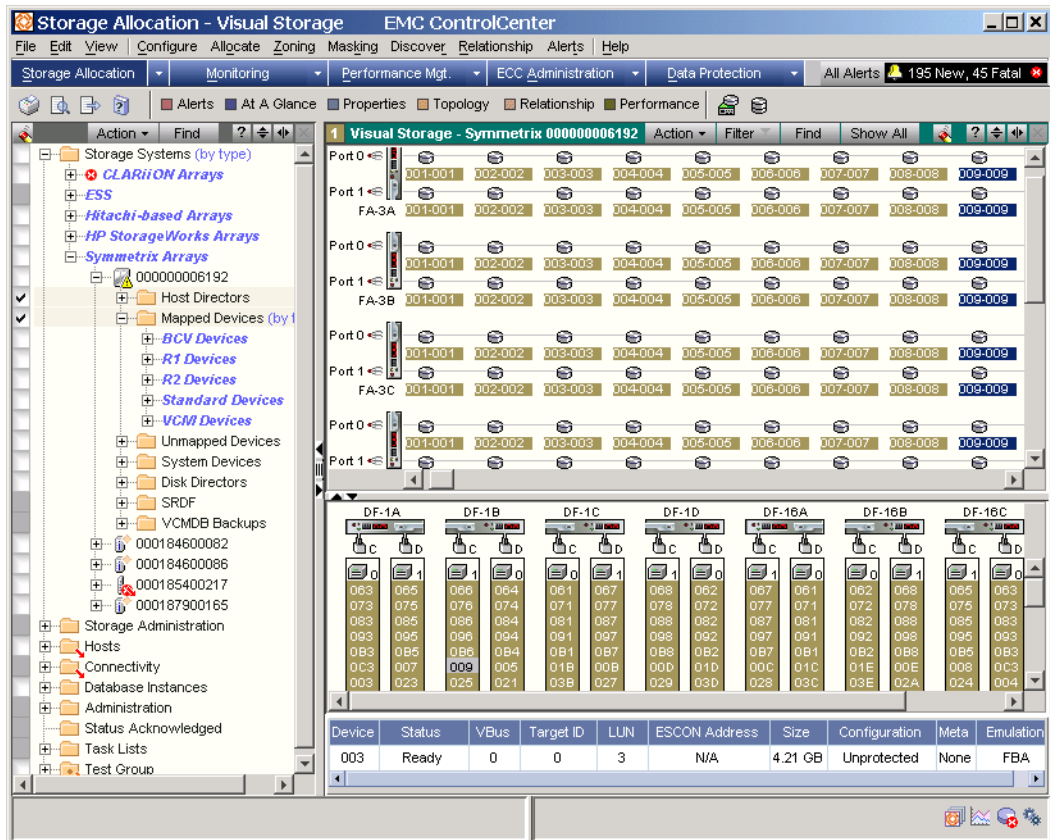


Figure 4-13 Visual Storage View of a Symmetrix System

Physical Display View

The Physical Display view shows a picture of the front and rear views of a Symmetrix system together with some general information about the Symmetrix array, such as its serial number and name.

As you interactively check and uncheck devices in the tree panel, the Physical Display view in the target panel changes to reflect your selections, thus helping you locate a physical device in your Symmetrix system, if you know only the logical device identifiers.

TimeFinder Manager and SRDF

Data protection, in the context of ControlCenter, covers two related functions:

- ◆ **TimeFinder** — Addresses business continuance needs by creating separately addressable mirrored logical devices within the *same* Symmetrix array as the primary devices.
- ◆ **SRDF** — Addresses disaster recovery needs by creating and maintaining separately addressable mirrored logical devices on a *remote* Symmetrix array. By maintaining real-time copies of data in different physical locations, SRDF enables you to recover from disasters or planned outages, or perform data center migration with minimal impact.

TimeFinder

TimeFinder manages the relationship between standard storage devices (STD) and separately addressable mirrored volumes (BCV) within the local Symmetrix system. These mirrored volumes contain a copy of the data while the original device is online for regular I/O operation.

You pair the BCV with a standard Symmetrix volume, establish a mirror image on the BCV, split the BCV from the standard device, manipulate the data (back it up or perform applications testing) on the BCV, and later reestablish the mirror image with the standard device. In normal operation, you would combine many STD/BCV pairs into a group and operate on the group as a whole.

Figure 4-14 shows a TimeFinder view showing the attributes of the BCV devices that are related to the selected objects. To perform actions on one or a group of BCV pairs, you select an action from the TimeFinder menu.

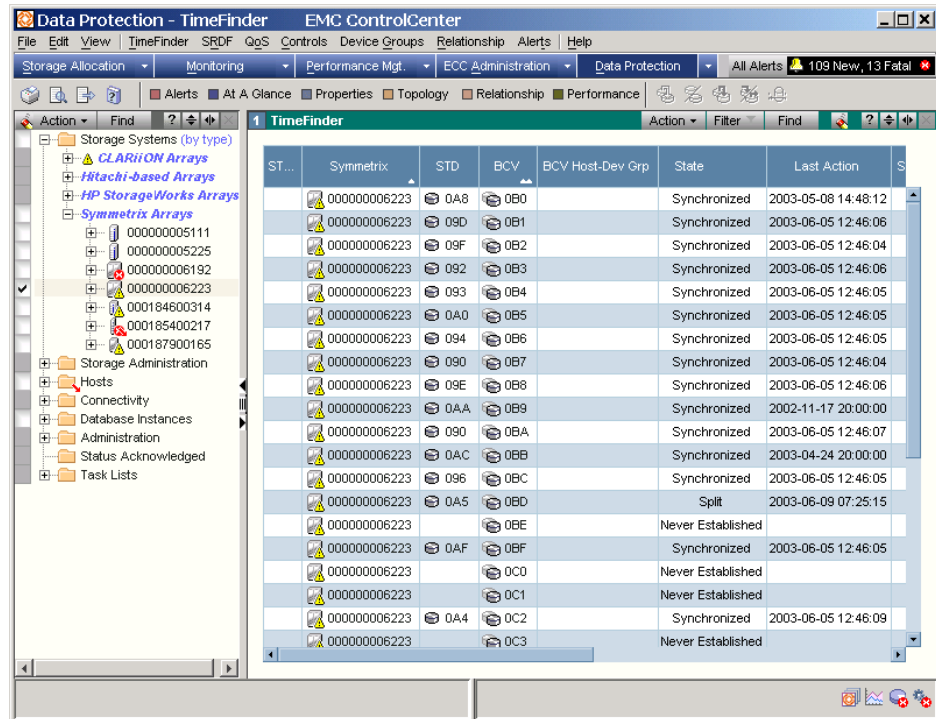


Figure 4-14 TimeFinder View

TimeFinder Clone

The TimeFinder clone feature allows you to make copies of data simultaneously on multiple target devices from a single source device. The data is available to a target's host instantly. You can copy data from a single source device to as many as 16 target devices. A source device can be either a Symmetrix standard device or a TimeFinder BCV device. A target device can also be either an STD or BCV device designated to be a clone.

Unlike a BCV mirror copy, which must be completely synchronized with its source, and then split to access the data, the clone copy activation makes data on the clone immediately accessible to its host, even while copying is occurring in the background. The following TimeFinder Clone commands are available in ControlCenter:

Create Clone Copy — Create the relationship between the source and target devices.

Activate Clone Copy — Activate the copy operations.

Terminate Clone Copy — End the relationship between the source and target devices.

SRDF

SRDF creates and maintains a mirror image of one or more logical volumes on a remote Symmetrix system. Before you can use SRDF, the local and remote Symmetrix systems must each be set up with at least two remote link directors (RLDs) through which the two systems are linked. The Symmetrix system being mirrored is designated as the source; the Symmetrix system maintaining the remote mirror is designated as the target. Information is transferred across the SRDF link from the source to the target system. SRDF systems can be up to 12,000 miles apart. (In practice, many customers simply link two Symmetrix systems and have each maintain a mirror of the other. In this case, each is both a source and a target, with information being transferred in both directions.)

Figure 4-15 shows the SRDF view listing the topology and attributes of SRDF devices. You perform SRDF operations from the SRDF menu.

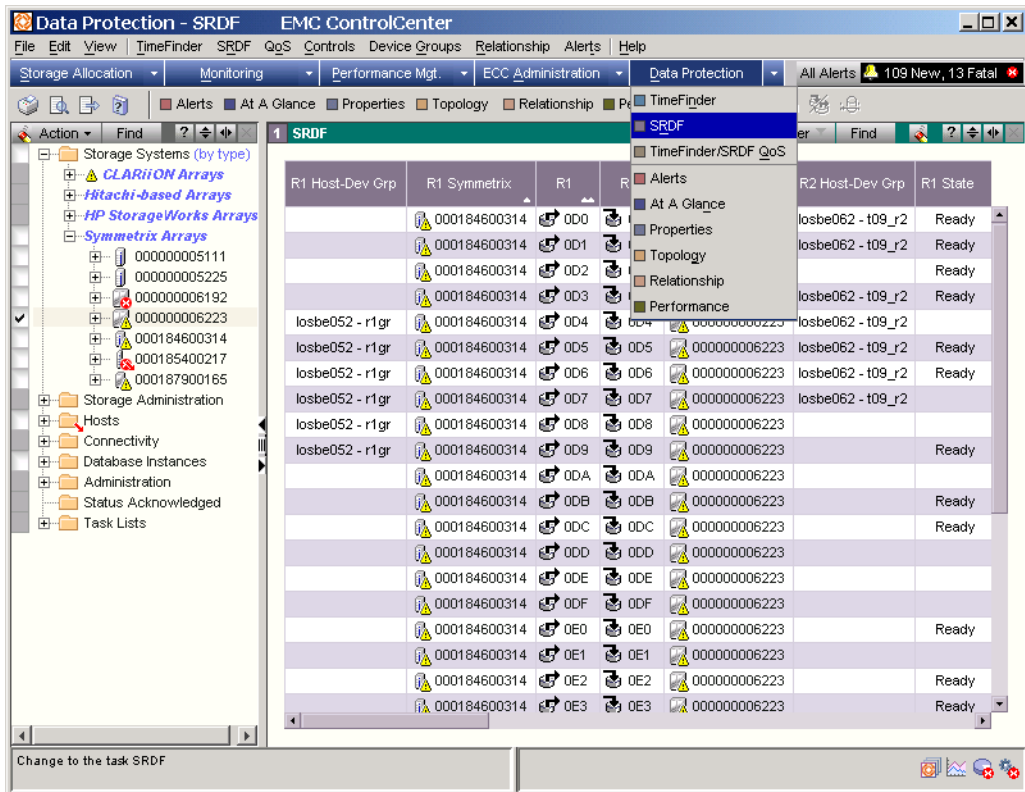


Figure 4-15 SRDF View

SRDF Asynchronous Mode

SRDF Asynchronous mode allows a group of SRDF R1 devices to group their I/Os into a cycle and periodically destage the data to the R2 side. This feature can be used when you determine that the cost of immediate replication is not required for certain classes of data.

- ◆ SRDF/A is supported only on pairs of Symmetrix DMX Series systems.
- ◆ All operations must be performed on either an RA group or a device group that contains all devices under that RA group. There are no controls for individual device pairs. You can only configure one SRDF/A group per DMX system.
- ◆ Dynamic SRDF operations are not supported for SRDF/A-backed devices.
- ◆ Concurrent SRDF devices that have an SRDF/A-backed mirror are not supported.

Mode Control

In the SRDF Mode Control dialog box, specify Asynchronous when setting the mode. This mode is available only for groups.

SRDF/A pair state

SRDF/A pairs within the group can have the state Consistent, indicating that the data they contain is maintainable after interruptions.

Active commands

The Mode Control dialog box allows you to specify the Asynchronous mode, and the Device Group wizard supports the creation of groups of SRDF/A pairs. Use RDFA Enable to enable consistency protection on SRDF/A-backed devices, and RDFA Disable commands to disable consistency protection.

All other relevant SRDF/A operations are supported in the normal SRDF dialog boxes.

Symmetrix Optimizer

Symmetrix Optimizer helps you increase the performance of a Symmetrix system by spreading I/O activity evenly across the physical disks. When a particular drive is in high demand, there is excessive head movement on that drive. This movement slows down read and write activity. By balancing highly active and less active logical devices across drives, seek activity is balanced, and contention among drives is reduced. Throughput within the overall Symmetrix system is improved, and you experience optimal response times.

Optimizer performs self-tuning of Symmetrix data configurations from the Symmetrix service processor by:

- ◆ Analyzing statistics about Symmetrix logical device activity.
- ◆ Determining which logical devices should have their physical locations swapped to enhance Symmetrix performance.
- ◆ Swapping logical devices and their data using internal Dynamic Reallocation Volumes (DRVs) to hold customer data while reconfiguring the system (on a device-to-device basis).

How Symmetrix Optimizer Works

Symmetrix Optimizer:

- ◆ Automatically collects logical device activity data, based upon the devices and time window you define.
- ◆ Identifies “hot” and “cold” logical devices, and determines on which physical drives they reside.
- ◆ Compares physical drive performance characteristics, such as spindle speed, head actuator speed, and drive geometry.
- ◆ Determines which logical device swaps would reduce physical drive contention and minimize average disk service times.
- ◆ Using the Optimizer Swap Wizard, swaps logical devices to balance activity across the back end of the Symmetrix array.

Optimizer is designed to run automatically in the background, analyzing performance in the performance time windows you specify and performing swaps in the swap time windows you specify.

QoS View

Quality of Service (QoS) allows you more flexibility in managing the performance of your Symmetrix array. By reducing the resources allocated for BCV or SRDF copy operations on selected logical volumes, you free Symmetrix resources and increase the overall performance of the other Symmetrix devices. Typically, you would assign the replication functions a lower priority during peak business activity.

For more information on Performance Management, refer to *Performance* on page 3-16 and *Performance Manager* on page 4-27.

Launching Open-Source Applications

Many open-source applications can be launched through the Console as if they were ControlCenter components.

Each application component must register itself on a host connected to the ControlCenter environment using an Integration Definition File (IDF). The launching mechanism discovers these components through the IDF file at runtime and launches the component on a defined host (possibly a host other than the component's host). For more information, refer to the EMC Powerlink website, <http://powerlink.emc.com>

What's Next?

This overview has provided a general introduction to ControlCenter.

If you now want to install ControlCenter, refer to the *EMC ControlCenter Planning and Installation Guide, Volume 1* for advice and guidance on planning your ControlCenter environment.

If ControlCenter is already installed, we recommend that you run the *Console Quick Start Tutorial* to learn the basic skills you need to use the Console effectively, and then read the *EMC ControlCenter Administration/User Guide* to learn how to use ControlCenter to manage your data storage environment.

The documentation library, which is available from the Console Help menu, provides information about using the Console and ControlCenter applications.

A

- Active Alerts view 3-17
- Active Integration 2-21
- Agent configuration 3-2
- agents 1-3, 2-14, 3-8
 - host 4-20
 - management 2-10
- Agents view 3-8
- Alert History view 3-17
- alerts 2-17
 - All Alerts button 3-17
 - autofixes 3-9
 - management 2-10
 - notification 3-18
 - templates 3-9
- Alerts view 3-17
- applications 4-2
- Assisted discovery 2-17
- At A Glance view 3-17
- authentication 2-10, 3-3
- authorization 2-10, 3-3
- autofixes 3-9, 4-13, 4-21
- Automated Resource Manager 1-6, 4-2
- Automatic discovery 2-16

B

- BCV 4-38
- BMC Patrol Enterprise Manager 2-20
- Brocade 1-11

C

- CA Unicenter 1-12, 2-20

- Celerra file server 1-11, 4-30
- Cisco 1-11
- CLARiiON storage array 1-11, 4-30
- Command History view 3-7
- common services 1-4
- Computer Network Technology Corp. 1-11
- configuration 2-15
- Connectivity device discovery 2-17
- Console 1-3, 2-4, 3-2
- count (metric) 2-17
- CSV format 4-23

D

- data collection policies 2-15, 3-9
- data model 2-11
- data protection 4-38
- device attribute definition 4-35
- device protection definition 4-35
- device type definition 4-35
- discovery 2-15, 2-16
- disk subsystem management 2-19, 4-29

E

- ECC Server 1-3, 2-10
- EMC Celerra 1-11
- EMC PowerPath 1-12
- event management 2-10

F

- framework applications 2-22
- Free Space view 4-14

H

HDS storage array 1-11, 4-30
 host management 2-18, 4-20
 HP LVM 1-12
 HP OpenView 1-12, 3-18
 HP OpenView Network Node Manager 2-20
 HP OpenView NNM VPO (ITO) 2-20
 HP StorageWorks storage array 1-11, 4-30
 HP Tru64 LSM 1-12
 HP XP 1-11
 HP/VERITAS VxVM 1-12

I

IBM AIX LVM 1-12
 IBM ESS storage array 1-11, 4-30
 IBM Tivoli Enterprise Console 2-20
 IBM Tivoli NetView 2-20
 IBM Tivoli Storage Manager 4-13
 Infrastructure 1-3
 installation 2-26
 Integration Gateway 2-4, 2-21
 interval (metric) 2-17

J

JBOD 1-11

L

LDAP 3-3
 LEGATO NetWorker 4-13
 licensing 2-10
 log utility 2-29
 logical device configuration 4-35
 login 2-10
 logs 2-15

M

managed objects 2-11
 Masking 4-10
 Master Agent 2-14
 McDATA/Connectrix 1-11
 meta device configuration 4-35
 MIB 2-21
 MicroMuse Netcool OMNIbus 2-20
 MicroSoft Operations Manager (MOM) 1-12, 2-20

migration 2-27
 monitoring 1-6
 Monitoring and Reporting 4-2

N

NAS 4-29
 Navisphere 4-34
 Navisphere Manager 1-7, 4-2
 Network Appliance filer 4-30

O

object management 2-10
 object model 2-11
 OIC 1-2
 Open Integration Components 1-2, 1-3
 open-source management 1-12

P

Passive Integration 2-22
 Performance Manager 1-6, 2-7, 4-2, 4-27
 performance statistics 2-15
 Performance view 3-16
 permissions 3-3, 3-5
 Physical Display view 4-38
 planning and provisioning 4-2
 plug-in products 1-2
 port flag settings 4-35
 Properties view 3-15
 provisioning 1-6
 proxy configuration 2-20

Q

Quality of Service (QoS) 4-44

R

rate (metric) 2-17
 Relationship view 3-13
 reporting 1-6
 Repository 1-3, 2-11
 retention policies 2-16, 4-27
 RLD 4-40
 rules 3-3, 3-4

S

- SAN 1-2
- SAN Architect 1-6, 4-2, 4-10
- SAN Manager 1-6, 4-2
- scalability 2-26
- SDR 4-35
- security 2-10, 3-3
- security management 3-2, 3-3
- SMI-S 1-12
- SNMP 1-12, 2-22, 3-18
- SNMP traps 2-10, 2-21
- Solaris 1-12
- Solutions Enabler 2-19
- SQL views 4-23
- SRDF device definition 4-35
- SRDF view 4-40
- SRM 1-2
- state (metric) 2-17
- status 2-15
- storage area networks 1-2
- storage arrays 4-30
- Storage Device Management 1-7, 4-2
- storage pools 4-16
- storage provisioning 4-17, 4-34
- Storage Provisioning Services 4-16
- storage resource management 1-2, 1-6
- StorageScope 1-6, 2-12, 4-2, 4-22, 4-23
- StorageScope File Level Reporter 1-6, 4-2
- StorageWorks XP 1-11
- Store 1-3, 2-13
- SUN 1-11
- SYMAPI 2-19
- SYMCLI 2-19
- Symmetrix Manager 1-7, 4-2, 4-34
- Symmetrix Optimizer 1-7, 4-2, 4-43

- Symmetrix storage array 1-11, 4-30

T

- Tape management systems 2-19
- TimeFinder 3-4
- TimeFinder view 4-38
- Tivoli Netview 1-12
- Tivoli products. *See* IBM
- Topology Edit Service 4-5
- Topology view 3-10
- Tree folders 1-5
- troubleshooting 2-28

U

- user groups 3-5
- user interface 1-3, 2-4
- users 3-3

V

- VERITAS NetBackup 4-13
- Visual Storage view 4-32, 4-36
- Volume Managers 1-12

W

- Web browser 2-4
- Web Console 1-3
- Web server 2-10
- Windows 2000 1-12
- WLA Archiver 2-12, 4-27

X

- XML files 2-7, 2-12, 4-23

