USING NETWORK APPLIANCE™ STORAGE SYSTEMS WITH IBM-RATIONAL CLEARCASE®

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1 SCOPE

This document describes the recommended policies and procedures for using network-attached storage (NAS) devices from Network Appliance, known as storage systems, in a ClearCase environment.

This discussion applies to all environments using Data ONTAP® v6.0 and Data ONTAP 7G and IBM-Rational ClearCase v4.1 or later. The following topics are discussed:

- IBM-Rational ClearCase Overview: The product, its key functionalities, components, and how those components interact
- Configurations: How a storage system is used in an IBM-Rational ClearCase environment
- Procedures: How to set up the storage system and the IBM-Rational ClearCase environment including specific commands
- UNIX® and Interop Procedure Guide
- Procedure Guide for Windows® Only
- IBM-Rational ClearCase Glossary

1.1   RELATED DOCUMENTS

The following documents are referenced in this discussion. (All IBM-Rational manuals are for ClearCase v2002, also known as v5.0.)

- Using Network-Attached Storage for VOBs and Views (white paper); IBM-Rational
- ClearCase Administrator's Guide; IBM-Rational
- Command Reference Manual; IBM-Rational
- Introduction for Rational ClearCase; IBM-Rational
- ClearCase VOB Database Troubleshooting (white paper); IBM-Rational
- Backup and Recovery of ClearCase Data (technical report); Network Appliance
- Data ONTAP System Administrator's Guide; Network Appliance
- Supporting the Rapid Pace of Software Development (solutions); Network Appliance
- Network Appliance Storage Solutions Certified for Use with Rational ClearCase (press release); Network Appliance

1.2 IMPORTANT CHANGES IN THIS REVISION

Structured and expanded "IBM Rational ClearCase Overview" including key functionalities, processes, hosts, explanation of component interactions, etc.

Added more definitions for Rational ClearCase Glossary appendix.

2   CLEARCASE OVERVIEW

This section contains:

- Brief Overview: Basic concepts and key functionality of the product and add-ons
- ClearCase Processes, File System and Hosts: Description of ClearCase Hosts, the File system associated ClearCase processes and data stores
- Using ClearCase

Many of the terms and definitions that appear in this section are also incorporated into the ClearCase Glossary. A term defined in the glossary is italicized in this section.

2.1   BRIEF OVERVIEW

IBM-Rational ClearCase is an enterprise critical software configuration management tool from IBM-Rational that stores and controls the evolution of "*artifacts*" in an organization. IBM-Rational ClearCase is available across both UNIX and Windows platforms.

Note: IBM-Rational ClearCase is also referred as Rational ClearCase or ClearCase throughout this document.

The key functions which Rational ClearCase provides are - Version Control, Workspace Management, Build Management and Process Configurability.

The following is a high level overview of how Rational ClearCase works. More detailed information is contained in "Change and Configuration Management" from IBM –Rational.

> http://www-306.ibm.com/software/rational/offerings/scm.html

At the heart of Rational ClearCase is a permanent, secure data repository which stores all the *artifacts*. This repository is called as *"Version Object Base"* or "*VOB*" in short. The VOBs have an embedded database which maintains and controls the data that goes "in" or "out" of the repository.

The paradigm is termed as the "*Checkout"–"Edit"–"Checkin"* process, resulting in version control. The *artifacts* are "read only" when checked in. Rational ClearCase creates an "editable" copy when you perform a checkout.

The VOBs usually reside on a centralized server, accessed by multiple client machines.

Users need to have their own private workspace configured to access the *artifacts* from the VOB. This workspace is called as a *"view."* The view workspace is in essence a directory tree that contains the artifacts stored in the repository.

A view basically acts as a filter. Though there are many versions of files and directories stored in a VOB, organized into version trees, the specific version of a particular file or directory that the user sees in a workspace is determined by the view. The control is achieved through set of rules called *configuration specification* (config –specs) defined for each view. Different views allow users to work on different change activities.
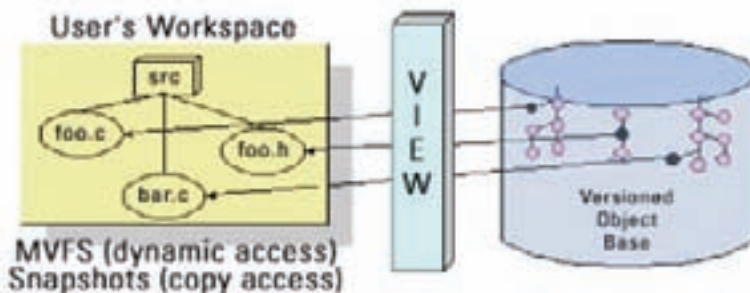

Figure 1) ClearCase functionality.

Work areas may be dynamic or snapshot. Dynamic workspaces access the VOB data in real time and allow more ClearCase functionality to be used. When working dynamically, the directory structure which a user uses is controlled by the *Multiversion File System (MVFS),* a virtual file system that is part of ClearCase. The ClearCase snapshot mechanism allows users to copy file versions selected by a view into a snapshot directory. Once a snapshot directory is downloaded, a user does not need to have access to the VOB repository or the view until they are ready to upload their changes. The user can work in a disconnected mode.

Note: Clearcase Snapshot directory and the WAFL® Snapshot™ are two different mechanisms.

Note: MVFS- Multi Version File System is discussed in the next section.

KEY FUNCTIONS

a. Version Control: Rational ClearCase goes far beyond source code control to version every object in software development lifecycle. By tracking changes to every file and directory, Rational ClearCase maintains complete version history of the artifacts. Users can quickly identify, rebuild and roll back to any previous version. Branching concept also offers users to create their own branches and work in parallel and then integrate (merge) their changes.

b. Workspace Management: A dedicated workspace (view) with its own set of rules for the artifact selection helps to access the appropriate versions without leaving their native Windows or UNIX development environment. This isolates the user from destabilizing changes.

c. Build Management: Rational ClearCase comes with inbuilt "make" utilities known as *"clearmake"* or *"omake,"* apart from the native make utilities available across the board. These utilities automatically produce a detailed bill of materials that documents the system builds, enabling users to completely and reliably recreate the environment of any build.

   In addition, Rational ClearCase also has a mechanism of sharing the build artifacts across different builds which in turn reduces the build cycles and enables parallel execution of build scripts.

d. Process Control: Additional configurability is available in Rational ClearCase through enabling customized processes. Triggers can be implemented using scripts. Metadata (labels, attributes etc) can be annotated which bring in more clarity to the said artifact.

IBM Rational ClearCase family has Rational ClearCase Multisite as an add-on product which goes with Rational ClearCase, allows the VOB repository to be replicated at multiple sites (usually across different geographical regions).

The set of *replicas* for a particular VOB is called a VOB family. Users can access the replica at their own sites. Manual or automatic synchronization process can be configured to propagate the changes made in each of the replicas.

2.2 CLEARCASE PROCESSES, FILE SYSTEM AND HOSTS

The Rational ClearCase network is distributed and scalable. But it is essentially made up of the following components: License Server, Registry Server, Backup Registry Server, VOB Server, and View Server.

Each of these components can be running on a single server or can be spread across different servers (barring few exceptions). For detailed information on how each of these components can be configured, refer the IBM–Rational ClearCase Administrator's guide.

2.2.1 ClearCase Server Processes

The following are the server processes which may be running on each host, depending upon how the host has been configured.

a. albd_server: The albd_server process is a long lived process runs on every ClearCase host and is the one which spawns the other processes when required. It handles a variety of tasks on configured hosts. The albd_server helps the client programs to use RPC (listens for RPCs on port 371) to connect with ClearCase servers. See the "ClearCase Hosts" and "Under the hood" subsections for more details.

b. admin_server: This process is invoked by the albd_server as and when needed; it basically performs miscellaneous administrative support functions and is short lived.

c. view_server: It's a long lived process which manages the activity of that particular view, reads the config spec and tracks the modifications to view private files.

d. vobrpc_server: Handles the request from the view_server (both metadata and system data).

vob_server: It's also a long lived process which manipulates data in the VOB storage pools in response to request from the client processes (through vobrpc_server).

e. db_server: Handles VOB database transactions on the host in response to requests from clients. Typically it handles mostly metadata related activities.

f. lockmgr: It arbitrates transaction requests to all VOB databases on that host from ClearCase client programs.

The concept of lock manager has been redefined in ClearCase V7.0. The lockmgr is now defined as set of files and the lockmgr activity is now per VOB than per host. This is applicable to UNIX based platforms. Refer the IBM Rational ClearCase support pages for more info and specific platforms supported.

2.2.2   Multiversion File System

This file system (known as MVFS) gives users transparent access to ClearCase data in a dynamic workspace. It is tightly bound with the operating system and must be running to access dynamic views/workspaces on a client. MVFS cache is used to optimize file system performance. An MVFS cache is assigned to a host, not individual views or workspaces.

2.2.3   ClearCase Hosts
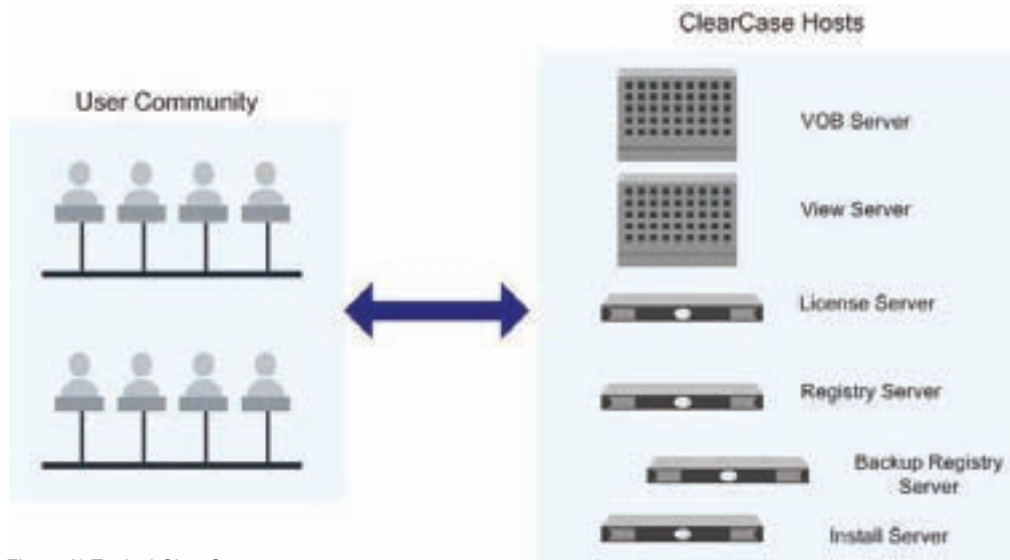
Figure 2) Typical ClearCase setup.

RELEASE HOST (INSTALL SERVER)

Any host in the network can act as a Network wide release host. A shared directory on this host, known as "Networkwide Release Area," stores the entire product release which has been extracted from the media. An installation framework known as site-preparation (site-prep) can then be built which defines the installation modes across different machines.

Simultaneous installation can be done on different hosts by using the defined installation framework (sitedefs.dat).

Rational ClearCase need not be running on the release host, but the host should be part of the domain. The network wide release area can be hosted on a storage system.

LICENSE SERVER

Every ClearCase network should have a License Server host(s) which serves the community with license requests. There are separate licenses for Rational Clearcase and Rational Multisite. Every user needs a license for almost all cleartool and multitool commands. The licenses are tied to a license server host (the host id needs to given while requesting for a set of licenses). You cannot move the set of licenses to another host.

Refer to http://www-306.ibm.com/software/rational/support/licensing/ in case you need to change your license host. You can have multiple license servers in the ClearCase network, each serving a different set of licenses, but only one can be used by any particular Client /Server.

The licenses are stored under the license.db file on the license server host. The albd_server fields license verification requests on the Rational ClearCase server host. The root user on a UNIX host does not require a license. A single user working simultaneously on many different hosts in many different windows consumes only a single license.

Refer to the IBM-Rational ClearCase licensing guidelines for the traditional (Atria) and Flexlm way of licensing, before you decide on installation setup.

REGISTRY SERVER

IBM-Rational ClearCase, being a distributed application, needs to have centralized "yellow pages" through which the community can locate the resources such as VOBs and Views available across the network. The ClearCase Registry stores all the details of the corresponding path and tags for each of the VOBs and Views registered on the network.

The albd_server process fields the requests for the registry information on ClearCase host.

BACKUP REGISTRY SERVER

It would be prudent to have a backup registry server configured. Rational ClearCase provides the ability for a "switchover" if need arises.

VOB STORAGE AND SERVER

The VOB, which is the core of the data storage, should be available all throughout for the user community. The VOB storage data is never directly accessed by users and is done only through ClearCase commands.

The VOB data cannot be accessed unless the user is in a view, providing ClearCase a context by which the data is accessed.
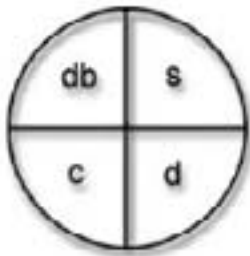

Figure 3) VOB storage components.

There are four components of VOB storage, the database and three storage pools. Each component has its own set of characteristics:

1. The **Database (db)** contains all ClearCase metadata and information on directories under version control. Only vob_server or db_server processes on the VOB host can access the database. Access to data in other storage pools may not be possible if the database is inaccessible or becomes corrupted. ClearCase uses a Raima database.

2. The **Source pool (s)** holds the contents of every version of every file under ClearCase control. For every text file, there is a single container file in the source pool (to minimize disk consumption). Any version of a text file can be constructed by a single top-down pass through the container file. Binaries under version control (files actually checked in and out, not just the result of a build) are stored as whole copies.

3. The **Cleartext pool (c)** contains temporary storage for cleartext files, constructed from data in the source pool, for file versions currently in use. Though there are many versions of a file stored in a VOB, only a few specific versions are generally being used in the development community. As these file versions are required, the appropriated cleartext file is created and placed in the cleartext pool. All ClearCase work areas that require read access to this particular version of a file then access the cleartext file. Disk I/O is the heaviest on average for this pool.

4. The **Derived object pool (d)** is only used if the customer uses the clearmake build utility in the ClearCase environment. When using clearmake, the first time a specific derived object is created it is stored in view-private storage. When builds in other work areas require the same exact executable, instead of rebuilding it, the derived object in the original view is promoted, copied into the VOB derived object pool, and then that copy in VOB storage is winked in to the other work areas.

The VOB server host is the one which hosts the VOB storage. The vobrpc_server, vob_server and db_server are the processes running on this host.

VOB Space Requirements: VOB storage requirements are growing exponentially over the years. Typically the data in a single VOB is less than 10GB, but there might be a few exceptional instances. It is always recommended to have a larger number of smaller VOBs than having all in one. This facilitates easy administration and backups.

The Database is generally the smallest component of VOB storage. The storage needed for the database usually grows at a small, constant pace over time.

Source pool storage usually grows at a small constant pace over time (depending upon the phase of the project) but at a slightly greater rate than the database.

The Cleartext pool is periodically scrubbed of older versions of files that are no longer being accessed in any view work area. The storage needed for the cleartext pool can therefore fluctuate over time depending on the number of different revisions being worked on. However, the storage tends to grow at a steady pace, usually at a little faster rate than the source pool.

Derived object pool storage can fluctuate dramatically depending on the number of different releases/ versions being worked on and the size of the binaries involved. The derived object pool is also periodically scrubbed of objects that are no longer referenced by any view. Generally, ClearCase administrators must monitor the disk space being consumed by this pool much more closely than the other VOB components. Many ClearCase customers use the native make and therefore need no storage for this pool.

VIEW STORAGE AND SERVER

A view is an individual workspace used by the user to access the VOB. The view selects the appropriate version of the artifact through the config specs and also maintains the view private files. Usually views are created for each different activity of the project. There is no restriction on the number of views created by each user. Views can be either dynamic view or a snapshot view.

The view_server interprets the view config spec and accordingly populates the required artifacts into the workspace. The view storage area is never directly accessed by users, and only through ClearCase commands.
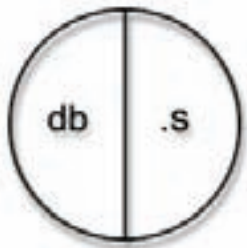

Figure 4) View storage components.

There are two components for the view storage:

1. **View-private storage (.S)** contains versions of files that are currently checked out in the view, unshared derived objects created by a build (which can be rebuilt), and files under a VOB mount point that are not under version control. Disk I/O can be particularly heavy during builds.

2. **Database (db)** contains information on the view state and is generally very small. ClearCase uses a Raima database.

The view database and the VOB database are usually in sync.

View Space Requirements

1. The size of the view database is usually negligible compared to the size of the view-private storage.

2. The view-private storage can grow as per the number of files checked out, number of view private files and usually the total size of all the derived objects created during a complete build for the largest target.

3. The view storage area required for all views is directly proportional to the number of views.

The View Server host is the one which hosts the View storage. The view_server process runs on this host.

2.2.4 Under the Hood

Rational ClearCase uses lot of Remote Procedure calls or RPCs.

What is an RPC? – RPC is a particular type of message that functions like a subroutine call between two processes that can be running on different machines. When a client process calls a subroutine on a server, the RPC data is sent across to the server (using protocols such as TCP or UDP), which in turns executes the code and responds to the client. The client continues with the original process on receipt of inputs from the server. RPCs are synchronous and bidirectional; i.e., the client does not continue processing until it receives a response.
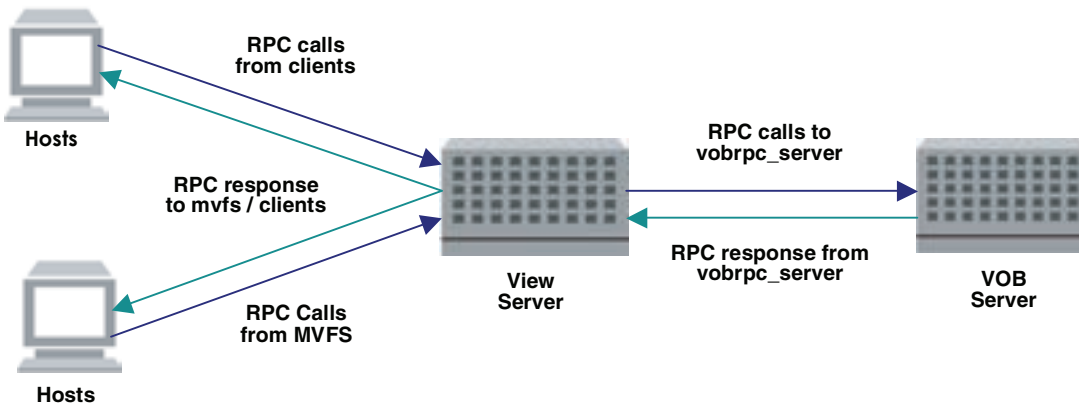
Figure 5) RPC interactions.

In a typical ClearCase transaction, either MVFS or a client will send an RPC to the View server. The View server in turn calls the RPC on the VOB server, which in turn serves back the required data based on the appropriate ClearCase command. The response first comes back to the view server, and then a second response carries the results to the client.

The data flow diagram shown in Figure 6 summarizes all the various processes (circles) and data storage (parallel lines)
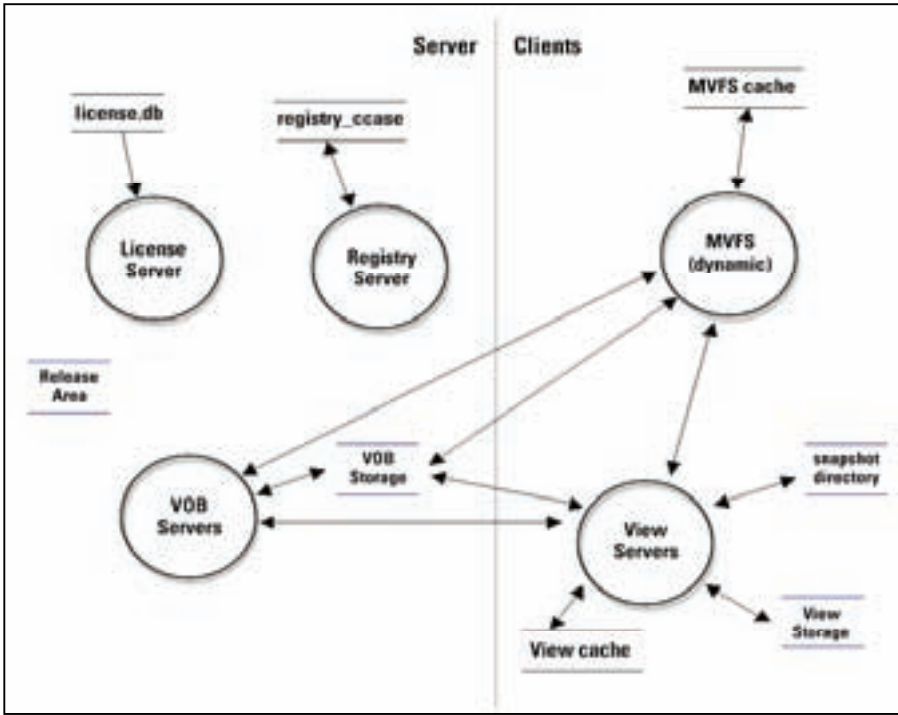
Figure 6) ClearCase components.

2.2.5   Snapshot Directories

Snapshot views require a view storage area for the associated view server process that is the same as a dynamic view. They also require a snapshot directory. ClearCase copies cleartext files from the VOB to the snapshot directory. The space required depends on the size of the cleartext files and the number of snapshot views.

2.3 USING CLEARCASE

ClearCase provides both a command line and graphical user interface. UNIX users primarily use the command line. Windows users primarily use the GUI provided through the Rational ClearCase Explorer; cleartool and multitool are the shells used while working with CLI.

You can find cleartool/multitool at the following locations:

UNIX:

```
/usr/atria/bin/cleartool
/usr/atria/bin/multitool
```

Windows:

```
:\Program Files\Rational\Clearcase\bin\cleartool.exe
:\Program Files\Rational\Clearcase\bin\multitool.exe
```

The Rational ClearCase Explorer is started by clicking the desktop icon or from the Programs menu.

3   CONFIGURATIONS

Rational ClearCase processes run on hosts where Rational ClearCase is installed. Since Rational ClearCase is not installed on a storage system (like all other applications), none of these processes runs on the storage system. However, IBM-Rational supports the use of storage systems for the following ClearCase data stores:

- VOB Storage
- View Storage
- Release Area
- Backup Area
- Snapshot View Directories

This section defines how storage systems are used in a hardware topology for a ClearCase environment, including:

- ClearCase Data Storage Requirements
- Advantages to Using Storage Systems
- ClearCase Hardware Topology that includes Storage Systems
- Remote VOB and View Database support
- Storage System Configuration
- Volume/Qtree Configuration

3.1   CLEARCASE DATA STORAGE REQUIREMENTS

An IBM-Rational ClearCase based software development environment places stringent requirements on the data storage devices used.

- Data must be highly available, usually 24 hours a day, 7 days a week. If VOB storage is unavailable, the entire development staff may be idled.
- Data must never be lost or corrupted. Backups must be taken quickly and regularly.
- Since Rational ClearCase is meant to be transparent to end users as they work in the file system, access to stored information must be as fast as possible. Disk I/O bottlenecks are a primary reason for poor Rational ClearCase performance.
- Rational ClearCase storage areas grow over time, sometimes dramatically. Running out of disk space can have disastrous consequences in a ClearCase environment. Users must be able to easily expand data storage areas when needed.
- In many ClearCase environments, VOB data must be accessible from both UNIX and Windows clients.

3.2   ADVANTAGES TO USING STORAGE SYSTEMS

NetApp storage systems are a cost-effective means of meeting all Rational ClearCase data storage requirements and have advantages specific to the Rational ClearCase environment.

- High Availability of VOB Data
- Superior Backup Capabilities
- Supports Mixed UNIX and Windows Environments

Related information can also be found in the article "Supporting the Rapid Pace of Software Development" on the Network Appliance Web site.

3.2.1   High Availability of VOB Data

Above all, storage systems make reliable repositories for critical VOB storage that are extremely easy to set up and maintain while providing maximum availability.

- All writes to disk are ensured to complete even in case of system or power failure.

- Storage protection via RAID protects against disk failures, avoiding disruption of service to users, with no loss in performance.

- Reboots in one to two minutes (no fsck required), restoring access quickly.

- Storage system Snapshot feature backs up storage in seconds.

- Storage can be grown on-the-fly without interrupting access.

- Consolidates large data sets from multiple servers onto the storage system, making administration much easier and manageable. Less administration overhead lowers the cost.

- Uptime measured in excess of 99.999%.

3.2.2 Superior Backup Capabilities

The Snapshot, SnapMirror®, and SnapRestore® features of Data ONTAP provide superior solutions for backup and restore operations involving Rational ClearCase data.

VOBs need to be locked only for a few seconds while a Snapshot online backup is created, thus greatly reducing the time that users do not have write access. Please refer to the "Backup and Restore of ClearCase Data" technical report from Network Appliance for details on:

- Rational ClearCase requirements for backup and restore operations in specified types of failures
- Solutions provided by Network Appliance for each failure scenario, including the options available, the advantages and disadvantages of each option, and the recommended best practices
- Procedures (actual commands to back up and restore Rational ClearCase data)

3.2.3 Supports Mixed UNIX and Windows Environments

A Rational ClearCase environment that requires both UNIX and Windows clients to share a common VOB repository is referred to in the ClearCase community as an "Interoperability or Interop" environment. Because UNIX clients cannot access Windows VOBs or Views, a Rational ClearCase restriction, customers working in an Interop situation invariably place their VOB servers on UNIX hosts. By placing VOB storage on a Network Appliance storage system, it is possible for Windows clients to access UNIX VOB data without installing an NFS product on every Windows client or an SMB (CIFS) on the UNIX server. Data ONTAP provides native support of NFS and CIFS within its kernel.

3.3 CLEARCASE HARDWARE TOPOLOGY

The following diagram illustrates a typical ClearCase hardware topology in which a storage system is a component in a mixed UNIX and Windows ClearCase environment.
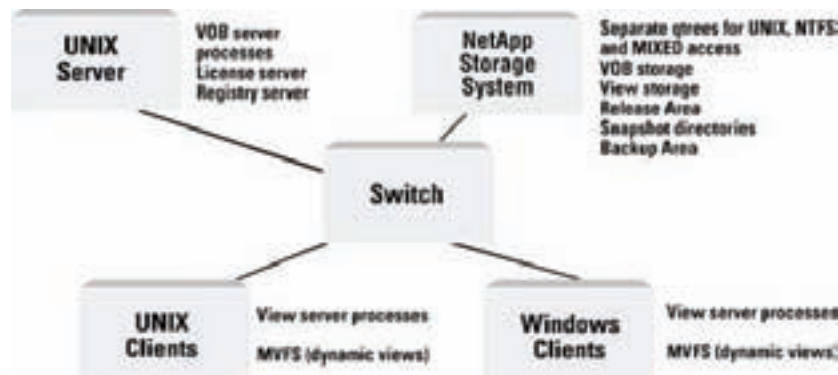

Figure 7) Storage system in an Interop environment.

Such an environment may contain multiple storage systems and VOB servers, which are preferably on the same subnet. In addition, some sites, especially those with many users, may choose to incorporate large dedicated view server hosts on which all ClearCase view server processes run.

3.4 IBM-RATIONAL CLEARCASE AND NETAPP SUPPORT MATRIX

IBM-Rational ClearCase has always supported putting VOB pools and view-private storage onto a storage system for the UNIX platform. Rational Software now supports placing the VOB and View database components of storage on Network Appliance storage systems for the following products and versions. The following has been certified with Rational ClearCase (including Multisite and UCM) versions 4.2, 4.3, 5.0, 6.0 and 7.0.

NetApp	Data ONTAP	Platform
Series 7xx	6.1.2R3 6.2.x 6.3.x 6.4.x 6.5.x 7.0.x	UNIX and Windows
Series 8xx	6.1.2R3 6.2.x 6.3.x 6.4.x 7.0.x 6.5.x 7.0.x 7.1.x	UNIX and Windows
FAS9xx	6.3.x 6.4.x 6.5.x 7.0.x 7.1.x	UNIX and Windows
FAS250	6.4.x 6.5.x 7.0.x 7.1.x	UNIX and Windows
FAS270	6.5.x 7.0.x 7.1.x	UNIX and Windows
NearStore® R200	6.4.x 6.5.x 7.0.x 7.1.x	UNIX and Windows
FAS3xxx	7.0.x 7.1.x 7.2.x	UNIX and Windows
FAS6xxx	7.2.x	UNIX and Windows

Note: Also refer the system requirement page for each of the Rational ClearCase versions.

3.5 STORAGE SYSTEM CONFIGURATION

This section contains recommendations on the use of Network Appliance features that are configured at the machine level, including:

- Network Interface
- Network Protocol
- Hot Spare Disk
- Time Synchronization
- Clustering

More information on all of these subjects is available in the Data ONTAP System Administrator's Guide.

3.5.1 Network Interface

It is always best to have many big pipes available. To this end, it will be common for VOB, View, and Build Servers to have large pipes (e.g., Gigabit Ethernet) connected directly to the storage system while the users will likely be accessing over switched 1Gb/100Mb Ethernet. All channels are simultaneously utilized, resulting in a large, well-balanced environment. It is recommended that customers:

- Use the biggest pipes available, ideally one or more Gigabit Ethernet connections
- Use dedicated paths to I/O critical or intensive servers such as VOB, View, or Compile servers
- Use switched 1Gb/100MB connection paths to user desktops

3.5.2   Network Protocol

- Start with TCP and see if performance is acceptable. If not, then try UDP and see if it improves performance.
- Both TCP and UDP are supported. Historically Network Appliance has recommended UDP for performance reasons, and on reliable, noise-free networks UDP works fine. However, most performance issues with TCP have been addressed by most of the vendors to the point where several of them actually have better performance and reliability.
- Use the most up-to-date NFS options possible.

3.5.3   Hot Spare Disk

A hot spare disk is not part of any RAID group and does not contain file system data. In the unlikely event of a disk failure, the storage system automatically rebuilds the data (or parity) onto a hot spare disk, which then replaces the failed disk in the RAID group. A hot spare disk cannot replace a failed disk that is larger than the spare. If you use only one hot spare in a storage system, make sure the hot spare is as large as the largest disk present.

- Always use at least one hot spare disk.

3.5.4   Time Synchronization

All Network Appliance storage systems and ClearCase servers should periodically set their clocks to one common reference.

See the timed options in the Data ONTAP System Reference Guide. Having an NTP server in the overall environment is a good idea. If an NTP server is not available, one server system should be set as the "master clock" and periodically (two to three times each day) be used to set the clock on all other machines in the environment via the rdate command.

3.5.5   Clustering

A cluster consists of a pair of Network Appliance storage systems that are connected and configured in a special way to provide fault tolerance. When one storage system in a cluster undergoes a system failure, the partner storage system in the cluster can take over the failed storage system's functions and server the data on the failed storage system's disks.

Use clustering for VOB storage in large development environments with many users where no downtime in the software development process is acceptable.

3.6 VOLUME QTREE CONFIGURATION

Data on a Network Appliance storage system is organized in volumes. A volume is an independent file system with its own RAID group(s). Every RAID group must contain at least two disks. Each storage system must have a root volume to boot (named /vol/vol0).

- ClearCase storage should preferably not be placed in the root volume. Always try to use separate data volumes.
- A volume's disk I/O performance improves as more disks are assigned to it.
- It is generally a good idea to put ClearCase storage in a volume with as many disks as possible and avoid volumes with fewer than four data disks.
- If it makes sense from a performance and disk usage perspective, it is recommended that all ClearCase storage be placed in its own volume.

A qtree is a special subdirectory of the root directory of a volume that gives customers greater flexibility when their storage needs do not demand multiple volumes. Volumes are themselves considered a qtree and can be the target of qtree commands. Therefore, it is recommended that customers use qtrees from the start.

- Create a separate qtree for VOB storage (vobstg), View storage (viewstg), Release Area (rls), and for Snapshot directories if needed (ssview). Do not use remote VOB pools.

- In Mixed UNIX and Windows environments create separate qtrees for the Windows view storage (viewstgwin), Release Area (rlswin), and Snapshot views (ssviewwin).
- Each qtree should have its own NFS mount point and/or CIFS share where appropriate.

Both qtrees and volumes have the following operational features that need to be considered in a ClearCase environment. Note that by default, qtrees inherit the settings of the parent volume's root directory.

3.6.1 Security Style

The security style determines if files can use UNIX security, NTFS security, or both (MIXED).

- Use MIXED mode for VOB storage qtrees that will be accessed by both UNIX and Windows clients.
- Use UNIX for all ClearCase qtrees accessed only from UNIX hosts. Use NTFS for all ClearCase qtrees accessed only from Windows hosts.

3.6.2 Database File Protection

- Use the nvfail option of the vol options command to use the special file protections for databases provided by Data ONTAP.

The option, when enabled, allows a storage system to detect NVRAM inconsistencies at boot time. If the storage system finds any problems, database instances hang or shut down, and the storage system sends error messages to the console. The user should then call IBM Rational support and use the ClearCase dbcheck facility (as instructed by IBM Rational) to check the state of the database.

3.6.3 CIFS Oplocks

In a hosted environment that is Windows only, oplocks can be enabled for all volumes/qtrees.

3.6.4 Quotas

Storage system disk quotas restrict disk space and the number of files used by a user, a group, or a qtree. Rational ClearCase VOB storage areas in particular may contain many, many files. If such a limit is exceeded, ClearCase error messages refer to being out of disk space. However, system administration commands will show available disk space.

- If using quotas, be careful in setting limits on the number of files allowed.

4 PROCEDURES

There are five roles for a storage system in a Rational ClearCase environment. After the subsection "Notes on Examples," each role is subsequently discussed in detail. This also includes explicit instructions on how to set up the storage system and the ClearCase environment for each role, except for backup, which is discussed in a separate document.

Before using a storage system for one of these purposes, be sure to review the Storage System Setup subsection.

- VOB Storage - physical disk space used by VOBs
- View Storage - physical disk space used by Views
- Release Area - ClearCase executables used for installation
- Snapshot Directory - work area for Snapshot Views
- Backup and Recovery of ClearCase Data technical report

4.1 NOTES ON EXAMPLES

UNIX VERSUS WINDOWS

Examples in the following subsections are mainly for environments that are UNIX only or Mixed UNIX and Windows environments. Commands and configuration information that appear throughout this section are also collected together into the UNIX and Interop Procedure Guide appendix. Since instructions for an environment that is Windows only are very similar to those for UNIX, they are not repeated in detail in this

document. Any exceptions for an environment that is Windows only are noted in the text. Commands and file entries used in an environment that is Windows only are collected together in the Windows Procedure Guide appendix.

COMMAND LINE INTERFACE

All ClearCase command line examples begin with cleartool, the primary command-line interface executable. Most ClearCase commands allow the user to input a comment through a variety of options. To keep the examples simple, no comment option is shown. Rational ClearCase will typically prompt for a comment after a command is executed when no comment option is specified. Manual pages for ClearCase commands in this section can be found in the Command Reference Manual from IBM-Rational Software and on the command line with cleartool man <cmd>.

The Data ONTAP commands are shown as executed on the storage system. They can also be performed as part of a remote shell command from selected UNIX hosts (provided the user and host are trusted) using the command line syntax:

```
rsh <Storage Systemname> <Data ONTAP command>
```

TOPOLOGY ASSUMPTIONS

In the following subsections, assume that ClearCase VOBs are on the UNIX platform will be owned by the user cmadm and that members of the group devel are to have read-write access to all VOBs from both UNIX and Windows clients. The UNIX host vobserver will host the VOB related server processes and all storage will be placed in the ccvol volume on the storage system Netapp.

STORAGE SYSTEM SETUP

1. Make a ClearCase Volume.

2. Configure a Volume for ClearCase.

3. Enable TCP/UDP Network Protocol.

4.1.1   Make a ClearCase Volume

To make a new volume named ccvol with 14 disks, simply execute the following Data ONTAP command on the storage system that will host the volume. Security style is set to UNIX, database file protection nvfail is off, and oplocks is enabled by default.

```
vol create ccvol 14
```

4.1.2   Configure a Volume for ClearCase

The following commands explicitly configure a volume as recommended in previous subsections for environments that are UNIX only and Mixed UNIX and Windows environments. The qtree configurations can be refined at the qtree level.

```
vol options ccvol nvfail on quota off ccvol qtree security /vol/ccvol/ unix (use
ntfs for Windows-Only environments) qtree oplocks /vol/ccvol/ disable
```

4.1.3   Enable TCP/UDP Network Protocol

Data ONTAP version 6.2 and later uses TCP by default. Earlier releases use UDP by default. The network protocol to be used can be set via options on the storage system.

```
option nfs.tcp.enable on
```

4.2 VOB STORAGE

1. Make a VOB Storage Qtree.

2. Access a VOB Storage Area from a UNIX Host.

3. Access a VOB Storage Area from a Windows Host.

4. Make a VOB.

5. Access a UNIX VOB from a Windows Region.

6. Other VOB Storage Procedures.

4.2.1   Make a VOB Storage Qtree

To make a new qtree named vobstg to be used for VOB storage, accessible to members of group devel from both UNIX and Windows clients, execute the following Data ONTAP commands. The security style is set to that of the volume by default. It should be set explicitly as shown. Note that MIXED is used in the example since this is a mixed UNIX and Windows environment.

```
qtree create /vol/ccvol/vobstg
qtree oplocks /vol/ccvol/vobstg disable
qtree security /vol/ccvol/vobstg mixed
```

Use unix for environments that are UNIX only; use ntfs for environments that are Windows only

4.2.2   Access a VOB Storage Area from a UNIX Host

To access the VOB storage area vobstg through NFS on UNIX hosts, do the following.

1. Update the /etc/exports file on the storage system.

   Note: The albd_server process on a VOB server host also must have read/write access to volumes containing VOB storage. If ClearCase was installed by the root user (the usual case), the albd_server process will be owned by root, meaning that the root user on a VOB server host must have read/write access to the VOB storage area. The storage system must be explicitly told to allow root user access by using the -root option. This requirement can be avoided if another user like the VOB owner that would normally have read/write access installs ClearCase. In this case, the -root option is not required. Assume that there are three VOB servers: vobserver1, vobserver2 and vobserver3 that will access vobstg and root installed ClearCase on all three machines. Add the following entry to the system /etc/exports file on the storage system.

   ```
   /vol/ccvol/vobstg -root=vobserver1:vobserver2:vobserver3
   ```

2. Run the Data ONTAP exportfs command.

   ```
   exportfs -a
   ```

3. Add the appropriate mount point information to the /etc/fstab or /etc/vfstab file on all UNIX hosts that mount volumes from the storage system. Alternatively, if using an automounter, the appropriate auto map files (/etc/auto_*) must be modified. Automounting of VOB database storage on the VOB server hosts themselves should not be used, and automounting is discouraged in general.

   Each qtree should be mounted separately. All storage containing ClearCase VOB or View databases must be hard-mounted. Use the intr option so that the I/O can be interrupted if the server goes down for an extended period. The bg option should also be used. You can specify the protocol (tcp) and version number (nfs v3) in addition to the r/w size. See the man page for mount_nfs for further information. If not using the automounter on Solaris™, make the following entries to /etc/vfstab:

   ```
   netapp:/vol/ccvol/vobstg - /netapp/vobstg nfs - yes \
   hard,intr,bg,proto=tcp,vers=3,rsize=32768,wsize=32768
   ```

   If the automounter is used, update /etc/auto_master. The VOB storage area will then be accessed through /net/netapp/vol/ccvol/vobstg on the UNIX host.

4. If not using the automounter, as the root user on the UNIX host, make the mount-point directory /netapp/vobstg. Give all users read-write-execute access. Mount the directory on the host.

```
mkdir /netapp/vobstg; chmod 777 /netapp/vobstg; mount /netapp/vobstg
```

4.2.3   Access a VOB Storage Area from a Windows Host

To access the data in UNIX VOBs (VOBs whose VOB server processes reside on a UNIX host) from a Windows client, some additional steps must be followed.

1. Make sure that the CLEARCASE_PRIMARY_GROUP user environment variable is properly set on the Windows client. In this example, it should be set to devel. You can set the variable by navigating the following GUI path and defining the user (not system) variable name and value.

```
Programs->Settings->Control Panel->System
```

2. ClearCase requires credentials mapping between UNIX and Windows. All user and group accounts on Windows must have a corresponding UNIX user and group account that has the identical name. To check the credentials mapping, use the credmap utility from the command line prompt on the Windows host.

There is one parameter to credmap, the name of the VOB server you are checking to see if you have the proper access permissions. Note that both the User and Primary Group values on both the Windows client and the UNIX host must be defined (e.g., not set to nobody).

```
C:\Program Files\RATIONAL\ClearCase\etc\utils> credmap vobserver
```

Identity on local Windows NT® system:

      User: HQ\cmadm (NT:S-1-5-21-2070180195-817500532-1019697294-33708)

      Primary group: HQ\devel (NT:S-1-5-21-2070180195-817500532-1019697294-35089)

      Groups: (8)

      <group list deleted>

      Identity on host "vobserver":

      User SID: UNIX:UID-1202

      Primary group SID: UNIX:GID-38

      Group SID list: (8)

      <group list deleted>

3. The VOB storage directory must be accessible as a share from all Windows client machines that wish to access the VOB. This is done using the Data ONTAP commands cifs shares and cifs access.

In this example, make sure that CIFS access on the storage system gives user cmadm and members of group devel complete access to the VOB storage directory (e.g., \\netapp\vobstg).

```
cifs shares -add vobstg /vol/ccvol/vobstg "UNIX VOB Storage Area" cifs access
/vol/ccvol/vobstg -g devel "Full Control"
```

4. The special Windows user account clearcase_albd, used only by the Rational ClearCase product, will also be operating on the VOB storage area. Note that the name of this account can be customized to another value when installing Rational ClearCase, so be sure to use the same naming convention. To give clearcase_albd access, log into the administrative host for the storage system. From there, add an entry to the /etc/usermap.cfg file on the storage system that maps clearcase_albd to the VOB owner (e.g., cmadm).

```
<domain name>\clearcase_albd=>cmadm
```

If there are multiple VOB owners, you will need to create a user account that belongs to each of the VOB primary group(s) and map clearcase_albd to that user.

4.2.4   Make a VOB

You can create a VOB on a UNIX ClearCase host with all VOB storage on the storage system with the following process. Assume a VOB storage area has already been created as outlined above.

1. Log in to the UNIX VOB server (e.g., vobserver) as the VOB owner (e.g., cmadm). Use the UNIX id -a command to make sure you are in primary group devel. If not, use the newgrp UNIX command.

2. Execute the ClearCase command to make a new VOB (e.g., /vobs/src hosted by vobserver):

```
cleartool mkvob -tag /vobs/src -c "Source code" -public -host vobserver \ -
hpath /netapp/vobstg/src.vbs -gpath /netapp/vobstg/src.vbs \
/netapp/vobstg/src.vbs
```

To make a public VOB, you must know the ClearCase registry password. If you don't, remove the -public option from the above command line to create a private VOB. Most production VOBs are public.

3. Mount the VOB on all UNIX hosts. Public VOBs are automatically mounted when a UNIX host is rebooted. You still must have a view to access VOB data.

```
cleartool mount /vobs/src ( for mounting a particular VOB)
```

You can also use the cleartool mount –a command to mount all VOBs.,

4.2.5   Access a UNIX VOB from a Windows Region

To access a UNIX VOB from a Windows client, the VOB must be registered in the ClearCase region used by Windows clients. To register the VOB, log into any ClearCase Windows client in the target region. If all VOB pools are in the vobstg qtree, you may use the Region Synchronizer (paying special attention to the host, local path, and global path options under Advanced Options).

4.2.6   Other VOB Storage Procedures

Most other procedures targeting VOB storage areas do not need to be modified beyond using the -host, -gpath, and -hpath options on the command line. Please consult the Using Network-Attached Storage for VOBs and Views white paper and the ClearCase Administrator's Manual, both from IBM-Rational, for details on each of the following.

* Move a VOB to the storage system
* Consolidate VOB Remote Pools (white paper only)
* Replace a VOB Server Host
* Reformat a VOB

4.3   VIEW STORAGE

1. Make a UNIX View Storage Qtree.

2. Access a UNIX View Storage Area from UNIX Hosts.

3. Make a UNIX View.

4. Make a Windows View Storage Qtree.

5. Access a Windows View Storage Area from Windows Hosts.

6. Make a Windows View.

7. Other View Storage Procedures.

4.3.1   Make a UNIX View Storage Qtree

To make a new qtree named viewstg to be used for UNIX View storage, accessible to members of group devel, execute the following Data ONTAP commands. The security style is set to that of the volume by default. It can be set explicitly as shown.

```
qtree create /vol/ccvol/viewstg
qtree oplocks /vol/ccvol/viewstg disable
qtree security /vol/ccvol/viewstg unix
```

4.3.2 Access a UNIX View Storage Area from UNIX Hosts

To access the View storage area viewstg through NFS on UNIX hosts, do the following. Consult the Access a VOB Storage Area from a UNIX Host subsection of this document for more details.

1. Add the following entry to the /etc/exports file on the storage system.

```
/vol/ccvol/viewstg -root=ccunix (-root required if ClearCase installed by
root on ccunix)
```

2. Run the Data ONTAP exportfs command.

```
exportfs -a
```

3. Add the appropriate mount point information to the /etc/fstab or /etc/vfstab file on all UNIX hosts that mount volumes from the storage system.

```
netapp:/vol/ccvol/viewstg - /netapp/viewstg nfs - yes hard,intr,bg
```

4. If not using the automounter, as the root user on the UNIX host, make the mount point directory /netapp/viewstg. Give all users read-write-execute access. Mount the directory on the host.

```
mkdir /netapp/viewstg; chmod 777 /netapp/viewstg; mount /netapp/viewstg
```

4.3.3 Make a UNIX View

You can create a View on a UNIX ClearCase host with all View storage on the storage system with the following process.

1. Log in to a UNIX ClearCase host (e.g., machine ccunix) as a member of group devel. Use the UNIX id command to make sure you are in primary group devel. If not, use newgrp, groups.

2. Execute the ClearCase command to make a new View (e.g., user_vu):

3. cleartool mkview -tag user_vu -host ccunix \

```
-hpath /netapp/viewstg/user_vu.vws -gpath netapp/viewstg/user_vu.vws \
/netapp/viewstg/user_vu.vws
```

4.3.4 Make a Windows View Storage Qtree

To make a new qtree named viewstgwin to be used for Windows View storage in a Mixed UNIX and Windows environment, execute the following. The security style is set to that of the volume by default. In this case, it should be set explicitly as shown.

```
qtree create /vol/ccvol/viewstgwin
qtree oplocks /vol/ccvol/viewstgwin disable
qtree security /vol/ccvol/viewstgwin ntfs
```

4.3.5 Access a Windows View Storage Area from Windows Hosts

To make the Windows View Storage Area accessible to members of group devel and the special ClearCase user account clearcase_albd on Windows hosts, execute the following Data ONTAP commands.

```
cifs access /vol/ccvol/viewstgnt -g devel "Full Control" cifs access
/vol/ccvol/viewstgnt clearcase_albd "Full Control"
```

4.3.6 4.3.6 Make a Windows View

You can create a View on a Windows host with all View storage on the storage system with the following process.

1. Log in to a Windows ClearCase host as a member of group devel. Use CTRL+Alt+Del to check how you are logged in.

2. Execute the ClearCase command to make a new View (e.g., user_vu). Be sure not to use a drive letter with the host path (hpath) option even if one exists.

```
cleartool mkview -tag user_vu -host ccnt -hpath \\netapp\viewstg\user_vu.vws -
gpath \\netapp\viewstg\user_vu.vws \\netapp\viewstg\user_vu.vws
```

4.3.7   Other View Storage Procedures

Most other procedures that target View storage areas do not need to be modified beyond using the -host, -gpath, and -hpath options on the command line. Please consult the Using Network-Attached Storage for VOBs and Views white paper and the ClearCase Administrator's Manual, both from Rational Software, for details on each of the following.

•   Move a UNIX View to the storage system

•   Replace a View Server Host

•   Reformat a View

4.4 OTHER STORAGE AREAS

4.4.1   Release Area

IBM-Rational ClearCase releases should be copied from the Rational Web site to a directory on the storage system that is known as the Release Area. Patches for releases should also be reviewed and downloaded where appropriate. Once a site_prep script is run in the Release Area, Rational ClearCase can be installed on clients across the network.

1. For the UNIX version, log in as root on a UNIX machine that is allowed root access to the storage system. For Windows, log in as the Domain Administrator.

2. Create an rls qtree in the ccvol volume (e.g., /vol/ccvol/rls) on the storage system (e.g., machine netapp) that can be read by anyone across the network with NFS for UNIX. This directory must be globally accessible to all ClearCase hosts that wish to install ClearCase from this Release Area.

3. Follow the directions in the ClearCase Installation and Release Notes manual to:

    a. Copy ClearCase bits to the Release Area.

    b. Apply patches as needed.

    c. Run the site_prep script.

    d. Install ClearCase onto clients using the Release Area.

4.4.2   Snapshot Directory

You can create a Snapshot view whose Snapshot directory resides on a storage system by using the following process.

Make a Snapshot View: From the command line on the UNIX client, execute the following to create a UNIX Snapshot view named nightly_build whose Snapshot directory and View storage directory are on the storage system netapp.

```
cleartool mkview -tag nightly_build -snapshot -host ccunix \ -hpath
/netapp/viewstg/nightly_build.vws \ -gpath netapp/viewstg/nightly_build.vws \
/netapp/viewstg/nightly_build.vws
```

APPENDIX A: UNIX AND INTEROP PROCEDURE GUIDE

Make a ClearCase Volume	```vol create ccvol 14```

Configure a Volume for ClearCase	```vol options ccvol nvfail on```
	```quota off ccvol```
	```qtree security /vol/ccvol/ unix```
	```qtree oplocks /vol/ccvol/ disable```

Enable TCP/UDP	```option nfs.udp.enable on -or- option nfs.tcp.enable on```

Make a VOB Storage Qtree	```qtree create /vol/ccvol/vobstg```
	```qtree oplocks /vol/ccvol/vobstg disable```
	```qtree security /vol/ccvol/vobstg unix```

Access VOB Storage from UNIX	```/vol/ccvol/vobstg - root=vobserver1:vobserver2:vobserver3```
	```exportfs -a netapp:/vol/ccvol/vobstg - /netapp/vobstg nfs -```
	```yes \ hard,intr,bg,proto=tcp,vers=3,rsize=32768,wsize=32768```
	```mkdir /netapp/vobstg;```
	```chmod 777 /netapp/vobstg;```
	```mount /netapp/vobstg ;```
	```cleartool mkstgloc -vob -host vobserver - gpath```
	```/netapp/vobstg \ -hpath /netapp/vobstg navobstg```
	```/netapp/vobstg```

Access VOB Storage from Windows	```Programs->Settings->Control Panel->System```
	```CLEARCASE_PRIMARY_GROUP=devel```
	```C:\Program Files\RATIONAL\ClearCase\etc\utils> credmap```
	```vobserver;```
	```cifs shares -add vobstg /vol/ccvol/vobstg "UNIX VOB Storage```
	```Area"```
	```cifs access /vol/ccvol/vobstg -g devel "Full```
	```Control"<domain name>\clearcase_albd=>cmadm```
	```(/etc/usermap.cfg)```

Make a VOB	```id -a; newgrp ;```
	```cleartool mkvob -tag /vobs/src -c "Source code" - public \```
	```-host vobserver \ -hpath /netapp/vobstg/src.vbs -gpath```
	```/netapp/vobstg/src.vbs \ /netapp/vobstg/src.vbs;```
	```or```
	```cleartool mkvob -tag /vobs/src -c "Source code" - public -```
	```stgloc navobstg ;```
	```cleartool mount /vobs/src```

Access UNIX VOB from Windows	```cleartool mktag -vob -tag \src -public -host vobserver -```
	```hpath /netapp/vobstg/src.vbs -gpath```
	```\\netapp\vobstg\src.vbs \\netapp\vobstg\src.vbs```

Make a View Storage Qtree	```qtree create /vol/ccvol/viewstg```
	```qtree oplocks /vol/ccvol/viewstg disable```
	```qtree security /vol/ccvol/viewstg unix```

| Access View Storage from UNIX | ```
/vol/ccvol/viewstg -root=ccunix
exportfs -a netapp:/vol/ccvol/viewstg - /netapp/viewbstg
nfs - yes hard,intr,bgmkdir /netapp/viewstg;
chmod 777 /netapp/viewstg;
mount /netapp/viewstg
cleartool mkstgloc -view -host ccunix -gpath
/netapp/viewstg \ -hpath /netapp/viewstg naviewstg
/netapp/viewbstg
``` |
| Make a UNIX View | ```
cleartool mkview -tag user_vu -host ccunix \ -hpath
/netapp/viewstg/user_vu.vws \ -gpath
/netapp/viewstg/user_vu.vws \ /netapp/viewstg/user_vu.vws
cleartool mkview -tag user_vu -c "User view" -stgloc
naviewstg
``` |

APPENDIX B: PROCEDURE GUIDE FOR ENVIRONMENTS THAT ARE WINDOWS ONLY

| Make a ClearCase Volume | ```
vol create ccvol 14
``` |
| Configure a Volume for ClearCase | ```
vol options ccvol nvfail on
quota off ccvol
qtree security /vol/ccvol/ ntfs
qtree oplocks /vol/ccvol/ disable
``` |
| Make a VOB Storage Qtree | ```
qtree create /vol/ccvol/vobstg
qtree oplocks /vol/ccvol/vobstg disable
qtree security /vol/ccvol/vobstg ntfs
``` |
| Access VOB Storage from UNIX | ```
(not possible because of a ClearCase restriction)
``` |
| Access VOB Storage from Windows | ```
cifs shares -add vobstg /vol/ccvol/vobstg "NT VOB Storage Area"
cifs access /vol/ccvol/vobstg -g devel "Full Control"
``` |
| Make a VOB | ```
cleartool mkvob -tag \src -c "Source code" -public - host
vobserver -hpath \\netapp\vobstg\src.vbs -gpath
\\netapp\vobstg\src.vbs \\netapp\vobstg\src.vbs
cleartool mkvob -tag \src -c "Source code" -public - stgloc
navobstg
``` |
| Make a View Storage Qtree | ```
qtree create /vol/ccvol/viewstg
qtree oplocks /vol/ccvol/viewstg disable
qtree security /vol/ccvol/viewstg ntfs
``` |
| Access View Storage from UNIX | ```
(not possible because of a ClearCase restriction)
``` |
| Make a Windows View | ```
cleartool mkview -tag user_vu -host ccnt -hpath
\\netapp\viewstg\user_vu.vws -gpath
\\netapp\viewstg\user_vu.vws \\netapp\viewstg\user_vu.vws
or
cleartool mkview -tag user_vu -c "User view" -stgloc naviewstg
``` |

APPENDIX C: CLEARCASE GLOSSARY

Artifacts	The data which is kept in the repository. It might be word documents, binaries, etc.
Configuration management	Software engineering discipline used for the creation and evolution of software products.
Element	A file or directory under version control.
Checkin	Rational ClearCase operation to commit a change to a VOB and thereby create a new version of the element. The content of new version is moved from view to VOB storage.
Checkout	Rational ClearCase operations to gain write access to an element in order to create a new version of that element. Content of element version is copied from VOB to View storage.
Release Area	Storage area in the network containing the ClearCase and Multisite executables to be installed on ClearCase hosts.
License host, server	A license host is a machine designated to host and server Rational ClearCase Multisite licenses. The albd_server on the license host acts as the license server.
Registry host, server	A registry host is a machine designated to host Rational ClearCase registry that identifies all VOBs and views in a region. The albd_server on the registry hosts acts as the registry server.
View	A working context that selects the specific version of an element for a user work area.
view_server	ClearCase server process that manages activities in a particular view work area.
View host	A ClearCase host that hosts one or more view server processes.
Snapshot directory	Work area that contains copies of versioned objects extracted from VOBs. Created and maintained by Snapshot views.
Snapshot view	A view that copies data out of the VOB and into a directory structure that is not using MVFS.
View private storage	Data kept in View storage (not VOB storage). Includes versions of files that are currently checked out in the view, unshared derived objects created by a build (which can be rebuilt) and files under a VOB mount point that are not under version control.
Dynamic view	A workspace that uses the MVFS to dynamically access ClearCase versioned objects.
Config Spec	Or configuration specification. Contains a set of rules that the view server uses to determine what versions of elements under ClearCase control to place in a work area.
VOB	Or versioned object base. A central repository containing all the different files and directories under version control and the metadata associated with them.
VOB host	A ClearCase host that is home to one or more sets of VOB server processes.
VOB servers	Generic term for set of ClearCase server processes used to access VOB data. Includes the db_server, vob_server, vobrpc_server, and lockmgr processes.
db vista	Type of error message in ClearCase log files indicating problems with a ClearCase database.
Interop	Or interoperability. A ClearCase environment in which both UNIX and Windows clients need to access the same VOB repository (VOB server processes are always on a UNIX host).
Lock manager	Or lockmgr. ClearCase process used to manage transactions in the VOB database. Runs on the VOB host.

MultiSite	Sister product to Rational ClearCase that allows the VOB repository to be replicated at multiple sites. Users then access the copy of the VOB repository at their own sites. The VOB replicas at each site are then synchronized by MultiSite on a regularly scheduled basis. Storage system mirroring cannot be used to replace MultiSite.
MVFS	Or Multiversion File System. A virtual file system that dynamically places element versions selected by a view into a directory structure (used as the work area).
Clearmake /Omake	Make utilities that come along with Rational ClearCase, used in UNIX and Windows environments.
Promote	Rational ClearCase operation that moves derived objects created by clearmake in a view to VOB storage so that they can be shared across many view work areas.
Wink in	Rational ClearCase operation by which a shared derived object created by clearmake and stored in the VOB derived object pool is made available in a view work area.
Work Area	Or workspace. A directory that contains versioned objects under ClearCase control.