COMPAQ
White Paper

January 2001
147E-0101A-WWEN

Prepared by High Availability

Compaq Computer Corporation

Contents

Compaq StorageWorks RA4100 SAN Solutions Configuration and Setup Procedures

Abstract: The purpose of this documentation is to demonstrate the configuration steps for an entry level SAN environment. In this paper the Fibre Channel Arbitrated Loop (FC-AL) Switch 8 is used to connect different clusters and stand-alone servers from various operating systems including the following: Windows NT Server Enterprise Edition, Windows 2000 Advanced Server, NetWare 5.1 and Red Hat Linux 7.0.
There are three-configuration scenarios in this paper:

1. Multi-Cluster Non-Redundant Configuration
   - ❖ Windows 2000 Advanced Server Cluster Service (MSCS)
   - ❖ Windows NT Server Enterprise Edition Cluster Server (MSCS)
   - ❖ NetWare 5.1 Cluster Services (NCS)

2. Cluster and Stand-alone Non-Redundant Configuration
   - ❖ Windows 2000 Advanced Server Cluster Service (MSCS)
   - ❖ Windows NT Server Enterprise Edition Cluster Server (MSCS)
   - ❖ Stand-alone Servers
     - o Windows 2000 Advanced Server
     - o NetWare 5.1 Server
     - o Red Hat Linux 7.0 Server

3. Redundant Configuration
   - ❖ Windows NT Server Enterprise Edition Cluster Service (MSCS)
   - ❖ NetWare 5.1 Cluster Services (NCS)
   - ❖ Standalone Windows NT Server 4.0

Notice

Compaq StorageWorks RA4100 SAN Solutions Configuration and Setup Procedures
White Paper prepared by High Availability

First Edition (January 2001)
Document Number 147E-0101A-WWEN

Introduction

A Storage Area Network (SAN) is designed for multiple host servers to have access to a network of storage devices. It allows servers to share storage without impacting system performance on the primary communication network. The Compaq StorageWorks RAID Array 4000/4100 based SAN Solution configuration supports multiple servers and/or clusters running different operating systems.

The RA4100 SAN Solutions is an affordable SAN that simplifies storage management, manages explosive data growth, and reduces system downtime. This solution consolidates storage for multiple servers to one centralized SAN. By integrating primary and secondary storage on the same SAN, the RA4100 SAN Solutions increases availability, scalability, and system performance. The RA4100 SAN Solutions makes configuring, managing, and maintaining storage resources efficient and easy to use.

The RA4100 SAN Solutions configuration can include Compaq and multi-platform x86 servers running different operating systems such as Windows, NetWare, Linux, and UnixWare. Components are interconnected through the Compaq StorageWorks FC-AL Switch 8 with an optional 3-port expansion module.

This configuration and setup white paper describe some of the configurations that are supported in the RA4100 SAN Solutions. This paper is served as a guide to set up your configurations.

Compaq SAN Solutions

SAN Solutions

- Non-Redundant Configuration

  The RA4100 SAN Solutions non-redundant configuration supports stand-alone servers, clusters, and a combination of the two. This solution supports different operating systems mixed on the same Compaq StorageWorks FC-AL Switch 8. All servers in the SAN environment have only one Fibre Channel Host Bus Adapter (HBA) connected through one Compaq StorageWorks FC-AL Switch 8. This is a single loop environment.

- Redundant Configurations

  The RA4100 SAN Solutions Redundant configuration is a dual loop environment. This solution also supports different operating systems mixed on the same Compaq StorageWorks FC-AL Switch 8. All servers in the SAN have two Fibre Channel Host Bus Adapters (HBA) connected through two Compaq StorageWorks FC-AL Switch 8. These two loops are independent, if one of the loops fails, the other loop will perform the tasks.

- Mixed Redundant and Non-Redundant Configuration

  The RA4100 SAN Solutions mixed configuration supports stand-alone servers, clusters, and a combination of the two with non-redundant and redundant paths. This solution also supports different operating systems mixed on the same Compaq StorageWorks FC-AL Switch 8.

Tools used to configure SAN

Compaq StorageWorks FC-AL Switch 8 Management Utility

The Compaq StorageWorks FC-AL Switch 8 Management Utility uses a web browser to monitor and manage the status and port policy of the Compaq StorageWorks FC-AL Switch 8.

Port policies are used to control the access and broadcasting method of the Compaq StorageWorks FC-AL Switch 8. It is managed by Intelligent LIP (Loop Initialization Primitive) Control (ILC).

ILC is an advanced method of managing loop initialization events. A Loop Initialization Primitive (LIP) being issued by a device on the arbitrated loop prompts Loop initialization. The LIP can be issued at any time and is potentially disruptive if issued during frame transfer. If such a disruption occurs, error-handling code at the driver or application layer is triggered by a timeout to prevent I/O errors or data corruption. ILC avoids the disruption in the first place by holding the LIP, up to a certain maximum period, until a minimum gap in frame transfer occurs.

A LIP may be triggered for several reasons, such as adding a new device. The new device can be a former participant that has been powered on or an active device that has been

moved from one switch port to another. A LIP occurrence can cause an undesirable disruption of an ongoing process on the SAN.

LIP Propagation Policy (Port Policy) allows administrators to prevent LIPs generated by initiators to propagate to other ports, thus eliminating the impact of unnecessary LIPs in the data flow. When LIP Propagation is prevented the Compaq StorageWorks FC-AL Switch 8 will provide discovery information needed by the initiator, and targets are not disrupted. This policy is implemented on a per port basis.

Note: Refer to "Compaq StorageWorks Fibre Channel Arbitrated Loop Switch 8 (FC-AL Switch 8) User Guide" for further information.

Selective Storage Presentation (SSP)

Selective Storage Presentation (SSP) is an RA4000 controller firmware feature. RA4000 controller is the controller used in the Compaq StorageWorks RA4000/4100. It is a new access control feature that allows multiple hosts running multiple applications on the SAN to have controlled access to the Compaq StorageWorks RA4000/4100 storage system on the SAN. This selective access allows policies to be set as to which application can access which storage enclosure. The access can be controlled down to a logical volume level.

The RA4100 SAN Solutions integrates SSP functionality, which allows customers to allocate and restrict data access at the logical drive level and permits the sharing of storage devices between servers, including servers running different operating systems. SSP guarantees that the volumes created on a single storage subsystem can only be accessed by designated servers, allowing non-cooperating heterogeneous and homogeneous servers to share a storage subsystem without one server corrupting data from another. SSP partitions storage but, at the same time, prevents non-cooperating servers running different operating systems from sharing the same logical drives.

Note: Configuration restrictions of Compaq StorageWorks RA4000/4100 are listed at the end of this section. Storage systems allocated to a cluster cannot be shared with any other cluster or standalone server. For more information check on http://www.compaq.com/storage

Compaq Array Configuration Utility (ACU) v2.50 or higher

The ACU uses a graphical user interface (GUI) to help configure an RA4100 SAN Solutions. This GUI is used to configure the RA4000/4100 controller, add additional disk drives to an existing configuration, and reconfigure an array controller.

The SSP functionality is implemented in the array controller firmware, operating system drivers, and the ACU. In addition to making it easy to configure and expand the number of disk drive arrays, the ACU provides a means of mapping the worldwide names of server HBAs to connection names and setting up access control lists for logical drives based on worldwide or connection names.

Compaq Redundancy Manager (CRM)

The CRM software is a redundancy management solution, which provides a range of functionality for Windows NT 4.0 servers using the Compaq StorageWorks RA4000/4100 storage system. The CRM software provides the ability to configure the environment using redundant Compaq StorageWorks Fibre Channel Host Bus Adapters (HBA) and redundant Compaq StorageWorks RA4000/4100 Controllers.

The CRM can automatically configure multiple paths, with the first available path being set as active and the next path as standby. Once the environment is configured, the CRM provides redundancy and path management for the configuration.

The CRM software operates on Compaq ProLiant Servers and supports the following operating systems:

- ❖ Microsoft Windows NT Server 4.0 (stand-alone configurations)
- ❖ Microsoft Windows NT Server Enterprise Edition (cluster configurations)

The CRM (Fibre Channel) features include:

- Active/Standby paths - enables two or more HBAs to have active and standby paths on a Fibre Channel Arbitrated Loop.
- Active/Active paths - enables two or more host bus adapters to have active paths on a Fibre Channel Arbitrated Loop. (Required at lease two RA4000/4100's).
- I/O load balancing - allows online load balancing using two or more host bus adapters and Compaq StorageWorks RA4000/4100s.
- HBA failover - allows host bus adapters to failover all I/O between the adapters, either manually for maintenance or automatically due to failure.
- Event logging - provides descriptive event logging of informational, warning, and error messages.
- Graphical User Interface (GUI) - provides an easy-to-use GUI for configuring and viewing of the current configuration.

Compaq SANworks Secure Path for NetWare

Compaq SANworks Secure Path for NetWare is a high-availability software product that manages and maintains continuous data access to the Compaq StorageWorks RA4000/4100 storage system.

Secure Path eliminates the array controllers, HBAs, and interconnect hardware (cables, hubs or switches, and connectivity devices) as single points of failure in the storage system. Through the deployment of redundant hardware and advanced RAID technology, Secure Path enhances fault tolerance and storage system availability by providing automated failover capability.

Redundant physical connections define separate physical "paths" in a Secure Path configuration. Each path originates at a unique HBA port on the server, and ends at a unique controller port in the storage system.

Features

Secure Path provides the following features:

- Allows a single instance of Secure Path Manager (SPM) to control NetWare and Windows hosts simultaneously.
- Allows StorageWorks dual-controller systems and host servers equipped with multiple HBAs to have redundant physical connectivity along a FC-AL.
- Monitors each path and automatically re-routes I/O to a functioning alternate path if an HBA, cable, hub, switch, or controller failure occurs.
- Determines the "health" of available storage units and physical paths through the implementation of path verification diagnostics.
- Monitors and identifies failed paths and failed-over storage units.
- Automatically restores failed-over storage units and repairs paths with auto-failback capability enabled.
- Implements anti-thrash filters to prevent failover/failback effects caused by marginal or intermittent conditions.
- Detects failures reliably without inducing false or unnecessary failovers.
- Implements failover/failback actions transparently without disrupting applications.
- Provides client/server remote management capability and multiple storage system support.

Configuration Restrictions

1. Clustered Compaq StorageWorks RA4000/4100 storage systems cannot be shared or owned by more than one Windows NT 4.0 or Windows 2000 cluster. This means that each RA4100 storage cabinet used by a Windows NT 4.0 or Windows 2000 cluster must be dedicated for use exclusively by that cluster. That storage cabinet cannot be accessed by any other servers outside of the cluster.
2. RA4000/4100 storage systems owned by a Windows NT or Windows 2000 cluster cannot be shared with stand-alone servers.
3. Redundant RA4000/4100 storage systems cannot be shared with non-redundant servers. This means that a redundant storage system can only be accessed by servers that contain dual Host Bus Adapters (HBAs) connected to separate FC-AL Switch 8 connections. The servers may be clustered or stand-alone, but they must have dual HBAs.
4. A server supports only a single or redundant path to the SAN (that is, a server cannot attach to multiple SANs). If a server contains dual HBAs, both of them must be connected to the same dual path infrastructure.

Note: For the most current configuration restrictions, visit the Compaq website at http://www.compaq.com/storage

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Compaq SAN Solutions Configuration

The RA4100 SAN Solution is ideal for workgroups or departments that want to deploy primary and secondary storage solutions across servers on the same SAN. This solution allows workgroups and departments to share their departmental applications while avoiding the cost of an enterprise-level SAN. The RA4100 SAN Solution features include the following:

1. Support for heterogeneous operating systems, such as Windows, NetWare, Linux, and UnixWare, that access storage through the Compaq StorageWorks FC-AL Switch 8.
2. Support for redundant and non-redundant stand-alone servers, clusters, or a combination of the two.
3. Eight ports for high-performance switch connection of components using the Compaq StorageWorks FC-AL Switch 8 with the option to expand to eleven ports using the StorageWorks 3-Port Expansion Module (PEM).
4. Shared consolidated storage enabling business applications to be decentralized and specialized.

To demonstrate the features of SAN Solutions, three configurations are presented in this paper.

Configuration Scenario

Multi-Cluster Non-Redundant Configuration

There are six systems (Server A, B, C, D, E, F) and four Compaq StorageWorks RA4000/4100 in this configuration. Each of the servers has only one HBA connected to one FC-AL Switch 8 with PEM. Each of the storage subsystems will have one to three logical drives (LD) according to the following configuration:

Hardware Configuration:

System:

Server Name	*Operating System*
MW360W21	Windows 2000 Advanced Server
MW360W22	Windows 2000 Advanced Server
MW360NT1	Windows NT Enterprise Edition Server
MW360NT2	Windows NT Enterprise Edition Server
MW360NW1	NetWare 5.1
MW360NW2	NetWare 5.1

Storage Subsystem:

Worldwide ID	*Logical drives created*	*Can be accessed by server*
D952DBX10030	Logical Drive 1	MW360W21, MW360W22
	Logical Drive 2	MW360W21, MW360W22
	Logical Drive 3	MW360W21, MW360W22
D952DBX10056	Logical Drive 1	MW360W21, MW360W22
D952DBX10063	Logical Drive 1	MW306NT1, MW360NT2
	Logical Drive 2	MW306NT1, MW360NT2
	Logical Drive 3	MW306NT1, MW360NT2
D931DBX10140	Logical Drive 1	MW360NW1, MW360NW2
	Logical Drive 2	MW360NW1, MW360NW2
	Logical Drive 3	MW360NW1, MW360NW2

In this configuration, there are three clusters.

1. Windows 2000 Advanced Server cluster formed by two servers and two external shared storage subsystems.
    a. Server MW360W21
    b. Server MW360W22
    c. RA4000 controller ID D952DBX10030 (three 9.1GB drives attached).
    d. RA4000 controller ID D952DBX10056 (three 9.1GB drives attached).
2. Windows NT Server Enterprise Edition cluster formed by two servers and one external shared storage subsystem.
    a. Server MW360NT1
    b. Server MW360NT2
    c. RA4000 controller ID D952DBX10063 (three 9.1GB drives attached).
3. NetWare 5.1 cluster formed by two servers and one external shared storage subsystem.
    a. Server MW360NW1
    b. Server MW360NW2
    c. RA4000 controller ID D931DBX10140 (three 18.1GB drives attached).

Cluster and Stand-alone Non-Redundant Configuration

Hardware Configuration:

System:

Server Name	*Operating System*
MW360W21	Windows 2000 Advanced Server
MW360W22	Windows 2000 Advanced Server
MW360W23	Windows 2000 Advanced Server
MW360NW1	NetWare 5.1
MW360LX1	Red Hat Linux 7.0
MW360NT1	Windows NT Enterprise Edition Server
MW360NT2	Windows NT Enterprise Edition Server

Storage subsystem:

Worldwide ID	*Logical drives created*	*Can be accessed by server*
D952DBX10030	Logical Drive 1	MW360W21, MW360W22
	Logical Drive 2	MW360W21, MW360W22
	Logical Drive 3	MW360W21, MW360W22
D952DBX10041	Logical Drive 1	MW360W23
	Logical Drive 2	MW360NW1
	Logical Drive 3	MW360LX1
D952DBX10163	Logical Drive 1	MW360NT1, MW360NT2
	Logical Drive 2	MW360NT1, MW360NT2
	Logical Drive 3	MW360NT1, MW360NT2

Each server in this configuration has one HBA and is connected through one Compaq StorageWorks FC-AL Switch 8 with PEM.

In this configuration, there are two clusters and three stand-alone servers.

1. Windows 2000 Advanced Server cluster formed by two servers and one storage subsystem.
    a. Server MW360W21
    b. Server MW360W22
    c. RA4000 controller ID D952DBX10030 (three 9.1GB drives attached).
2. One stand-alone NetWare 5.1, one standalone Linux Red Hat 7.0 and one stand-alone Windows 2000 Advanced Server sharing one storage subsystem.
    a. Server MW360W23 (Windows 2000 Advanced Server)
    b. Server MW360NW1 (NetWare 5.1)
    c. Server MW360LX1 (Linux 7.0 Red Hat Server)
    d. RA4000 controller ID D952DBX10041 (Six 9.1GB drives attached).
3. NT 4.0 Enterprise Edition Server cluster formed by two servers and one storage subsystem.
    a. Server MW360NT1
    b. Server MW360NT2
    c. RA4000 controller ID D952DBX10063 (three 9.1GB drives attached).

Note: Before adding an HBA to the Linux Server, the administrator needs to write down the Worldwide ID of the HBA. The Worldwide ID is the serial number labeled on the HBA. In the Linux environment, there is not a location record that indicates which HBA is local to the Linux server.

Not all HBAs can be accessed by Linux. Compaq suggests a Compaq 64-Bit/66-MHz PCI-to-Fibre Channel Host Bus Adapter to be used in this configuration.

Redundant Configuration

In the redundant configuration, there are two data flow loops to provide high availability to the SAN environment. In order to achieve the dual-loop environment, two Compaq StorageWorks FC-AL Switch 8 are required. All servers will have two HBAs. All Compaq StorageWorks RA4000/4100 will have two controllers.

Hardware Configuration:

System:

Server Name	*Operating System*
MW360NT1	Windows NT Enterprise Edition Server
MW360NT2	Windows NT Enterprise Edition Server
MW360NW1	NetWare 5.1
MW360NW2	NetWare5.1
MW360NT3	Windows NT Enterprise Edition Server

Storage subsystem:

Worldwide ID	*Logical drives created*	*Can be accessed by server*
D952DBX10041	Logical Drive 1	MW360NT1, MW360NT2
	Logical Drive 2	MW360NT1, MW360NT2
D952DBX10063	Logical Drive 1	MW360NT1, MW360NT2
D952DBX10056	Logical Drive 1	MW360NT1, MW360NT2
D952DBX10040	Logical Drive 1	MW360NW1, MW360NW2
	Logical Drive 2	MW360NW1, MW360NW2
D952DBX10130	Logical Drive 1	MW360NT3

In this configuration, there are two clusters and one stand-alone server.

1. Windows NT Server Enterprise Edition cluster formed by two servers and three storage subsystems.
    a. Server MW360NT1
    b. Server MW360NT2
    c. RA4000 controller ID D952DBX10041 (three 9.1GB drives attached).
    d. RA4000 controller ID D952DBX10063 (three 9.1GB drives attached).
    e. RA4000 controller ID D952DBX10056 (three 9.1GB drives attached).
2. NetWare 5.1 cluster formed by two servers and one storage subsystem.
    a. Server MW360NW1
    b. Server MW360NW2
    c. RA4000 controller ID D931DBX10140 (three 18.1GB drives attached).
3. One Window NT 4.0 standalone server with one storage subsystem.
    a. Server MW360NT3
    b. RA4000 controller ID D952DBX10030 (three 9.1GB drives attached).

Multi-Cluster Non-Redundant Configuration

Multi-Cluster Non-Redundant Configuration

- Windows 2000 Advanced Server MSCS
- Windows NT Server Enterprise Edition MSCS
- NetWare 5.1 NCS

Pre-configuration assumptions:

1. Before installing the OS on the servers, all of the Compaq StorageWorks RA4000/4100 that belong to this configuration should be powered up. Then power on each system to install the OS.
2. Windows NT Server Enterprise Edition is properly installed, NTSSD and Service Pack 6a have been applied to both servers (MW360NT1, MW360NT2).
3. Windows 2000 Advanced Server is properly installed, the Compaq Support Paq (CSP) and Windows 2000 Service Pack 1 have been applied to both servers (MW360W21, MW360W22).
4. NetWare 5.1 is properly installed, the Compaq Novell NetWare SSD and Service Pack 1 have been applied to both servers (MW360NW1, MW360NW2).
5. The six servers are attached to port 1 through 6 of the Compaq StorageWorks FC-AL Switch 8.
6. All the StorageWorks RA4000/4100s and the Compaq StorageWorks FC-AL Switch 8 w/PEM should be flashed with the latest firmware. If any previous configurations exist, use the Compaq ACU to delete any configuration on the array controllers.
7. No cluster software is installed on any of the servers.

Port Policy Configuration

As described in the previous section, the LIP Propagation Policy allows administrators to prevent LIPs generated by initiators to propagate to other ports, thus eliminating the impact of unnecessary LIPs in the data flow. The administrator can either block a device to prevent interrupt or non-block a device to enhance the performance.

In the FC-AL environment, the administrator should enable LIP on the storage subsystems and disable LIP on the servers.

The Compaq FC-AL Management Utility is used to configure the Compaq StorageWorks FC-AL Switch 8. An internet browser is used to access the management tool. SNMP is used to communicate with the Compaq StorageWorks FC-AL Switch 8.

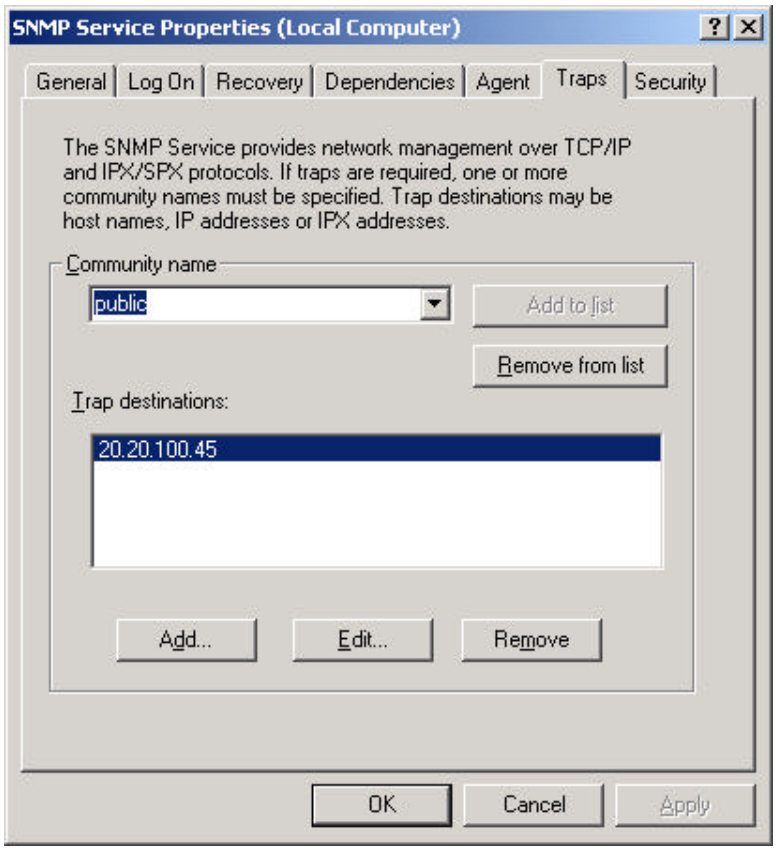
The configuration steps are as follows:

1. Use an Ethernet RJ-45 cable to connect the Compaq StorageWorks FC-AL Switch 8 to the network. This connection is used to provide management functionality through SNMP. By default, the Compaq StorageWorks FC-AL Switch 8 is configured to use an IP address of 127.0.0.1. To change the IP address, use a terminal emulator that is connected to the serial

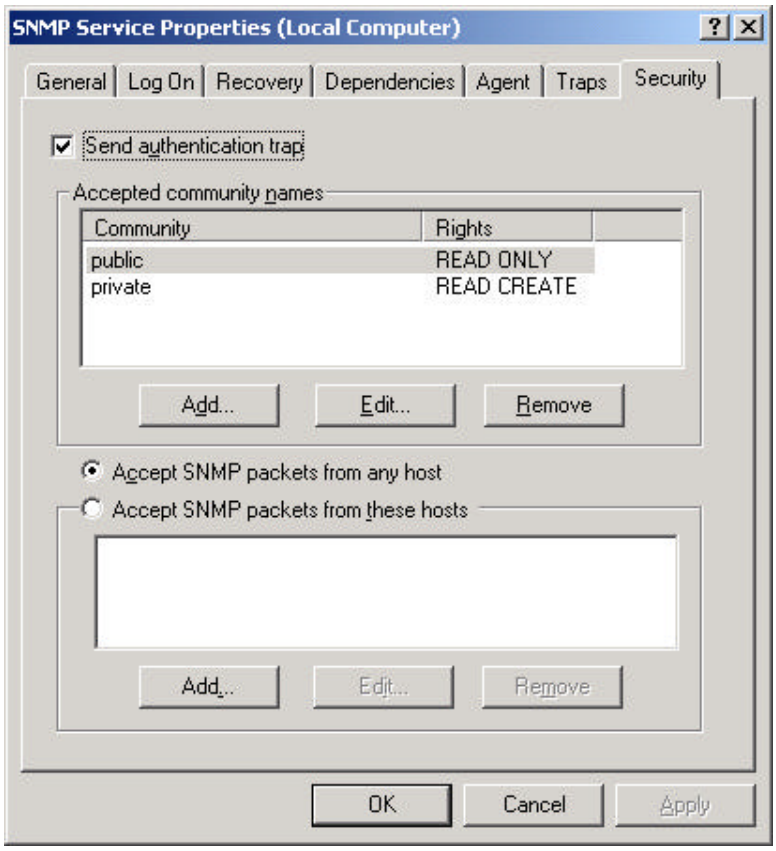
port on the switch. The Compaq StorageWorks FC-AL Switch 8 runs at 10mb/sec. Make sure the network hub that the Compaq StorageWorks FC-AL Switch 8 is attached to supports 10mb/sec.

Note: Refer to the "Compaq StorageWorks Fibre Channel Arbitrated Loop Switch (FC-AL Switch 8) User Guide" for additional information.

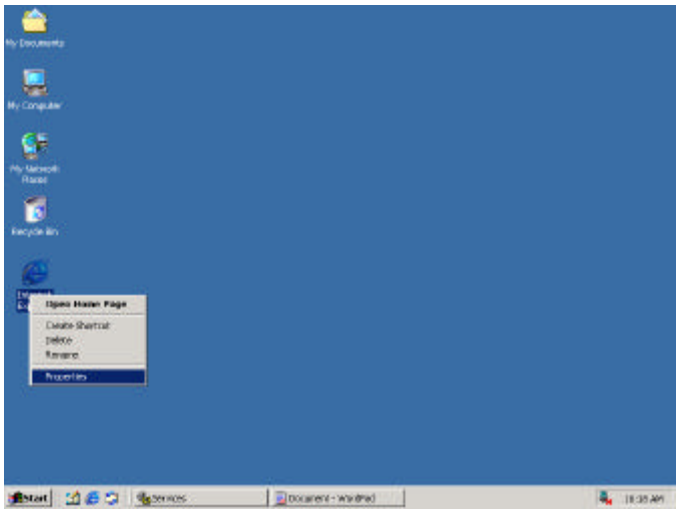
2. To enable the SNMP service on the Windows 2000 Advanced Server, open the property sheet of the SNMP service. Select the "Traps" tab. Use "public" for the community name.



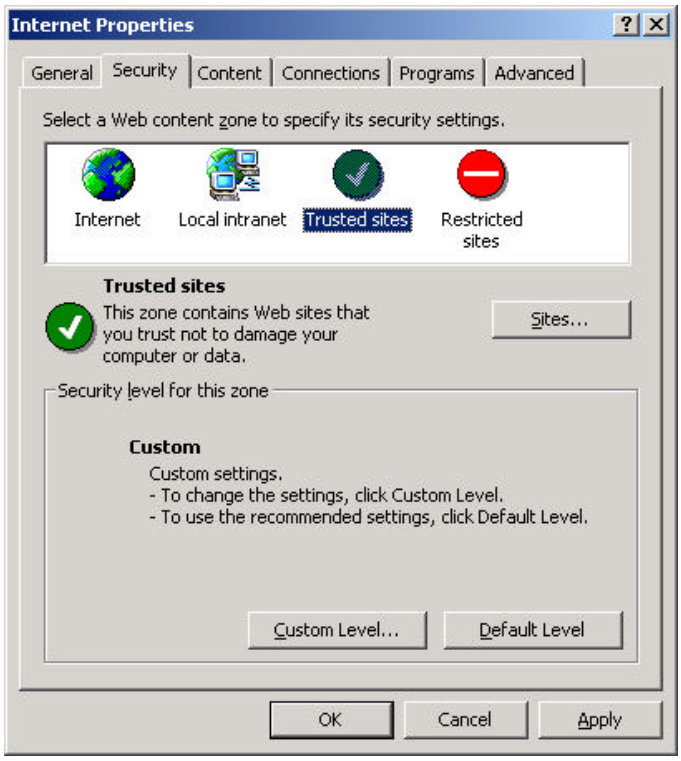
3. Select the “Security” tab and add the “private” community with “Read Create” rights.



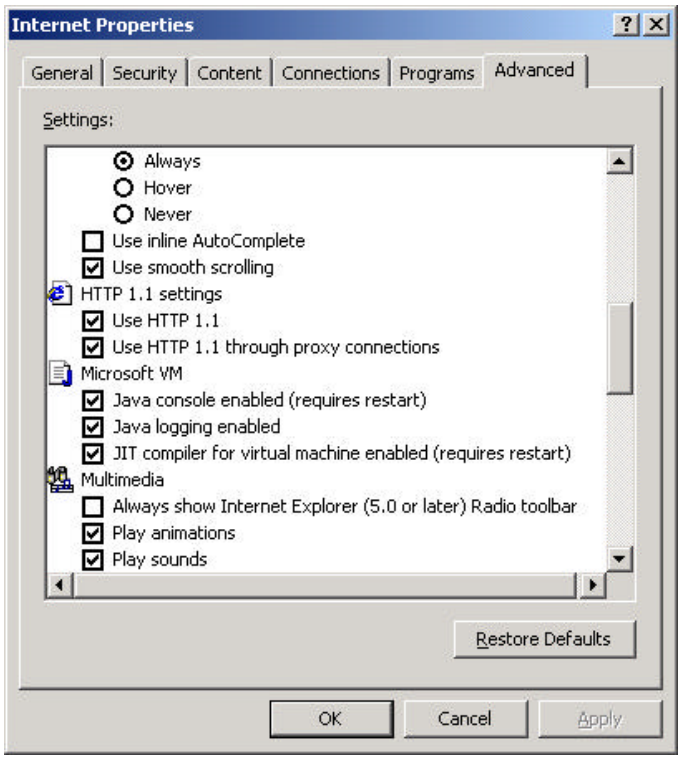
4. Microsoft Internet Explorer 5.0 or higher is required to access the management utility. Before the browser can access the Compaq StorageWorks FC-AL Switch 8, it needs to be configured. Open the properties of Internet Explorer.



5. In the properties of Internet Explorer, select the “Advanced” tab.

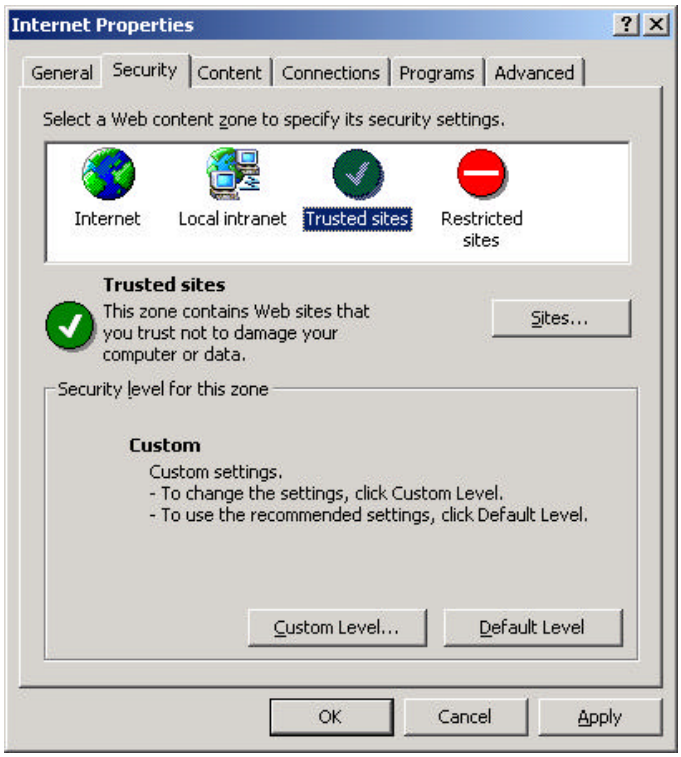


6. In the “Settings:” window of the “Advanced” tab, scroll down to find the Microsoft VM section. Enable all of the Microsoft VM options.

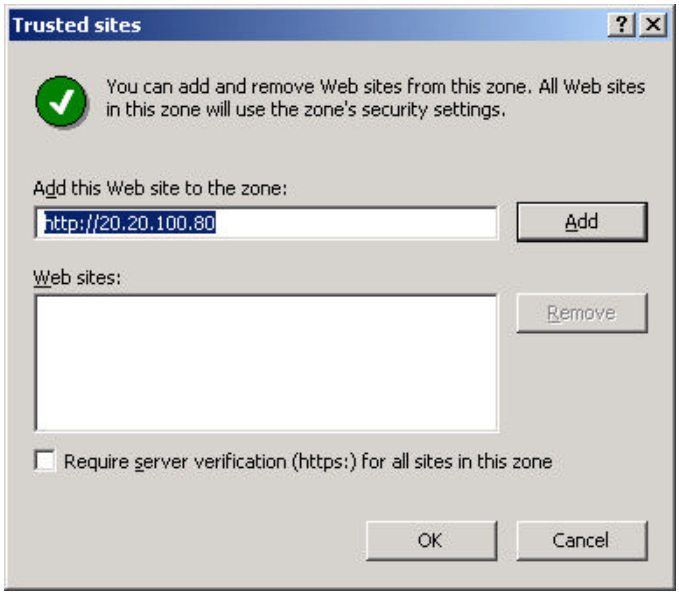


Note: A bug in an older version of the Microsoft Internet Explorer JVMs will prevent the applet from working unless the switch's IP address maps to a valid FQDN in the DNS server used by the browser host.

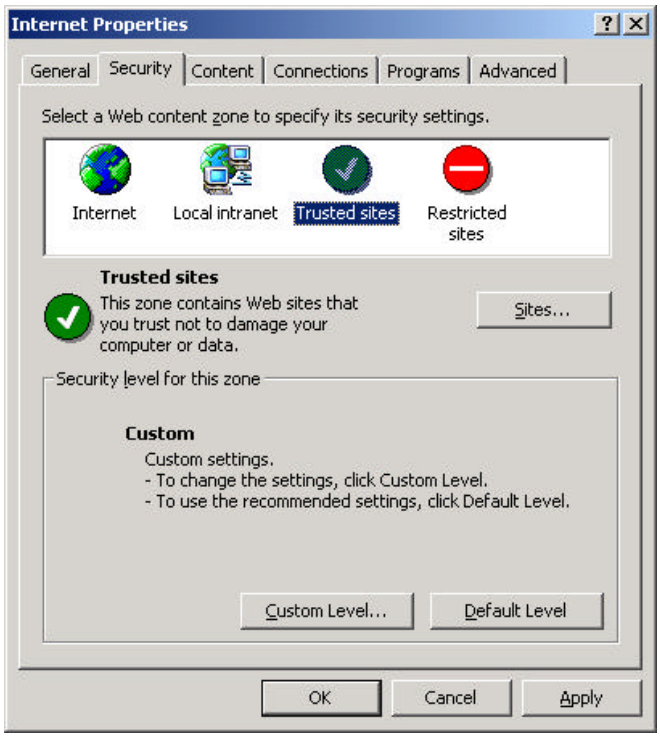
7. Open the "Internet Explorer" property sheet and click on the "Security" tab. Select the "Trusted" sites icon. Click on the "Sites" button to add the Compaq StorageWorks FC-AL Switch 8 IP address/Host name to the trusted sites.



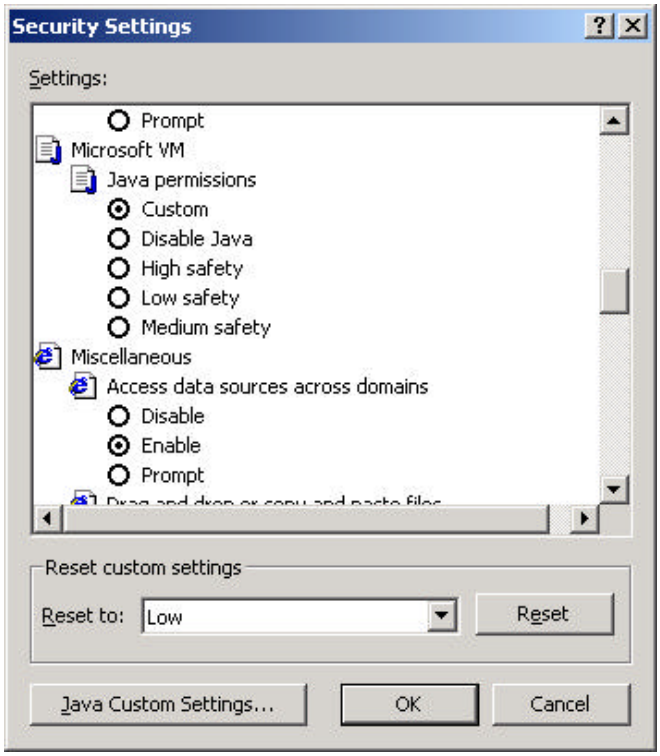
8. Add the hostname or the IP address of the Compaq StorageWorks FC-AL Switch 8 to the "Add this Web site to the zone:" field. The default IP address for the Compaq StorageWorks FC-AL Switch 8 is 127.0.0.1. To fit into the IP address schema of this test configuration, we have changed the Compaq StorageWorks FC-AL Switch 8 to 20.20.100.80. Uncheck "Require Server verification (https:) for all sites in this zone" in the check box. Click "OK" to leave this page.



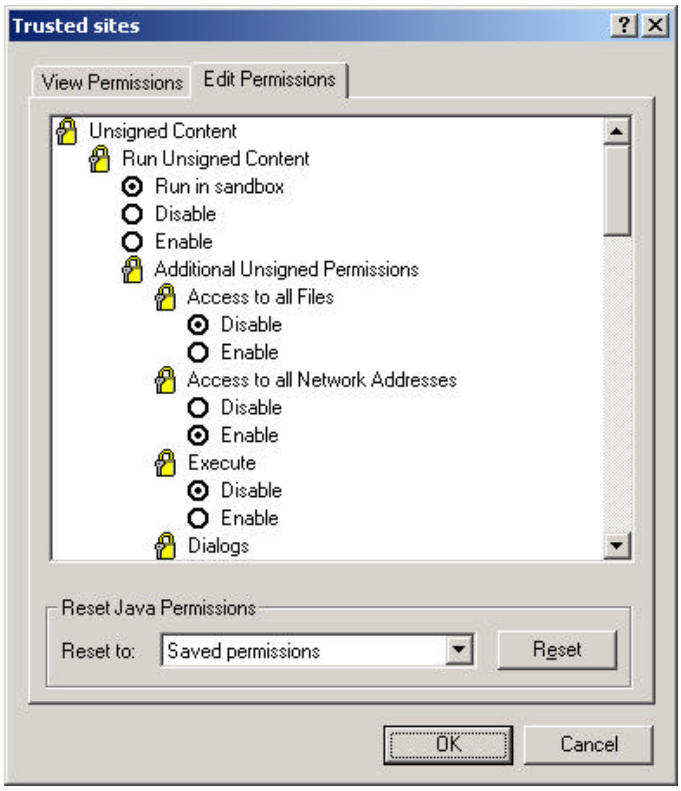
9. Once the "Internet Properties" page comes back, select the "Security" tab and click on the "Custom Level" button at the end of the page.



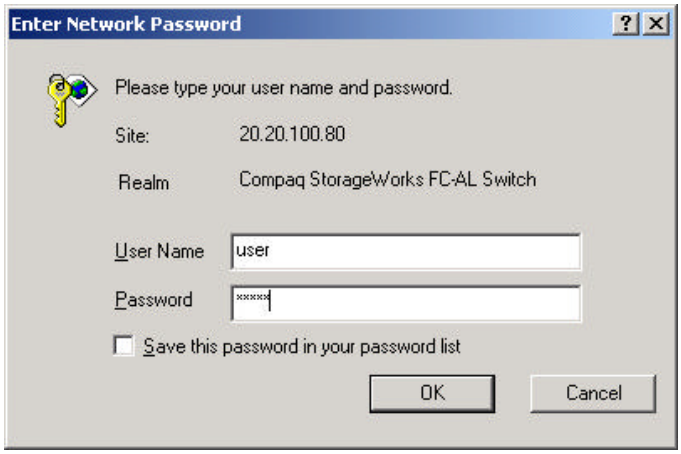
10. At the "Security Settings" page, scroll down to the "Microsoft VM" section. Set the "Java permissions" to "Custom". Then click the "Java Custom Settings" button at the bottom of the page.



11. Click the “Edit Permissions” tab in the “Trusted sites” page. Set the Unsigned Content to “Run in sandbox”, and “Enable” access to all network addresses.

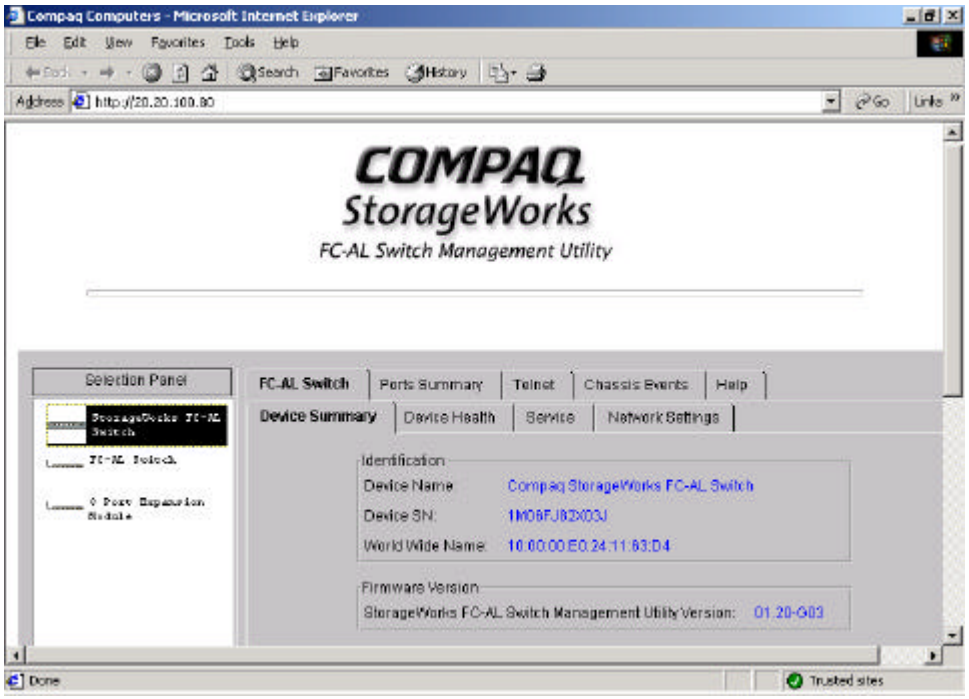


12. Click “OK” and exit the property sheet of Internet Explorer. If Internet Explorer is running, you must restart it for the changes to go into effect.
13. Start Internet Explorer. In the address bar, type FQDN if DNS is properly setup or enter the IP address of the Compaq StorageWorks FC-AL Switch 8. In this scenario, http://20.20.100.80 was typed in the location bar.
14. The login box of the Compaq StorageWorks FC-AL Switch 8 will show up. The default login is “user” with the password “ADMIN”.



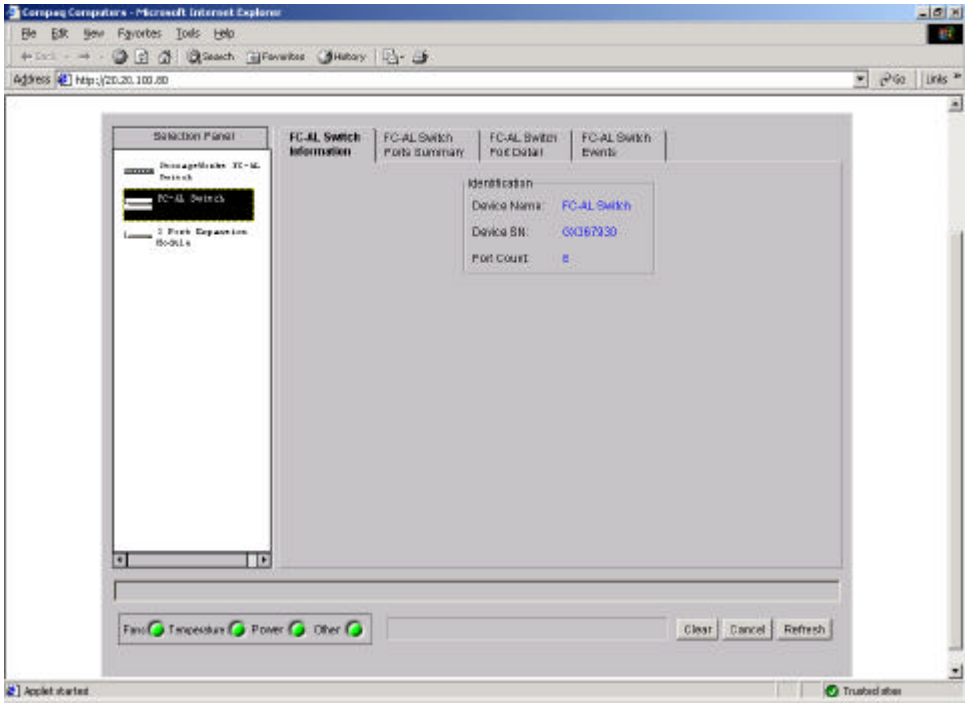
15. In the SNMP community settings, enter the proper community that was created during the set up of the SNMP Service properties. In this case, the Read Community is “public” and the Write Community is “private”. The properties are ***case sensitive***. Make sure the case matches the communities that were previous defined.

16. The Compaq StorageWorks FC-AL Switch 8 Management Utility main page will display. In the left side, the Compaq StorageWorks FC-AL Switch 8 with the IP address 20.20.100.80 and the 3 ports expansion module (PEM) is listed. There are several tabs that provide management information for the administrator. Please refer to the *"**Compaq StorageWorks User Guide - Fibre Channel Arbitrated Loop Switch (FC-AL Switch 8)**"*for more information. In this configuration, we want to define the port policy for the Compaq StorageWorks FC-AL Switch 8. Click on the Compaq StorageWorks FC-AL Switch 8 icon in the left panel.



17. There are four tabs in the FC-AL Switch 8 page.
    - The “FC-AL Switch information” provides descriptions, model numbers and serial number for the selected Compaq StorageWorks FC-AL Switch 8.
    - The “FC-AL Switch Ports Summary” gives summary information for all ports.
    - The “FC-AL Switch Port Detail” provides the configuration information for a specific port.
    - The “FC-AL Switch Events” reports the descriptions and the severity of events detected by the Compaq StorageWorks FC-AL Switch 8.

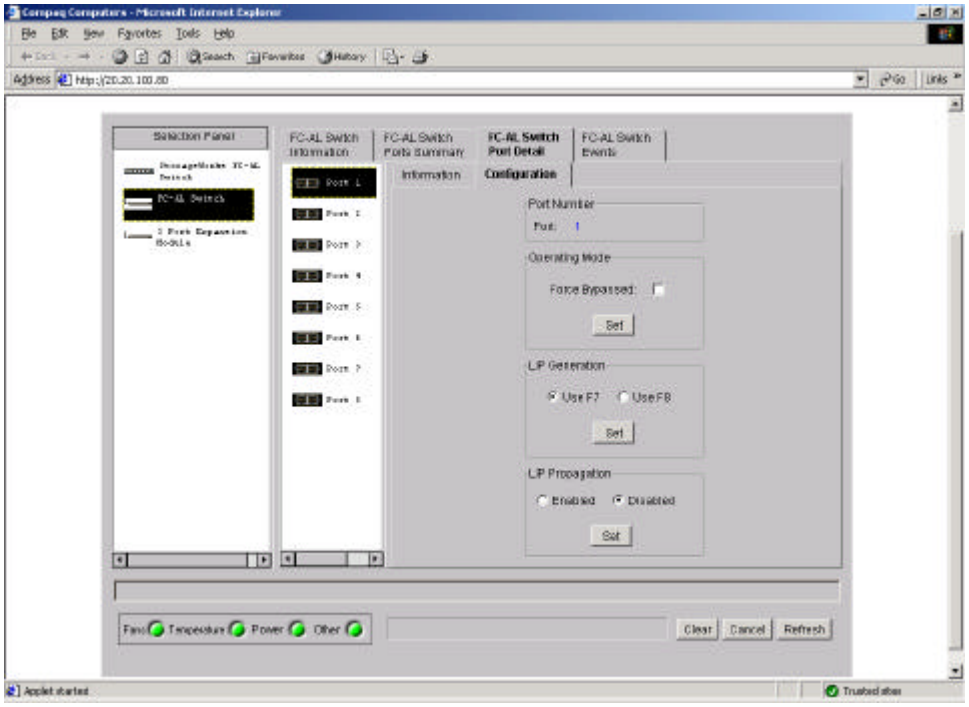
    In the first scenario there are six servers and four Compaq StorageWorks RA4000/4100s. To configure the port policy click on the Compaq StorageWorks FC-AL Switch 8 Port Detail tab.



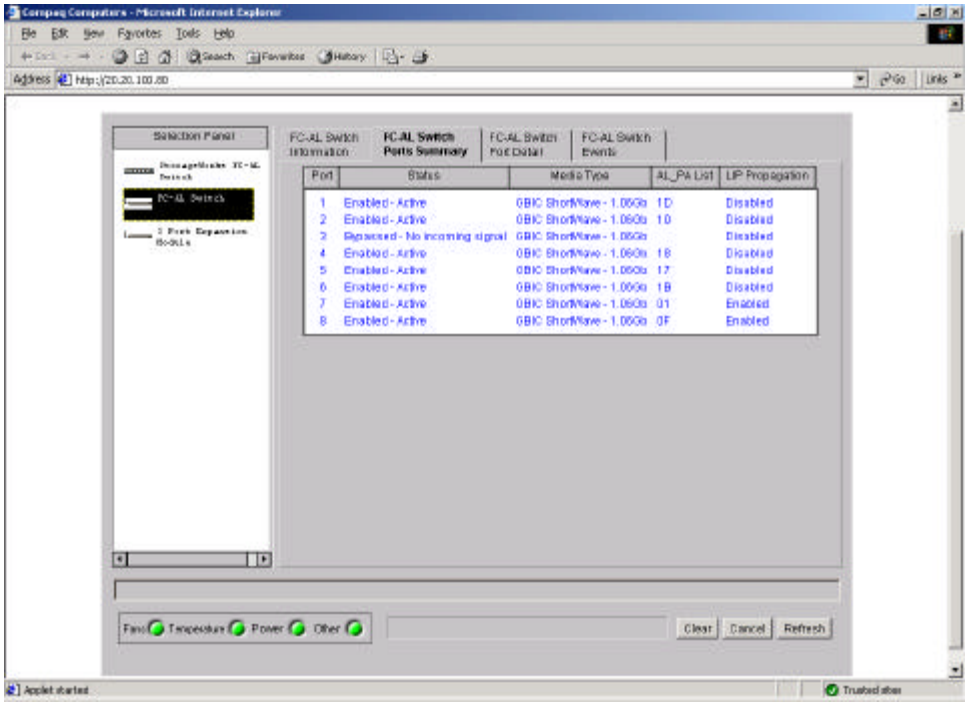
18. In the middle panel, there are 8 ports listed. Check the Configuration tab. The information in the right panel is for the port that is highlighted. There are four groups in the Configuration panel: Port Number, Operation Mode, LIP Generation and LIP Propagation.
    - Port Number
      Shows the number that identifies the selected port.
    - Operating Mode
      When “forced bypassed” is checked, a device can be connected to the port but it is not allowed into the loop. If “forced bypassed” is unchecked, a device which attached to that port is allowed to enter the loop.
    - LIP Generation
      The Compaq StorageWorks FC-AL Switch 8 can generate forced the LIPs when it is detects a change in a port state.
    - LIP Propagation

This specifies whether LIPs generated by devices attached to this port should be propagated to the other ports. Switch ports populated with hosts are candidates for disabling LIP propagation. LIP propagation should not be disabled for ports populated with target I/O devices.

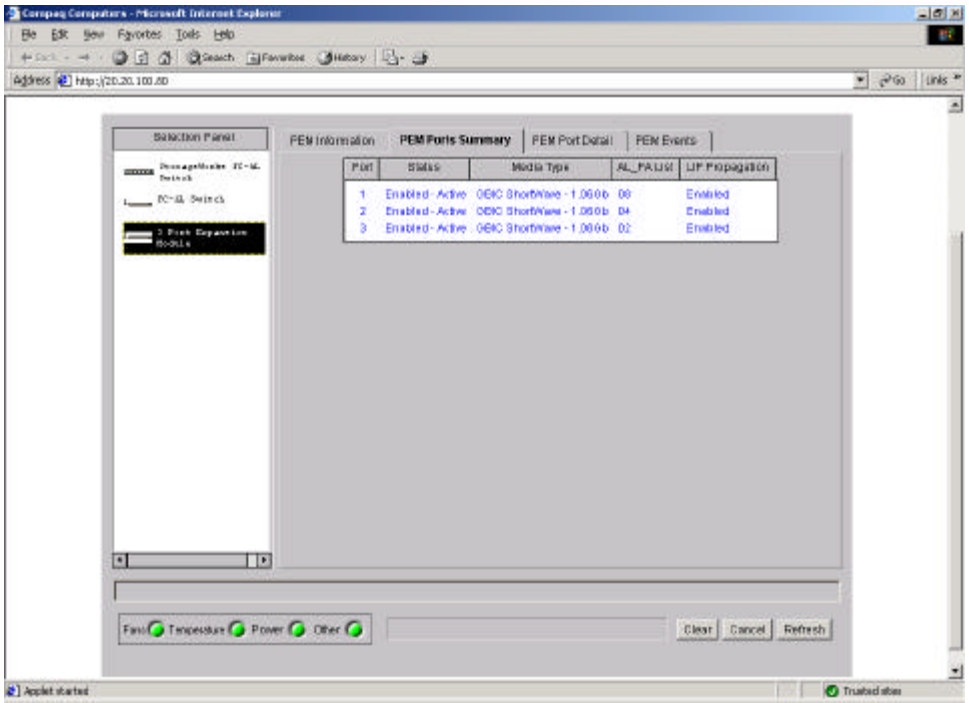
The six servers in this scenario should have LIP disabled, and the four Compaq StorageWorks RA4000/4100 should have LIP enabled. The servers are connected to ports one through six of the FC-AL Switch 8 and the Compaq StorageWorks RA4000/4100s are connected to port seven, port eight, and two ports on the PEM. Disable the LIP Propagation for the first six ports by selecting each port in the middle panel and clicking the disable option in the LIP Propagation section.



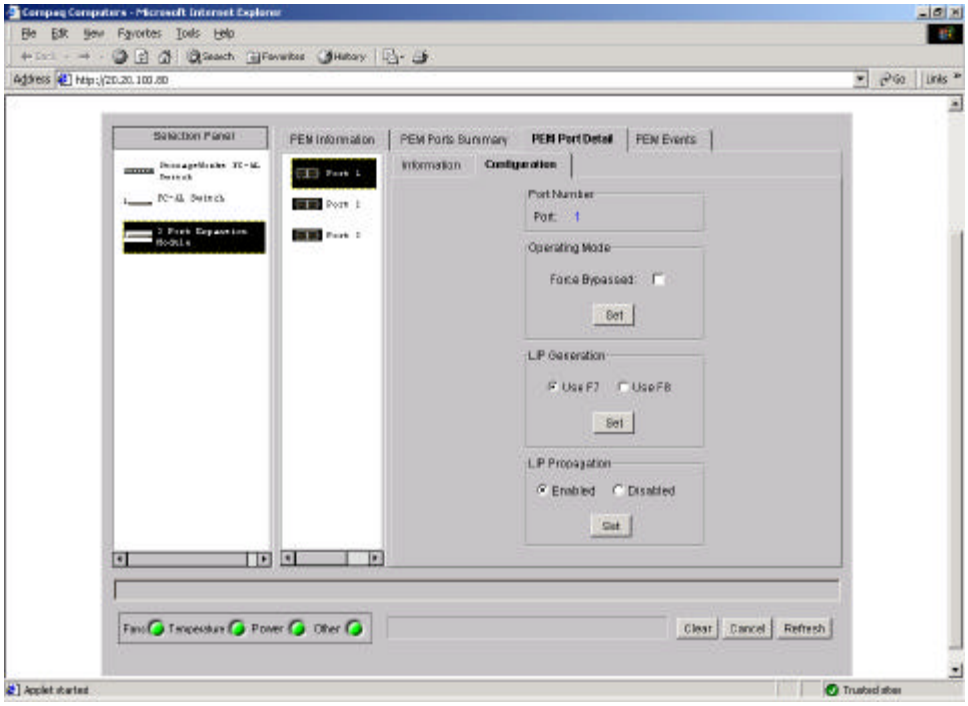
19. To check the status of each connection for all of the ports on the Compaq StorageWorks FC-AL Switch 8. Click on the “FC-AL Switch Port Detail” tab. The “Status” section will indicate which ports are active and which do not have a successful connection. In the “LIP Propagation section” it displays a summary of the LIPs setting. Make sure all connections are marked as “Active” and the LIP setting is correct ports 1 to 6 should be marked as “Disabled” and ports 7 and 8 should be marked as “Enabled”.



20. There are two Compaq StorageWorks RA4000/4100 attached to the PEM. In this scenario, the LIP setting of the two ports should be enabled. Click on the “3 Port Extension Module” in the left panel. Click on the “PEM Port Summary” tab. All three ports should have LIP enabled.



21. If any of the ports on the PEM are not LIP enabled, click on the “PEM Port Detail” tab and enable the LIP on each port. Close the browser when finished with the port configuration.



At this point, the configuration for the Port Policies is finished. We can start to configure each server in this scenario.

ACU and SSP in Windows 2000 Advanced Server

Windows 2000 Advanced Server Cluster Service is formed by two servers and two storage subsystems.

a. Server MW360W21

b. Server MW360W22

c. RA4000 controller ID D952DBX10030 (three 9.1GB drives attached) has three logical drives

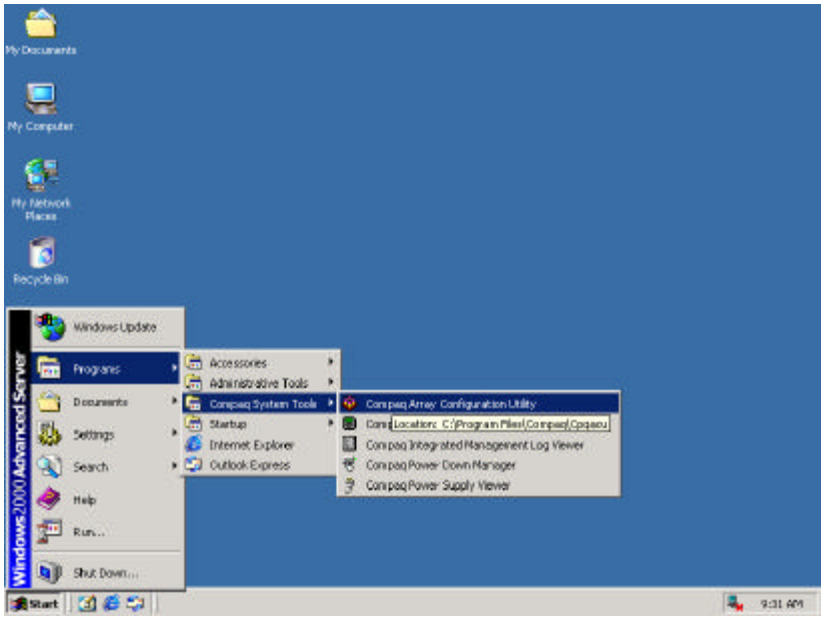
   1. 100MB logical drive for the quorum
   2. 10000MB logical drive
   3. 7251MB logical drive

d. RA4000 controller ID D952DBX10056 (three 9.1GB drives attached) has one logical drive

   1. 26033MB logical drive

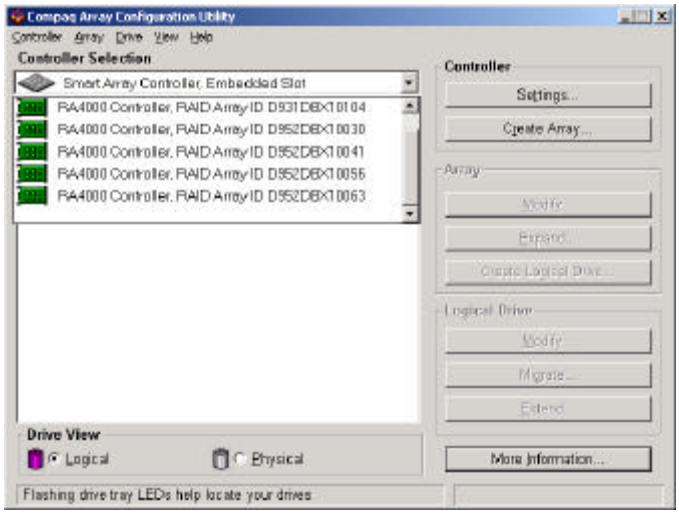
Configure the ACU

1. The Compaq ACU is GUI software for the Smart Array products and the StorageWorks RA 4000/4100. This utility is located on the SmartStart and the Support Software CD. If a server is properly installed through the Compaq SmartStart and the Compaq Support Paq was applied, The ACU can be accessed through workspace as shown below.

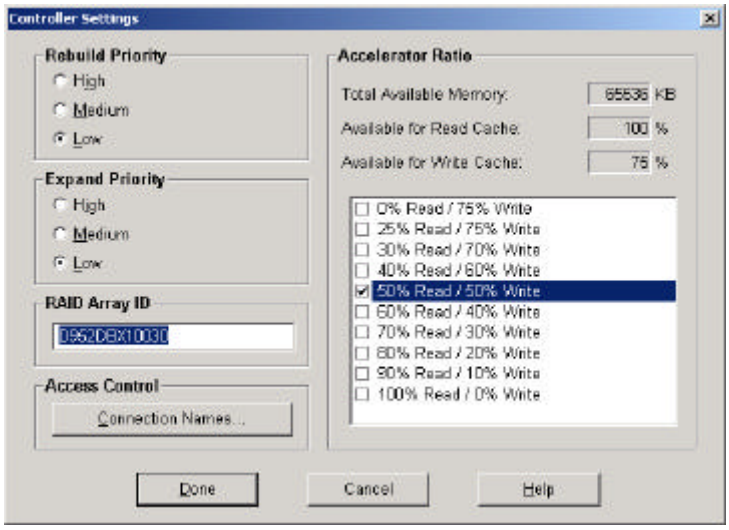


2. In this configuration, the ACU was accessed by server MW360W22. In the Controller Selection drop down box, RA4000 controllers are listed with specific worldwide ID and one embedded Smart Array Controller. These IDs will match the number in the upper right corner of the physical StorageWorks RA4000/4100 box.

   The controller name can be changed through the ACU. Click on the “Settings” button in the “Controller” section of the right panel.



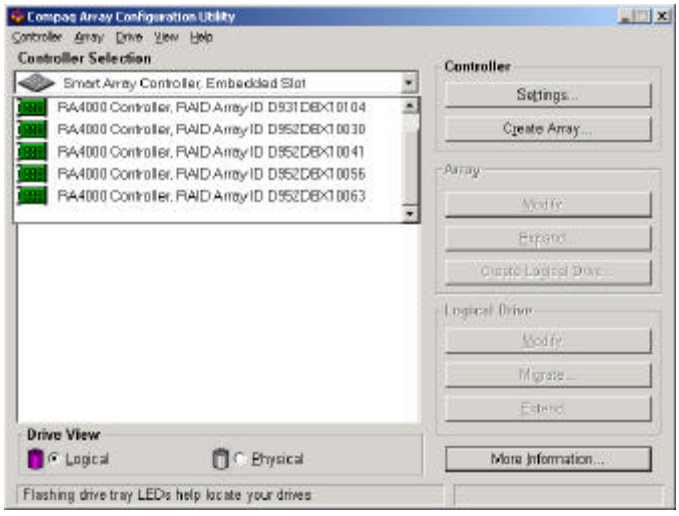
3. In this configuration the Worldwide ID will be the name of the array. In order for NetWare 5.1 to recognize the Worldwide ID name, it is suggested to retype the Worldwide ID in this section. Otherwise, NetWare will not pick up the ID in the NetWare ACU, it will all be labeled as “Unknown”, which will create some difficulties identifying the controllers. The administrator can change the name of the controllers according to practical needs.



4. According to the configuration plan, server MW360W22 should be able to access two RA4000 controllers, which are

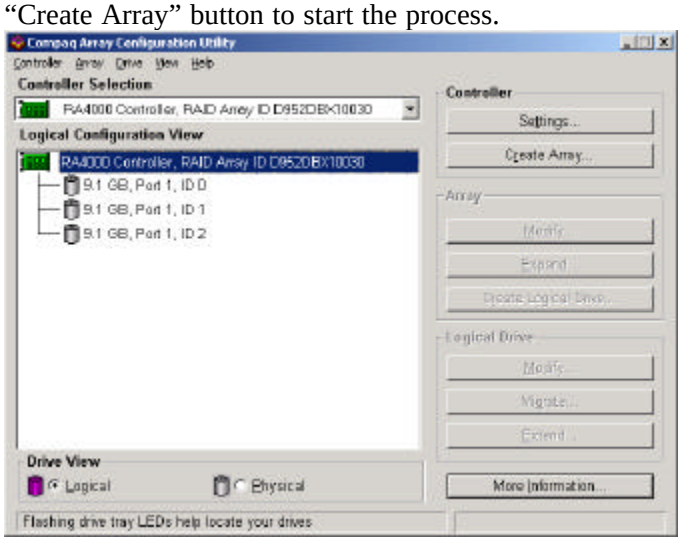
D952DBX10030	Windows 2000 Advanced Server
D952DBX10056	Windows 2000 Advanced Server

In the Controller Selection drop down menu both controllers are listed. Start the configuration process by select the first controller that belongs to this configuration, whic h is the controller with ID D952DBX10030.

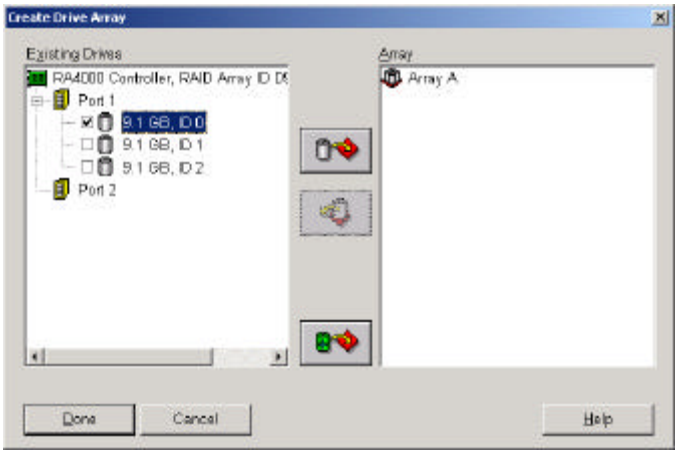


5. This controller has three 9GB drives attached. This RA4000 controller will host three logical drives for two servers, MW360W21 and MW360W22. In this scenario, create one RAID 5 array using three 9.1GB drives. Then create three logical drives in this array. Click on

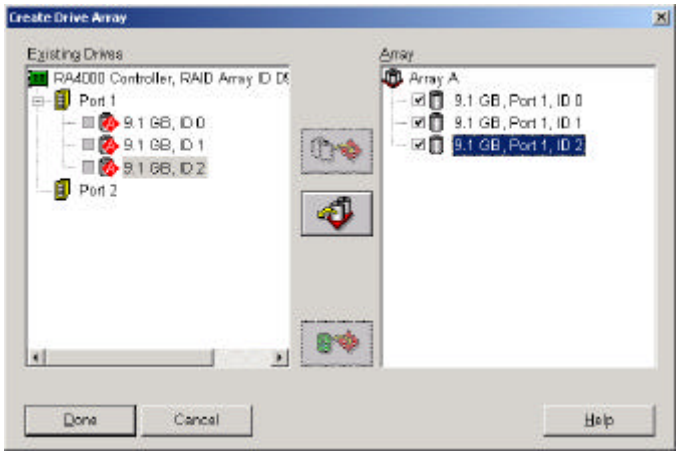
"Create Array" button to start the process.



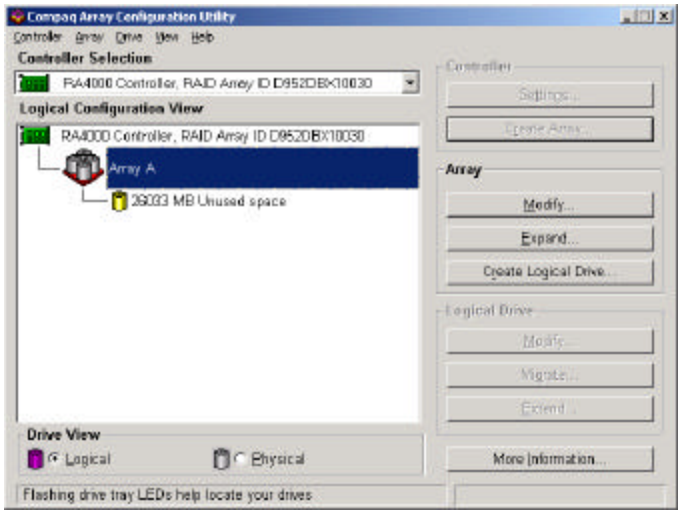
6. Select all three drives. Then click on the top icon to add drives to Array A.



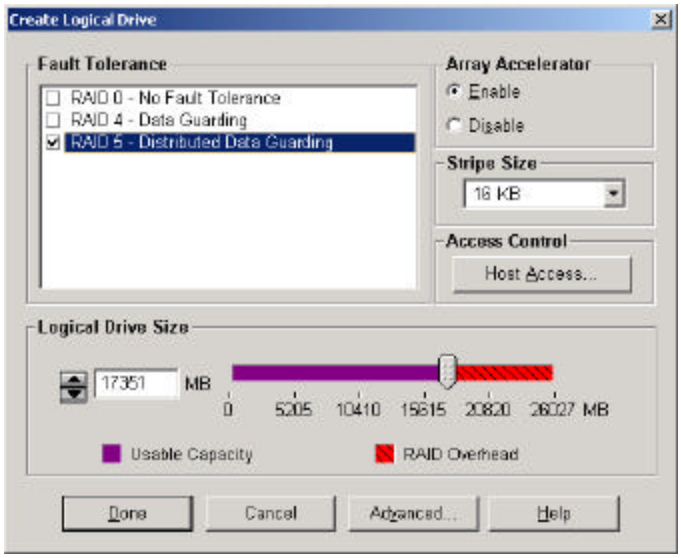
7. As shown below, all three drives have been moved to Array A. Click "Done" at the bottom of the dialogue box to return to the Main Configuration menu.



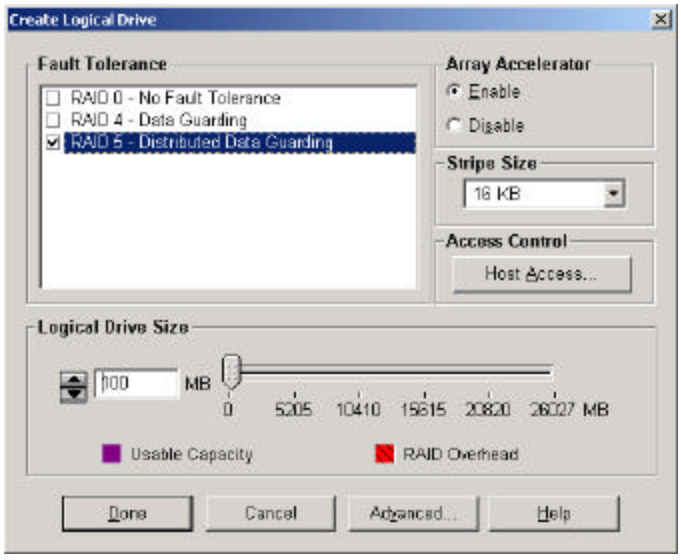
8. The "Logical Configuration View" indicates that Array A has been created. Click on the unused space and click the "Create Logical Drive" button.



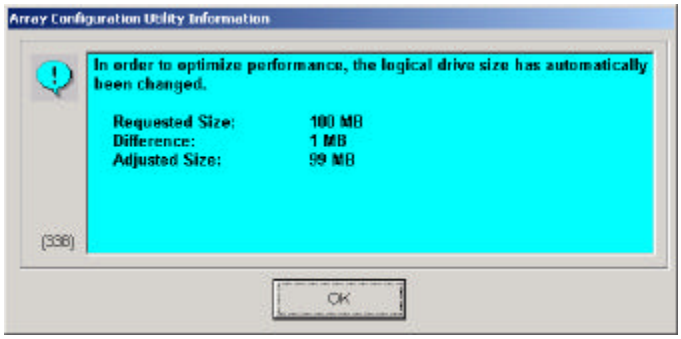
9. In the “Create Logical Drive” dialogue box, select “RAID 5-Distributed Data Guarding” then specify the size of the logical drive. All of the unused space is listed in the logical drive size box.



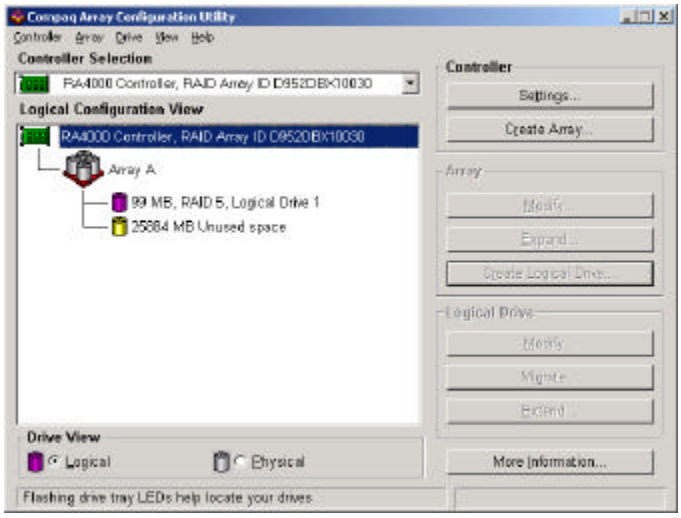
10. Create a 100MB logical drive for the quorum drive. Type 100 in the “Logical Drive Size” box to create the 100MB logical drive. Then click the “Done” button at the bottom of the dialog box.



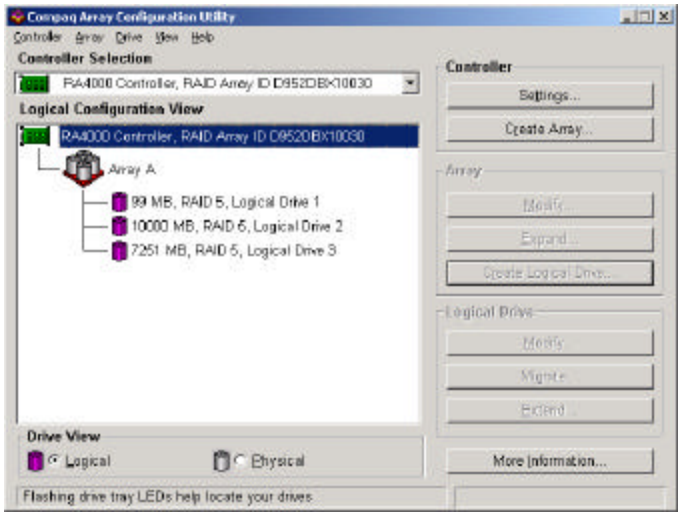
11. The ACU will confirm that a logical drive has been created. Click OK to return to the main screen.



12. In the logical configuration view box there is one RAID 5 drive created. 25884MB unused space is still available.



13. Repeat steps 8 through 11 until all three logical drives have been created and no unused disk space remains.



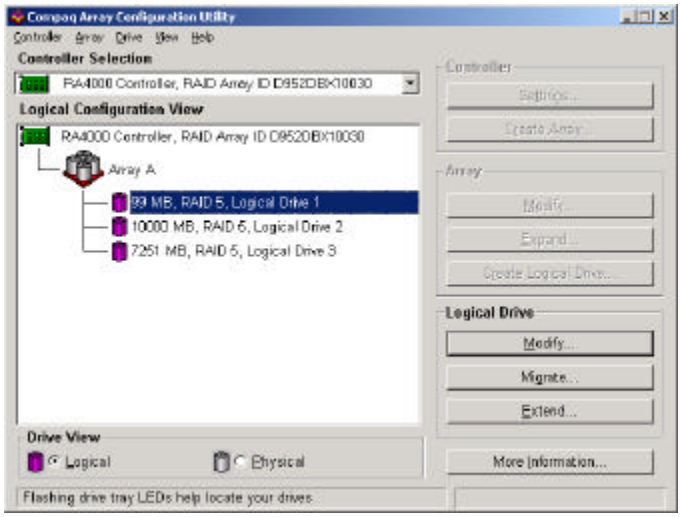
In this paper we will define the access rules. The SSP is used to regulate the host access of each logical drive.

Configure Select Storage Presentation (SSP)

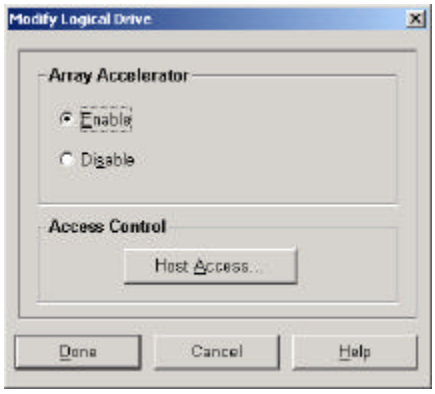
A. Grant access for server MW360W22 to access the shared drives.

The SSP is integrated into the ACU. It is a firmware level utility, which allows the administrator to allocate and restrict data access at the logical drive level. In this configuration, server MW360W22 needs to access two Compaq StorageWorks RA4000/4100 through the ACU.

1. Three logical drives were created in the RA4000 controller with ID D952DBX10030 in the previous section. Since the SSP works at the logical drive level, the configuration needs to be done for each logical drive. Click on the first logical drive. The “Logical Drive” section in the left panel becomes available. To modify the access control for this logical drive, click “Modify”.



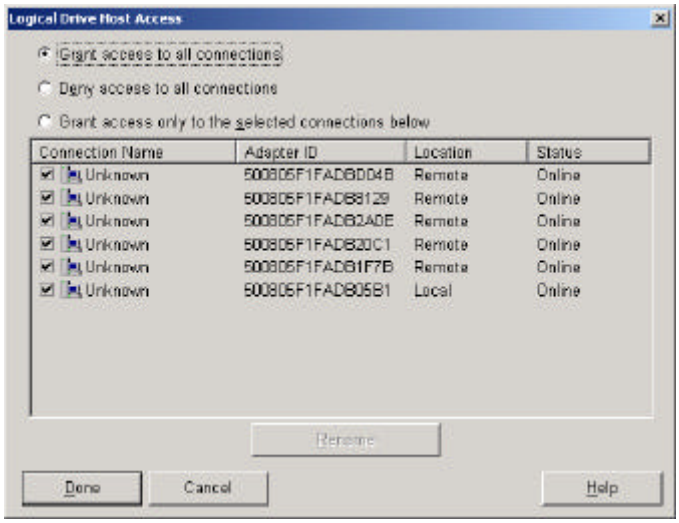
2. On the “Modify Logical Drive” screen Array Accelerator is enabled by default. Click on the “Host Access” button to bring up the SSP configuration screen.



3. Each connection represents the HBA in the server. The Adapter ID is the worldwide ID for the HBA, which is labeled on the HBA.

   The “Location” section indicates where the HBA is. In this scenario, the SSP is running on server MW360W22, which indicates the Adapter ID 500805F1FADB05B1 is sitting in the server MW360W22. As shown in the box, the location of the adapter is “Local”.

   Once the adapter is identified, access should be granted accordingly. By default, this logical drive grants access to all of the HBAs in the environment. In this configuration, the first logical drive in the RA4000 controller ID D952DBX10030 should only be accessed by server MW360W21 and MW360W22. Therefore, change “Grant access to all Connections” to “Grant access only to the selected connections below”.



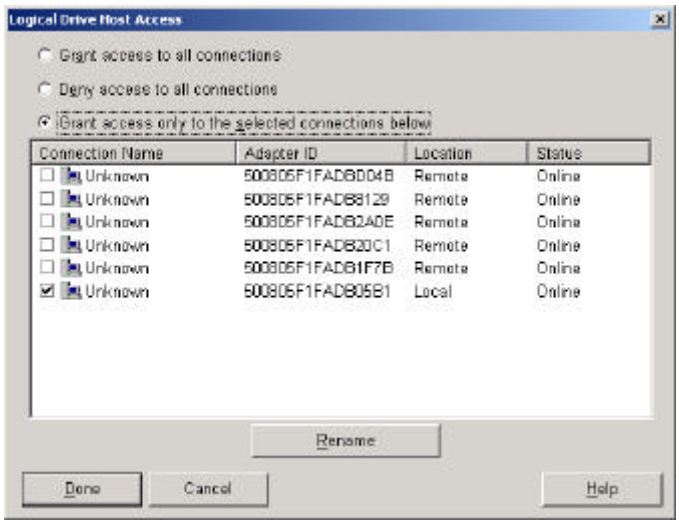
4. The names in the “Connection Name” column can be renamed. Check the "Connection Name" of the adapter that belongs to server MW360W22, with adapter ID 500805F1FADB05B1.

   Compaq strongly suggests you rename each connection to names that are meaningful. From a management perspective, it makes it easy for an administrator to identify connections for repair or maintenance.

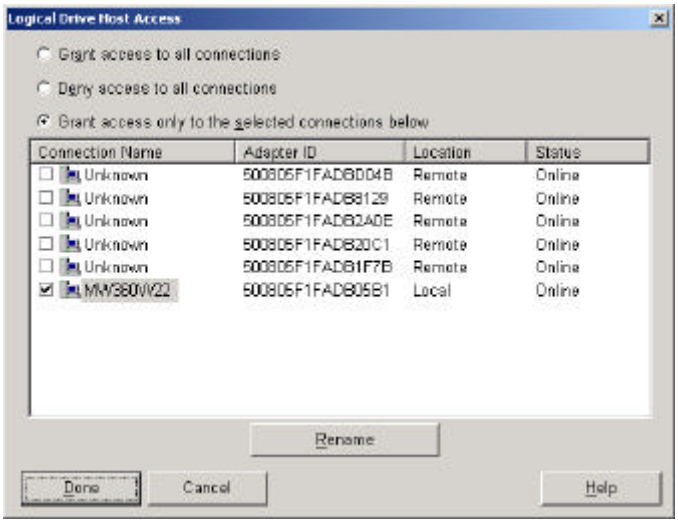
   This logical drive should be accessed by server MW360W22 and MW360W21. Unless the administrator collected the HBA Worldwide IDs before the HBA was added to server , there

is no indication of which adapter belongs to which server in the “Logical Drive Host Access” page.

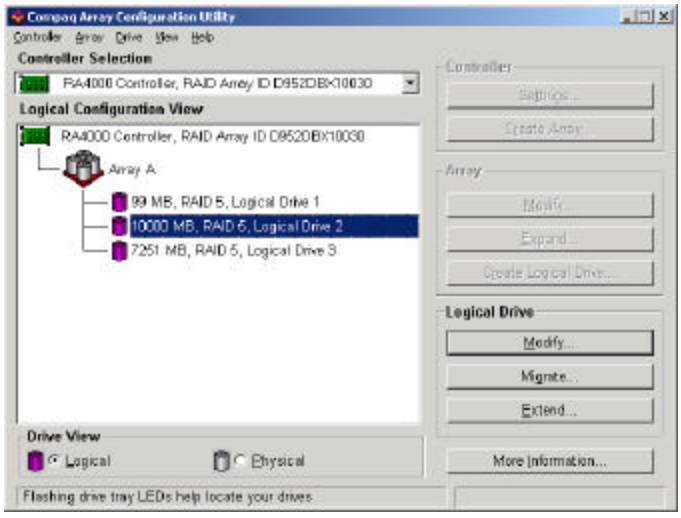
NOTE: It is highly recommended that the administrator record all the hardware information before configuring the SAN environment.



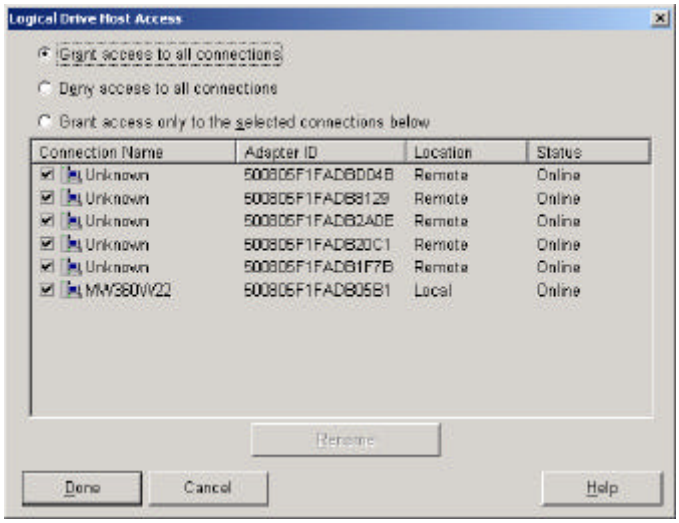
5. To rename a connection, click on the name of the connection and click the “Rename” button at the bottom of the page. Once the name space becomes available, type the desired name. In this configuration, the server name “MW360W22” is used to show the connection.



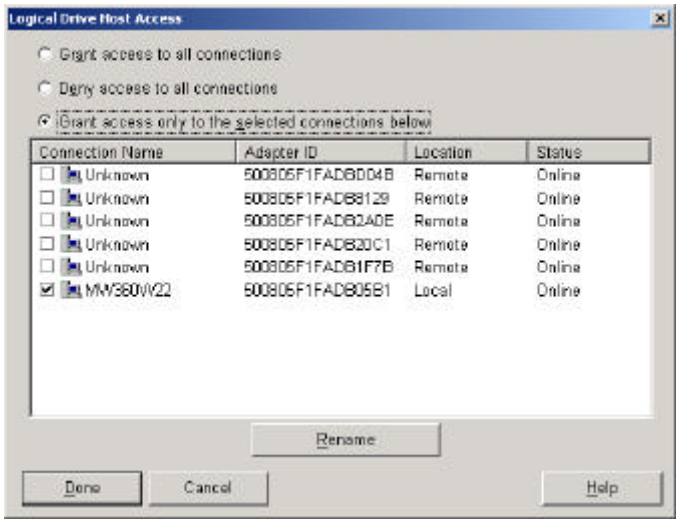
6. The SSP is performed at the logical drive level; the administrator should go through these processes for each logical drive in the array that was created. In this scenario, there is one Array and three logical drives created, so the same procedures will apply to all three logical drives. If there is more than one array created on the controller, use SSP to configure all the logical drives in the other array. Select the second logical drive in the array and click “Modify”.



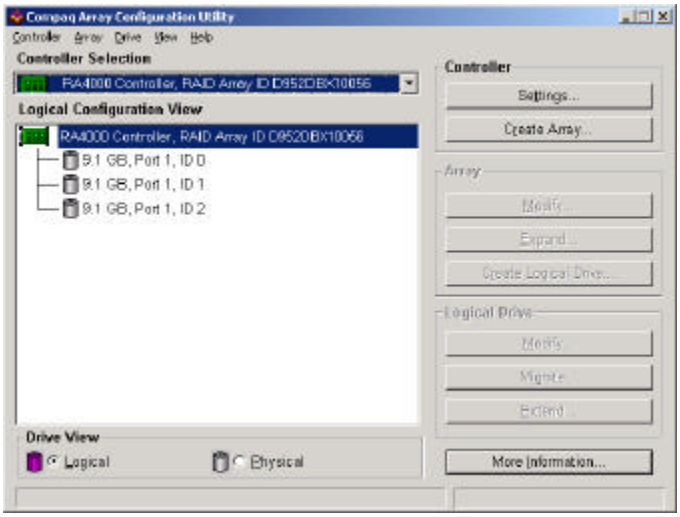
7. Since the connection name of the local adapter ID has been changed, the “Logical Drive Host Access “ page of the second logical drive keep the connection name. By default, the second logical drive grants access to all HBAs.



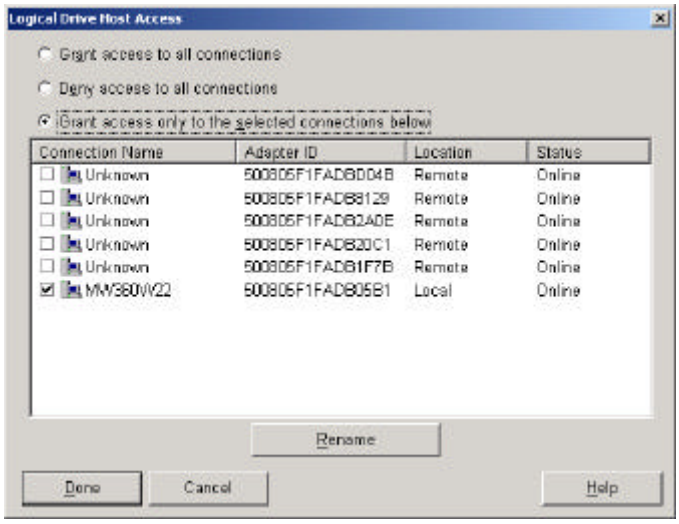
8. The second logical drive will be set to grant access to server MW360W22 using “Logical Drive Host Access”. Change the access condition for this logical drive. Grant access only to server MW360W22. Click “Done” and return to the main configuration screen of the ACU.



9. Repeat steps 6 through 8 for the third logical drive. After all three logical drives on the first array controller have been configured, exit to the main configuration screen of the ACU. In this scenario, there are two RA4000 controllers that need to be configured. Select the second controller D952DBX10056 from the ACU controller drop down menu.



10. Create one RAID 5 Array using all three 9.1GB drives. Then create one logical drive in this new array. Modify the access control page to let server MW360W22 have access to this new logical drive. Grant access to the Local HBA. The “Logical Drive Host Access” page should look like this.



11. Save the configuration and exit the ACU.

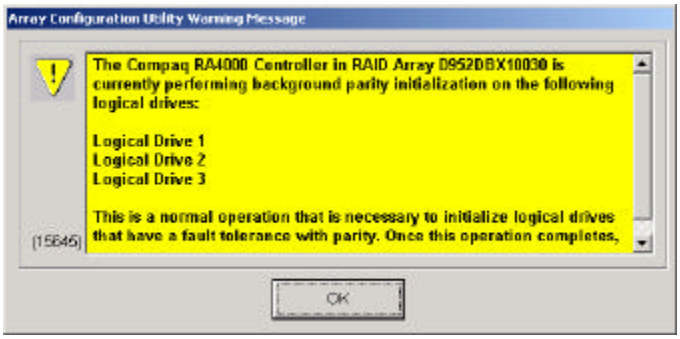
The configuration of ACU and SSP on server MW360W22 is finished. It is now the only system that can access all the logical drives in both RA4000 controllers.

Since server MW360W22 and server MW360W21 will form a Windows 2000 Advanced Server cluster, you must now grant access for server MW360W21 to access the shared drives.

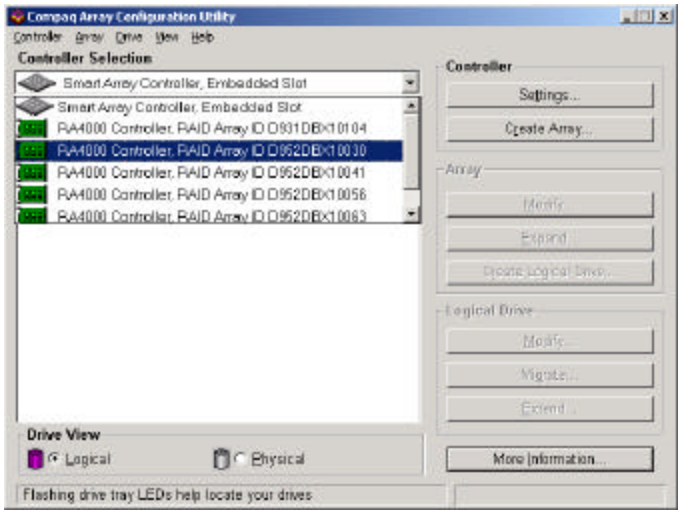
B. Grant access for server MW360W21 to access the shared drives.

In order to grant access to the HBA in the server MW360W21, the administrator should access the ACU and the SSP on server MW360W21 to identify the HBA that belongs to server MW360W21.

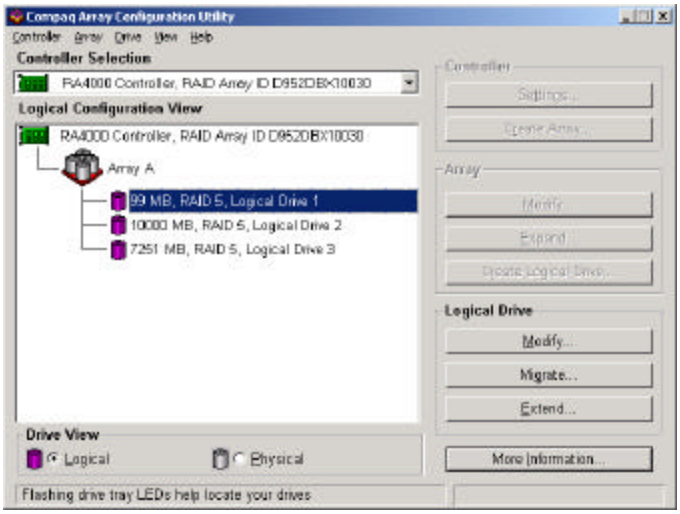
1. Open the ACU from MW360W21. Since two controllers in this configuration have just been configured through server MW360W22, several confirmation pages indicated controllers D952DBX10030 and D952DBX10056 have not finished the initialization process yet. Click OK to continue.



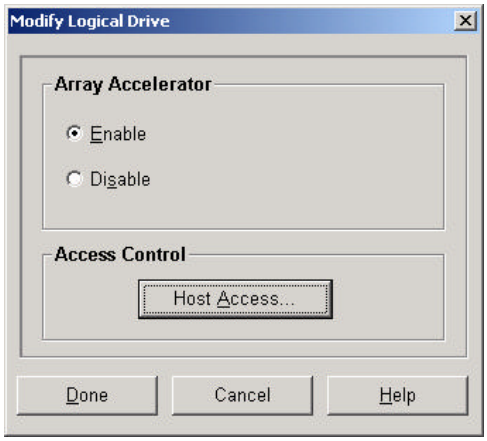
2. To grant server MW360W21 access to all the logical drives in the two RA4000 controllers, select the correct controller that hosts the shared logical drives through the ACU. At the drop down menu of controllers, select the controller that will be accessed by server MW360W21. In this case, select D952DBX10030.



3. This controller has already been configured with three logical drives in the configuration of server MW360W22. The next step is to grant the HBA in server MW360W21 access to each logical drive on this controller. Click on the first logical drive then click “Modify” in the “Logical Drive” panel.

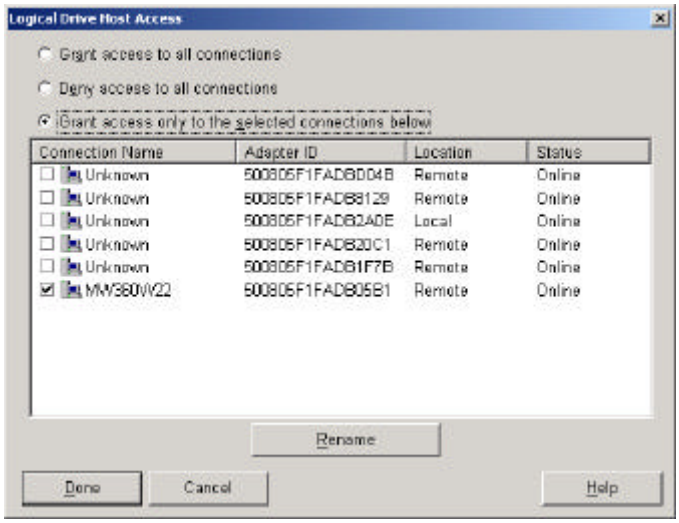


4. Click the “Host Access” button on the “Modify Logical Drive” page.

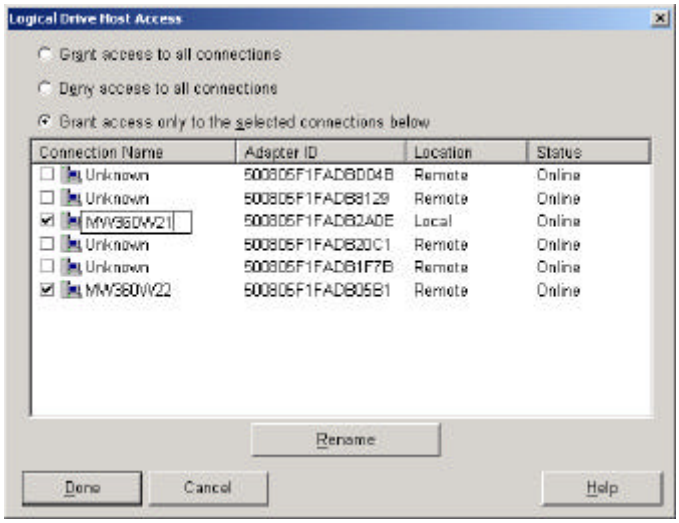


5. This will bring up the “Logical Drive Host Access” screen. In the configuration process of server MW360W22, this logical drive was granted access only to the HBA that is in server MW360W22. The connection that was made previously should be already checked.

   To locate the HBA in server MW360W21, use the following screen. Adapter ID 500805F1FADB2A0E is indicated as local, which means that the HBA is in server MW360W21. Grant server MW360W21 access to this logical drive by selecting the adapter that is marked as local.



6. Rename this connection to MW360W21. Click “Done” to finish the access control setting. At this point, this logical drive can only be accessed by two of the servers, which are servers MW360W21 and MW360W22.



7. Repeat steps 3 through 5 to grant server MW360W21 access to the other two logical drives that reside on controller D950DBX10030.

   Now controller D952DBX10056 needs to be configured. At the main ACU page select controller ID D952DBX10056. There is one logical drive that has already been created though the configuration of server MW360W22. Repeat step 3 to 6 to grant server MW360W21 the access to that logical drive. The “Logical Drive Host Access” page should look exactly the same as the previous screen. Click on “Done” to exit this page.

8. Save the configuration and exit the ACU.

Install MSCS

After all of the controllers have been configured, the system is ready to have MSCS installed. Use disk manager to create partitions and format the logical drives that where created through the ACU. In the Windows 2000 Disk Management Utility screen, there should be four logical drives. The first logical drive, which has a 100MB capacity, is the quorum drive for the cluster and the other three drives should be shared drives within the cluster. After MSCS is installed, reapply the Windows 2000 Service Pack 1.

ACU and SSP in Windows NT Server Enterprise Edition

The Windows NT Server Enterprise Edition cluster is formed by two servers and one storage subsystem.

a. Server MW360NT1

b. Server MW360NT2

c. RA4000 controller ID D952DBX10063 (three 9.1GB drives attached) with three logical drives

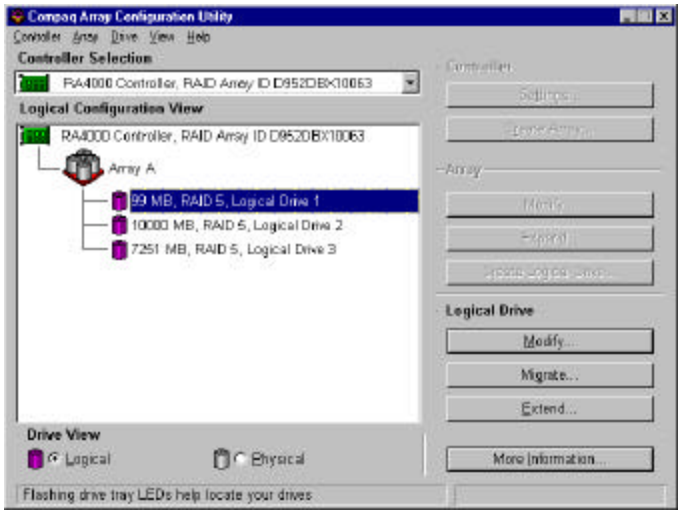
1. 100MB logical drive for the quorum
2. 1000MB logical drive
3. 7251MB logical drive

Use ACU to create three logical drives on the RA4000 Controller ID D952DBX10063. Then use the SSP to configure the host access. The SSP procedure will apply on both servers.

The configuration procedure summary:

1. Access the ACU through server MW360NT2. Select the RA4000 Controller ID 952DBX10063 from the “Controller Selection” drop down menu. Create three logical drives. The creation process for the array and logical drives is the same as in Windows 2000 Advanced Server.

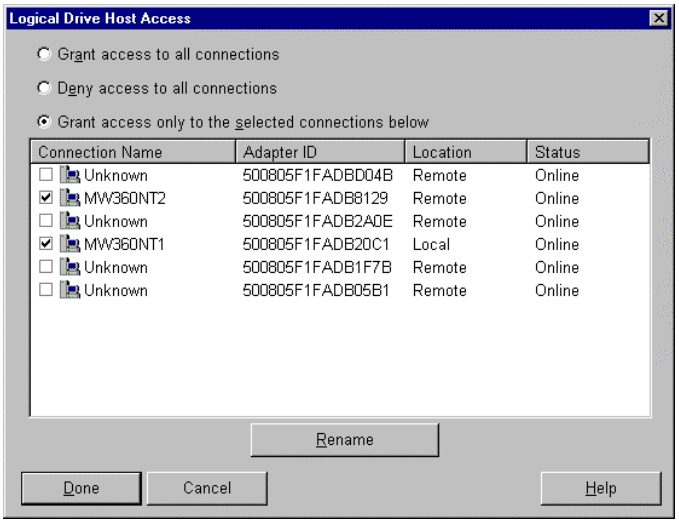
   In the following screen shot, three logical drives have been created on the controller D952DBX10063.



2. The “Logical Drive Host Access” indicates the connections for each logical drive. Identify the HBA in server MW360NT2 from the “Logical Drive Host Access” screen. By default each logical drive is granted access to all the connections. Chang the option to “Grant access only to the selected connections below”. Grant access to the connection that is local to server MW360NT2. Repeat the same processes for all three logical drives and grant access only to server MW360NT2.

3. The next step is to grant logical drives access to the second server MW360NT1. Access the ACU from server MW360NT1. Select the RA4000 Controller with ID D952DBX10063. There is one array with three logical drives listed. Access the SSP for each logical drive listed under the array.

   For each logical drive, identify the HBA through the “Logical Drive Host Access” page and grant access only to local connection. As shown in the following screen shot, adapter ID 500805F1FADB20C1 is local to server MW360NT1. Grant access to that connection and rename the connection to “MW360NT1”.



4. This process should apply to all three logical drives on the controller ID D952DBX10063. Click the “Done” button to leave this screen. Save the configuration of the ACU and exit. Once the information has been saved through ACU, the configuration of the ACU and the SSP for Windows NT Server Enterprise Edition is finished.

Install MSCS

Open Disk Manager in Windows NT Server Enterprise Edition. There should be three un-partitioned drives listed. Partition and format each drive accordingly. Then install MSCS. Use the first logical drive, which has a 100MB capacity, as the quorum drive. This cluster should own two logical drives. After MSCS is successfully installed, reapply Windows NT Service Pack 6a.

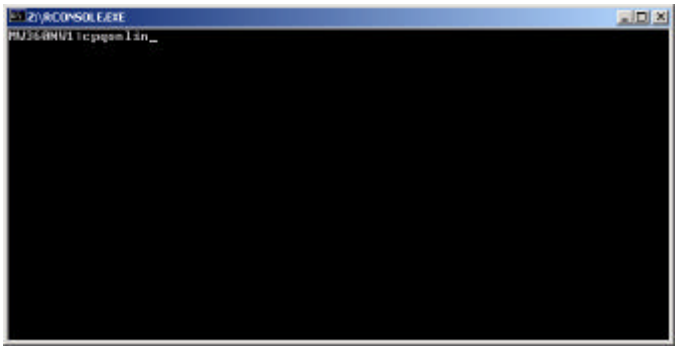
ACU and SSP in NetWare

NetWare 5.1 Server cluster formed by two servers and one shared storage subsystem.

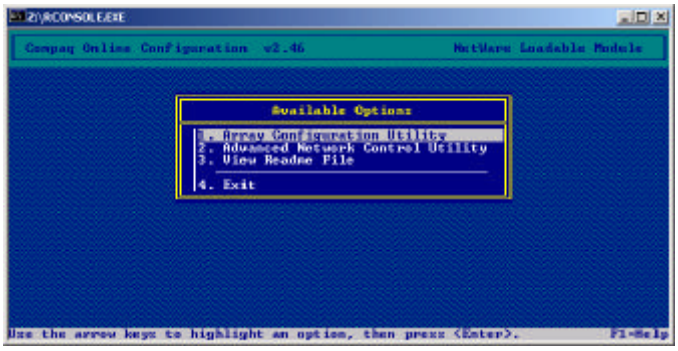
1. MW360NW1
2. MW360NW2
3. RA4000 controller ID D931DBX10104 (three 18.1GB drive attached). Two logical drives will be created.
    1. 100MB logical drive
    2. 34630MB logical drive

The following are the configuration steps for NetWare:

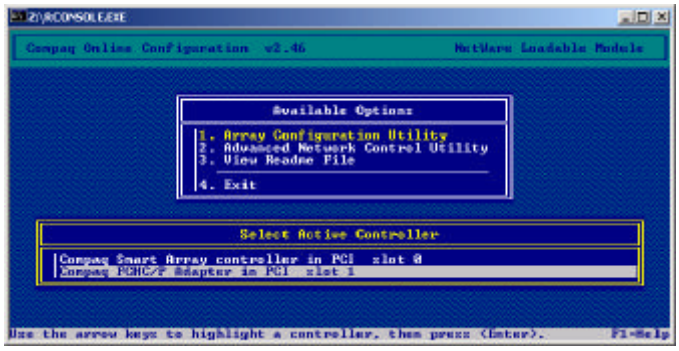
1. NetWare Online Array Configuration Utility, also called CPQONLIN, is a NetWare Loadable Module (NLM) for configuring drive arrays. It also provides information about the status of drives attached to the RA4000 controller. To access the CPQONLIN utility, at the NetWare console on server MW360NW1 type “CPQONLIN” to start the “Compaq Online Array Configuration Utility” on NetWare Server.



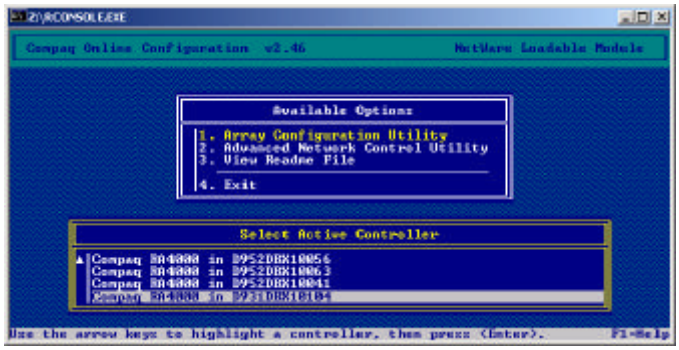
2. Select “Array Configuration Utility” in the “Available Options” list.



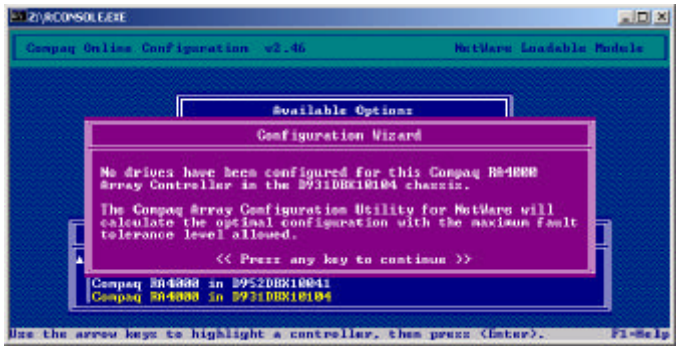
3. Then the “Select Active Controller” dialogue box will appear. On server NW360NW1, there are two controllers. One is the Embedded Compaq Smart Array controller the other is the fibre channel HBA. Select the fibre channel HBA which is listed as “Compaq FCHC/P Adapter in PCI Slot 1”



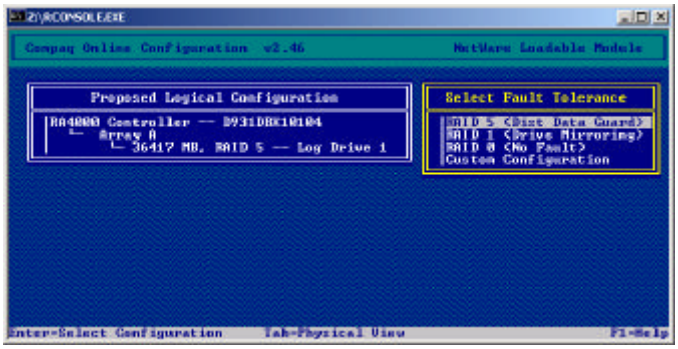
4. Since this controller is connected to the Compaq StorageWorks FC-AL Switch 8, all of the RA4000 Controllers will show up in the “Select Active Controller” section. Select the controller that is designated to this configuration, which in this case is controller ID D931DBX10104.



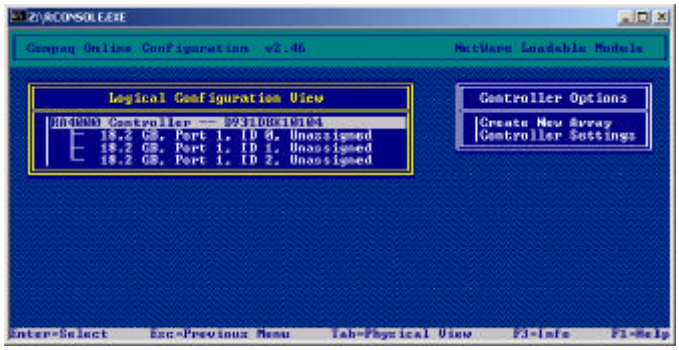
5. This controller has not been configured yet. The Compaq CPQONLIN utility will try to suggest the optimal configuration for this controller. Press any key to continue.



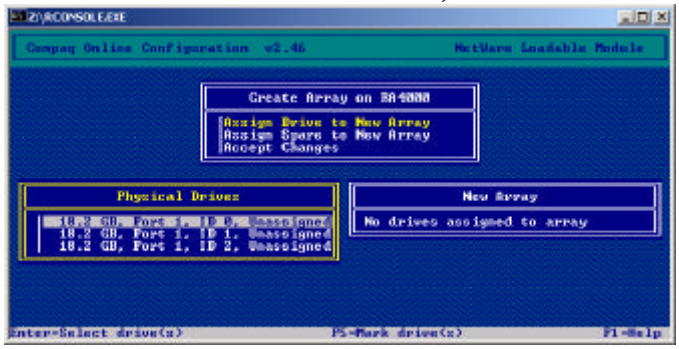
6. In the “Logical Configuration View”, it lists one array that combines all of the available drives attached to this controller. Since the CPQONLIN utility will try to optimize the configuration for the system, it provides all the possible options for this array. It can be set as RAID 5, RAID 1 or RAID 0. To enable the SSP functions at the logical drive level, the administrator must select the “Custom Configuration” option in the “Select Fault Tolerance” box.



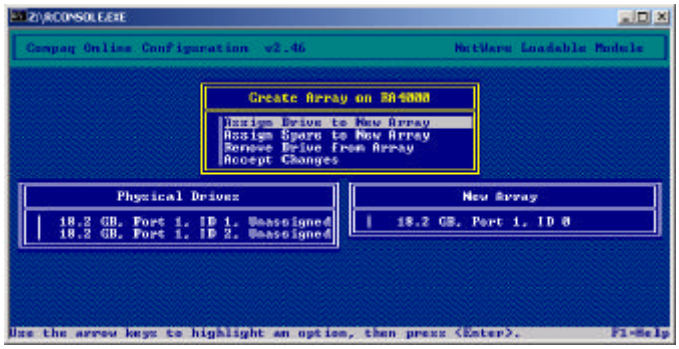
7. Three unassigned drives will be listed under the “RA4000 Controller D931DBX100104”. Press enter to move to the “Create New Array” option in the “Controller Options” window. Then press enter again to open the “Create New Array” menu.



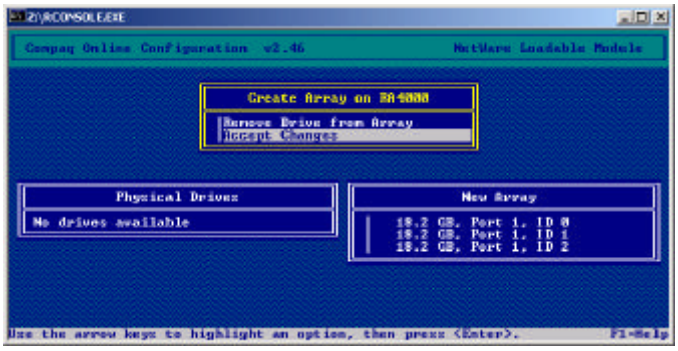
8. Select the “Assign Drive to New Array”. Every time you press "Enter", a drive will be selected and shown in a different box, which means that the drive is part of the new array.



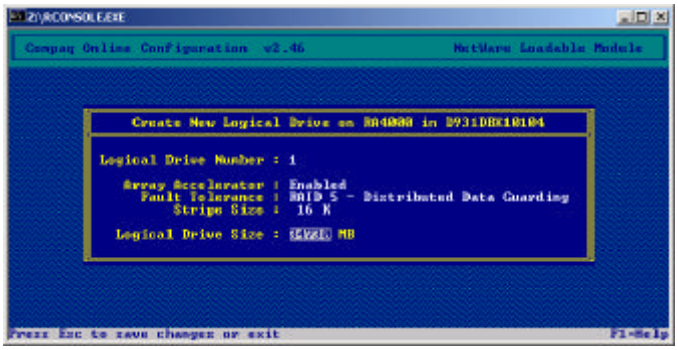
9. In this configuration, all three drives will be added to the new array. Press “Enter” to add the first physical drive to the array.



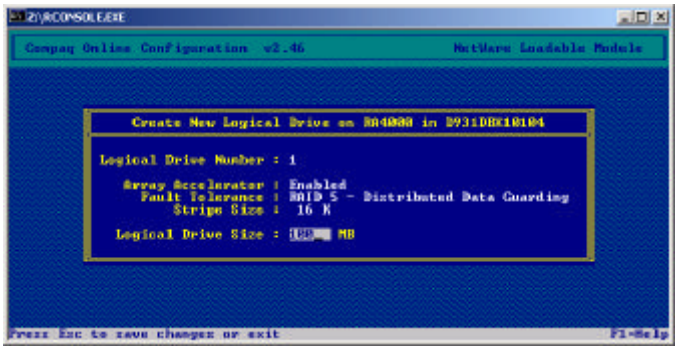
10. The curser will move to the second physical drive. Press “Enter” to add the second physical drive to the array. The curser will then move to the third physical drive. Press “Enter” to add the third physical drive to the array. When all three drives are added to the array, move the cursor to “Accept Changes” and press “Enter”.



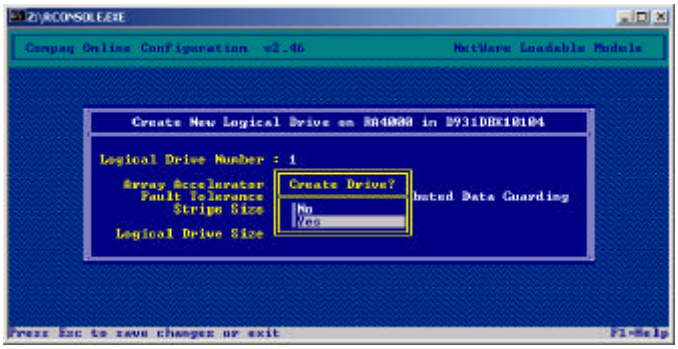
11. Then the “Create New Logical Drive on RA4000 in D931DBX10104” dialogue box appears. The capacity of this logical drive is 34738MB.



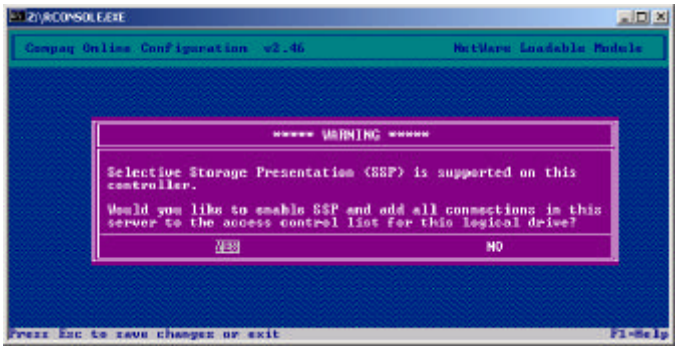
12. In this configuration, there are two logical drives that need to be created. Enter the desired size of the first logical drive. According to the configuration plan for this scenario, the size of the first logical drive should be 100MB. Enter 100 in the “Logical Drive Size” space.



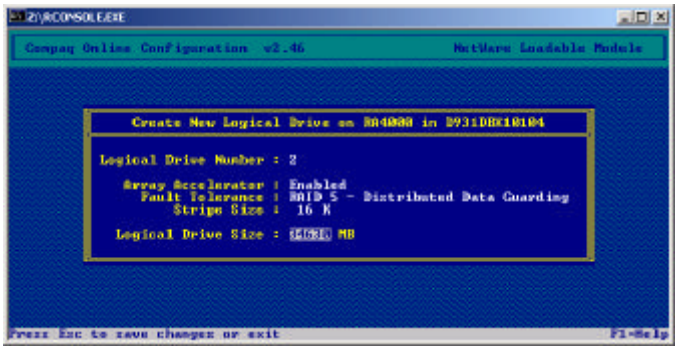
13. Confirm the creation of the first logical drive, by selecting “Yes” then press Enter.



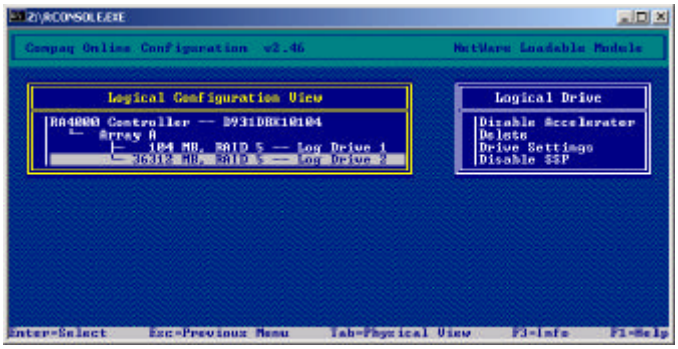
14. Once the logical drive has been created, the ACU will give you the option of running the SSP for this controller. Make sure the cursor is on “Yes” and press “ESC” to allow the SSP to run on this controller.



15. You will still have unused space in the array that was created on D931DBX10104. The CPQONLIN utility will bring you back to the “Create New Logical Drive on RA4000 in D931DBX10104”page.

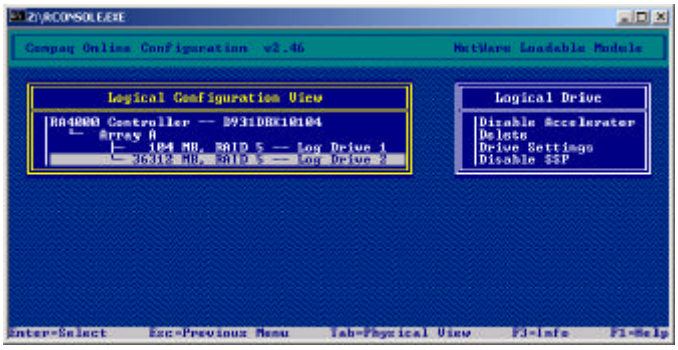


16. Create a new logical drive with all the space available and enable SSP for the new logical drive. After the SSP is enabled on all logical drives, press “Esc” to exit to the NetWare Console.



17. After enabling the SSP for server MW360NW1, the configuration is finished. Next, the SSP for the second NetWare Server MW360NW2 should be enabled. At the console of server MW360NW2, type CPQONLINE.

    Server MW360NW2 is accessing the same Compaq StorageWorks RA4000/4100 as server MW360NW1. Two logical drives have already been created in Array A. Enable the SSP on each of the logical drives. Once the SSP is enabled, the configuration of the second server MW360NW2, is finished. There are two logical drives owned by the two NetWare Servers.



Install NCS

Use the “NWCONFIG” utility to create the NetWare Volumes. Then install the NCS. After NCS is successfully installed, reapply NetWare Service Pack 1.

Cluster and Stand-alone Non-Redundant Configuration

Red Hat Linux 7.0, Windows 2000 Advanced Server and NetWare 5.1 will be installed as stand-alone servers that will share one Compaq StorageWorks RA4000/4100. Two clusters will be installed which are Windows 2000 Advanced Server and Windows NT Server Enterprise Edition.

NOTE: The servers that will share a storage box cannot be clustered. Refer to "Configuration Restriction" section in the beginning of the white paper.

Mix Non-Redundant Configuration

- Windows 2000 Advanced Server MSCS
- Windows NT Server Enterprise Edition MSCS
- Stand-alone Servers
  - Windows 2000 Advanced Server
  - NetWare 5.1
  - Red Hat Linux 7.0

Pre-configuration assumptions:

1. Before installing the OS on the servers, all of the Compaq StorageWorks RA4000/4100 that belongs to this configuration should be powered up. Then power on each system to install the OS
2. Windows 2000 Advanced Server is properly installed and the CSP and Windows 2000 Service Pack 1 are correctly installed on all three servers (MW360W21, MW360W22, MW360W23).
3. Windows NT Server 4.0 Enterprise Edition is properly installed, NTSSD and Service Pack 6a have been applied. (MW360NT1, MW360NT2).
4. NetWare 5.1 is properly installed and the Compaq Novell NetWare SSD and Service Pack 1 are properly installed. (MW360NW1).
5. Red Hat Linux 7.0 is properly installed (MW360LX1).
6. Seven servers are properly attached to port 1-7 in the Compaq StorageWorks FC-AL Switch 8.
7. All the StorageWorks RA4000/4100s and the Compaq StorageWorks FC-AL Switch 8 w/PEM should be flashed with the latest firmware. If any previous configurations exist, use Compaq ACU to delete any configuration on the array controllers.
8. No cluster software is installed on any of the servers.

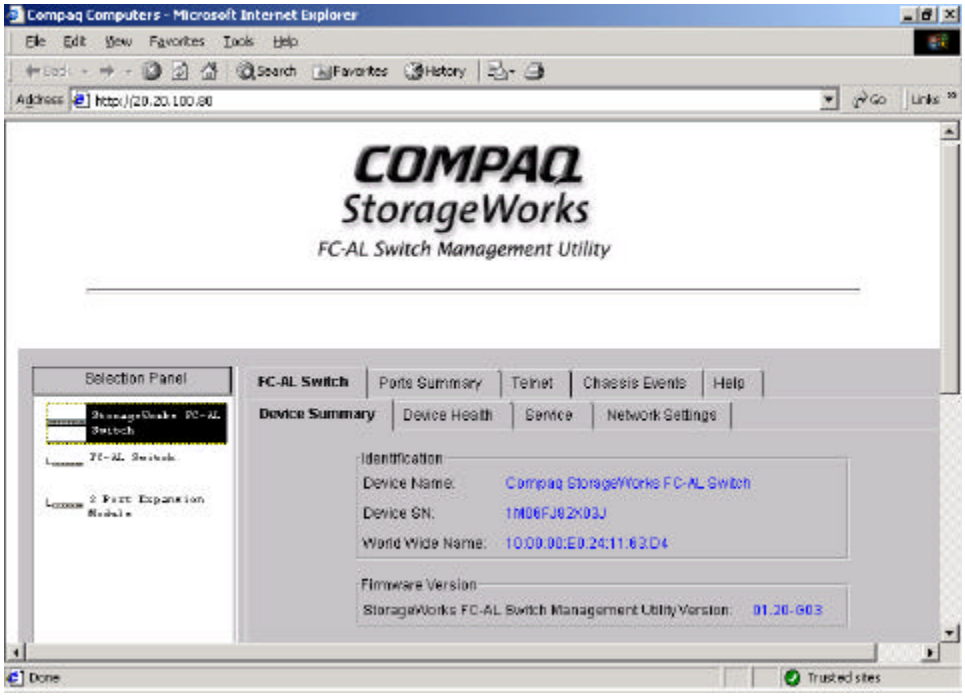
Redefine Port Policy

In this scenario there are seven servers and three StorageWorks RA4000/4100s. The port policy should be changed accordingly. All of the ports that the seven servers are attached to should be set to “Lip Disabled” and the ports that the three StorageWorks RA4000/4100 should be set to “LIP Enabled”.

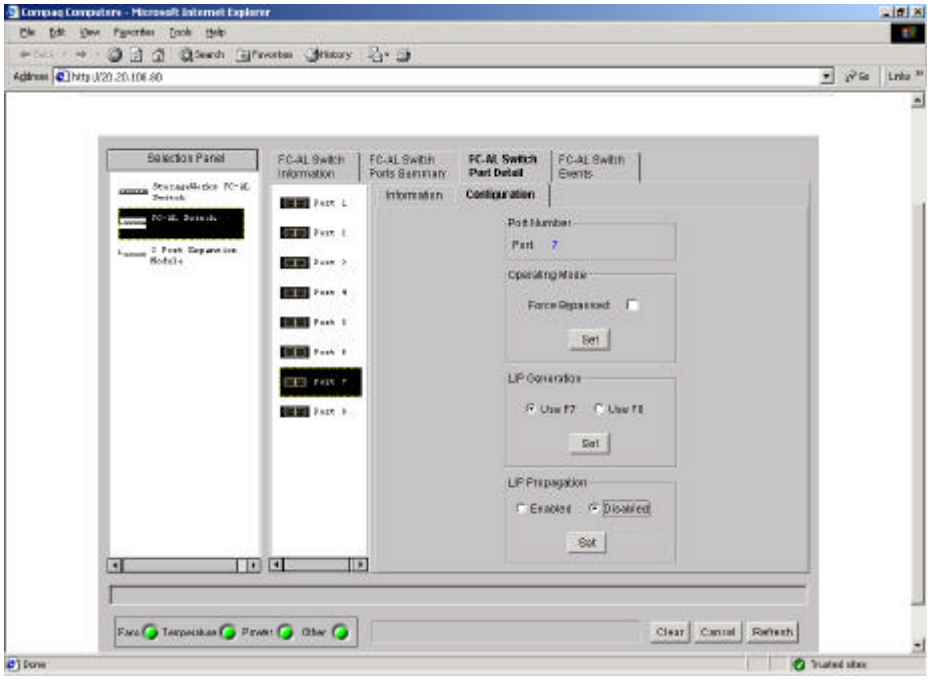
Access the “Compaq StorageWorks FC-AL Switch 8 Management Utility” through Internet Explorer (v5.0 or higher). Make sure the browser is properly set up.

Note: Please refer to the settings procedure for the browser in the **“Multi-Cluster Non-Redundant Configuration”** section.

In the address bar type the IP address of the Compaq StorageWorks FC-AL Switch 8. Login as “user” and use “ADMIN” as the password. Enter “public” for the read community and “private” for the write community.



Click on the Compaq StorageWorks FC-AL Switch 8 icon in the left panel and select the “FC-AL Switch Port Detail” tab. Select ports 1 to 7 respectively, and set of LIP Propagation section to “Disable”. “Enable” the LIP for port 8 and the three expansion ports, which are connected to the Compaq StorageWorks RA4000/4100.



ACU and SSP in Windows 2000 Advanced Server

The Windows 2000 Advanced Server cluster is formed by two servers and one storage subsystem.

a. Server MW360W21

b. Server MW360W22

c. RA4000 controller with ID D952DBX10030 (three 9.1GB drives attached). Three logical drives will be created.

   a. 100MB logical drive for the quorum

   b. 1000MB logical drive

   c. 7251MB logical drive

Configuration steps will be the same as in the first scenario. Please refer to the screen shots for Windows 2000 Advanced Server in the first scenario.

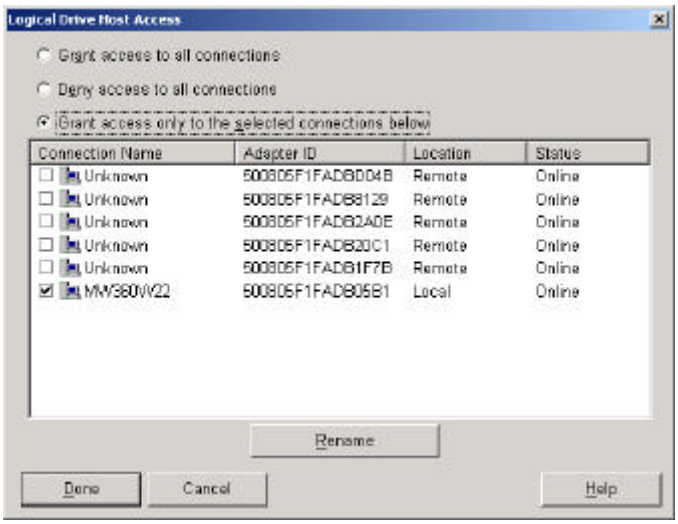
1. Access the ACU through server MW360W22.
2. Select the RA4000 Controller with ID D952DBX10030 from the drop down menu of the ACU.
3. Create one Array using all three 9.1GB drives.
4. Create three logical drives within the array

   a. 100MB logical drive for the quorum

   b. 1000MB logical drive

   c. 7251MB logical drive

5. Select the first logical drive and modify the logical drive to grant access only to the connection local to server MW360W22.
6. Rename the connection to MW360W22.



7. Repeat steps 5 and 6 for the other two logical drives.
8. Save the configurations and exit the ACU on server MW360W22.
9. Access the ACU on the server MW360W21.
10. Select the RA4000 Controller with ID D952DBX10030
11. There should be three logical drives listed under the array. Modify the host access of the first logical drive to grant access only to the connection local to server MW360W21.
12. Rename the connection to MW360W21.
13. Repeat step 11 and 12 for the other two logical drives.
14. Save the configuration and exit the ACU in server MW360W21.

Install MSCS

Use disk manager to create partitions and format the logical drives that where created through the ACU. In the Windows 2000 Disk Management Utility screen, there should be three logical drives. The first logical drive, which has a 100MB capacity, is the quorum drive for the cluster and the other two drives should be shared drives within the cluster. After MSCS is installed, reapply the Windows 2000 Service Pack 1.

ACU and SSP for Stand-alone Servers

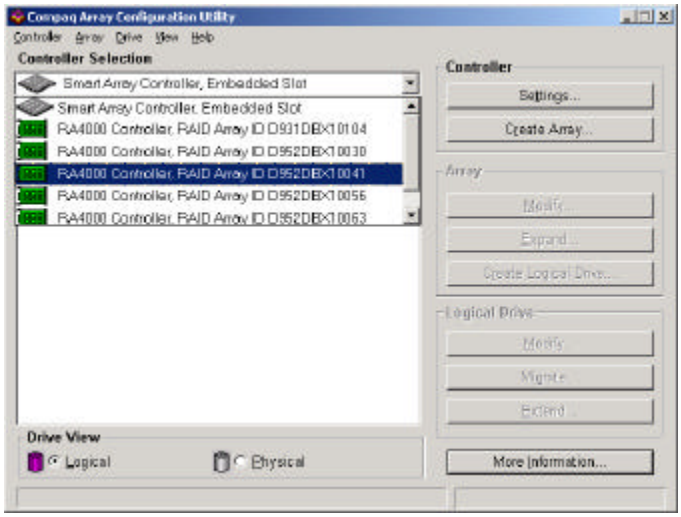
In this configuration, there are three stand-alone severs and one StorageWorks RA4000/4100.

1. Windows 2000 Advanced Server (MW360W23).
2. Red Hat Linux 7.0 (MW360LX1) with HBA ID 500805FFABD8129.
3. NetWare 5.1 (MW360NW1).
4. Compaq StorageWorks RA4000/4100 (IDD952DBX10041). There are six 9.1GB drives attached to this controller.

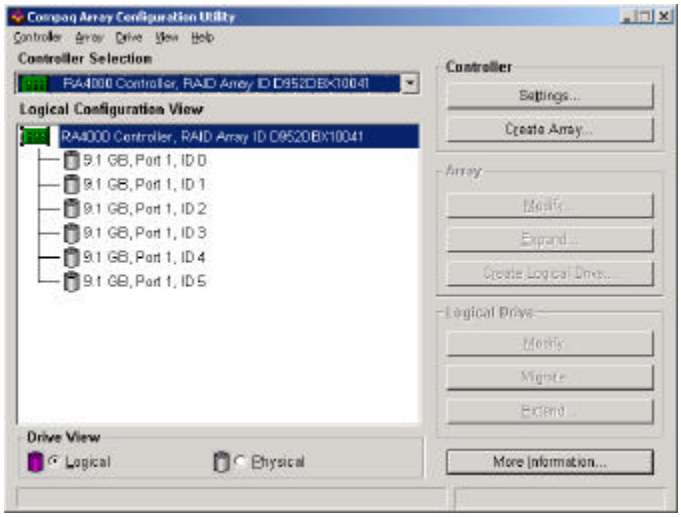
Configuration steps for each standalone server are described below.

Windows 2000 Advanced Server

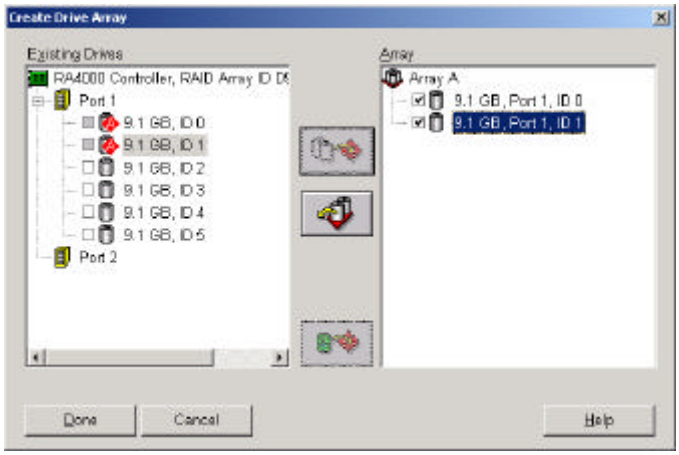
1. Access the ACU from Windows 2000 Advanced Server (MW360W23). Select the controller with ID D952DBX10041.



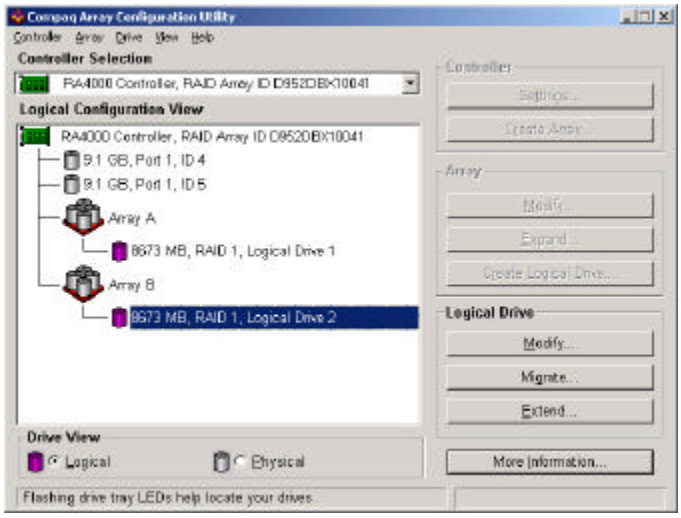
2. There are six 9.1GB drives attached to this RA4000 controller. In this configuration, three operating systems will share this storage subsystem. Each OS will have access to two of the drives.



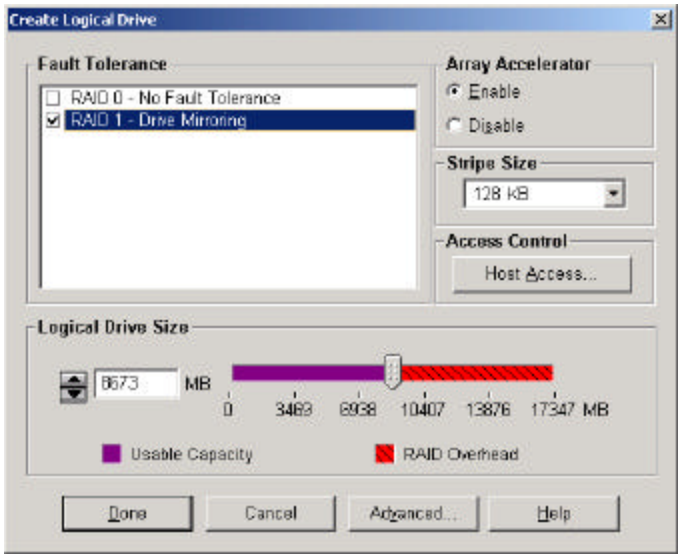
3. Select the first two 9.1GB drives to create an array (Array A) for Windows 2000 Advanced Server.



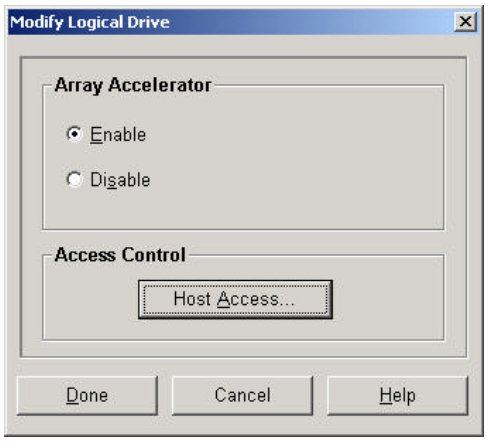
4. Use the next two drives to create another array (Array B) for the Linux server and leave the other two drives for the NetWare 5.1 server.



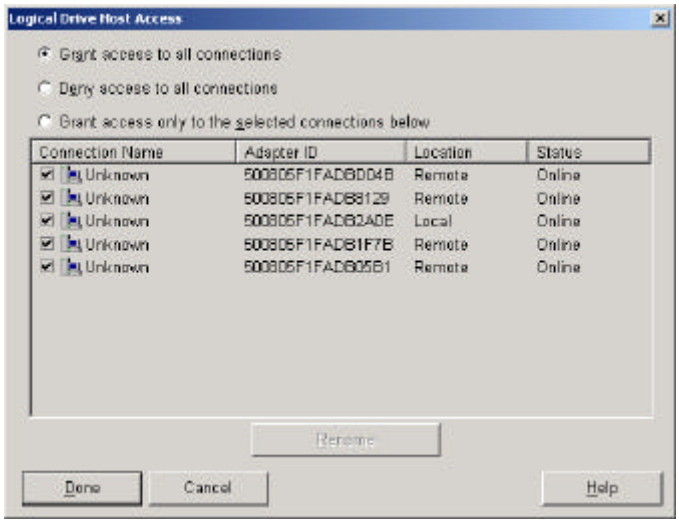
5. Move the cursor to “Array A”, then click the “Create Logical Drive” button. In the “Create Logical Drive” page, there are two fault tolerance levels to choose from. In this configuration, create a RAID 1 array. Click the “Done” button to exit this screen.



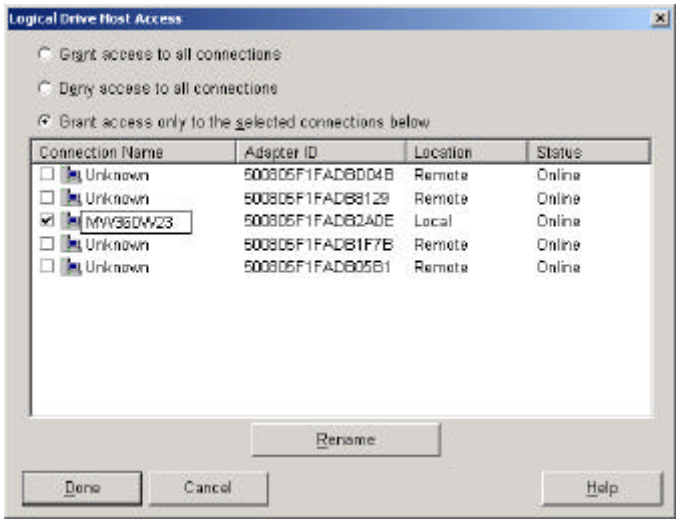
6. After the logical drive has been created for Array A, click on the “Modify” button in the “Logical Drive” section, this will bring up the access control screen for that logical drive. Click on the “Host Access” button to access the SSP.



7. By default, Array A will grant access to all of the HBAs in this environment. In this configuration, access to Array A only needs to be granted to the HBA in server MW360W23. The HBA ID 500805F1FADB2A0E is local to server MW360W23.



8. Change the access method from “Grant access to all connections” to “Grant access only to the selected connections below”. Check the HBA that is local to server MW360W23 and change the connection name to MW360W23. Then click “Done” to leave this page.



9. Save the configuration and exit the ACU.

   The access control for Windows 2000 Advanced Server is set to access the first two drives in the RA4000 controller with worldwide ID D952DBX10041. Use Disk Management Utility in Windows 2000 Advanced Server to partition and format the drive as an NTSF partition. Now server MW360W23 can access the logical drive.

Red Hat Linux 7.0

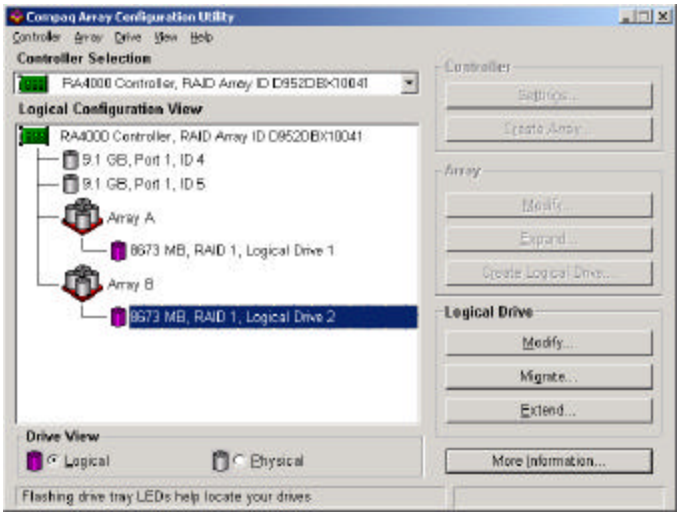
Linux does not have an ACU or an SSP to configure the array and access control. A Windows NT Server or Windows 2000 Server is needed to configure the ACU and SSP. In this configuration procedure, Windows 2000 Advanced Server ACU utility will be used to create the drive array for the Linux server and the Linux server command line will be used to assign the drives to Linux server. The configuration of Linux will be described in two parts.

1. Before adding the HBA to the Linux server, the administrator needs to write down the worldwide ID that is on the HBA. In the Linux environment, there is no location record that indicates which HBA is local to the Linux Server. In our configuration, HBA with ID 500805FFABD8129 is installed in the Linux Server.

2. Linux server MW360LX1 will share the Compaq StorageWorks RA4000/4100 with the previous Windows 2000 Advanced Server. In the previous configuration of the RA4000 Controller with ID D952DBX10041, two arrays were created. One for the access of Windows 2000 Advanced Server and the other is for Red Hat Linux 7.0 r.

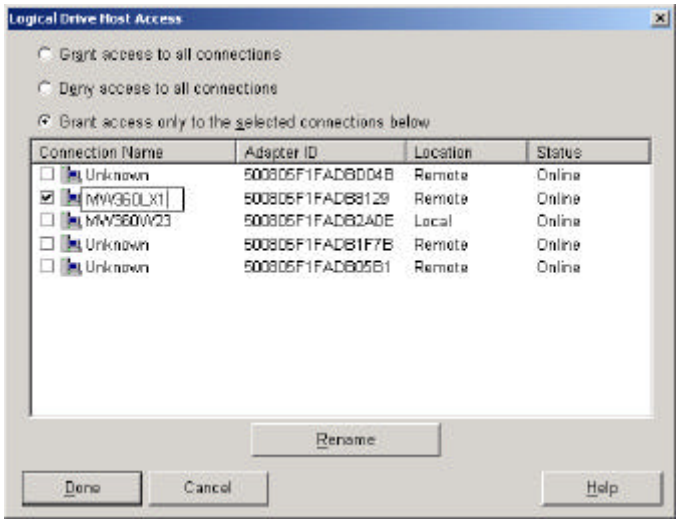
   Open the ACU on server MW360W23. Select the RA4000 Controller with ID D952DBX10041. There are two arrays. Array A is assigned access to server WM360W23. Array B will be assigned access to MW360LX1.

   In this configuration, one logical drive will be created in Array B. Use all of the space in Array B to create a RAID 1 logical drive.



3. Click on the logical drive in Array B and modify the access control property.

   In this scenario the Worldwide ID for the HBA in the Linux server is 500805FFABD8129, which was written down before the HBA was installed. In the Logic Drive Host Access menu, grant access to the adapter with ID 500805FFABD8129 and change the connection name to MW360LX1.



4. After successfully installing Red Hat Linux 7.0 , apply Compaq Fibre Channel Driver ***cpqfc.o*** which is located at

   /lib/modules/2.2.16-22/scsi (Linux is case sensitive, please type with lower case)

5. After changing to the correct folder, apply the Compaq Fibre Channel Driver by typing ***insmod cpqfc.o*** At the Linux command prompt and pressing enter to execute.

6. During the installation of the Compaq Fibre Channel Driver for Linux, it will detect that there are one logical drive that the Linux server can access. Linux will automatically assign a name to the logical drive. In this scenario it was ***sdb.***

7. For the Linux server to be able to access the drive, the administrator needs to map the drive and mount it on the Linux server. Use the following Linux commands to mount the logical drive to the Linux server. There are three steps to mount the drive.

   a. ***me2fs /dev/sdb*** (Creates a file system on drive ***sdb***)

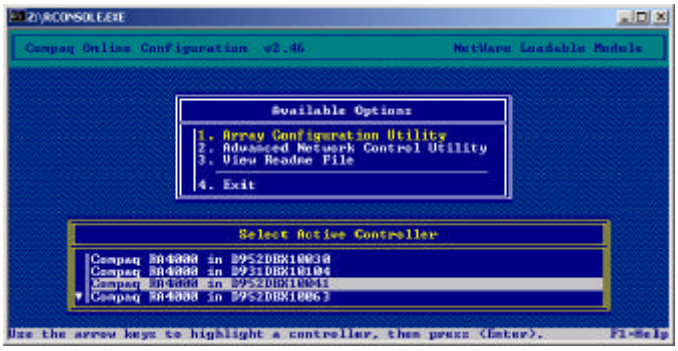
   b. ***mdir /disk1*** (creates a directory in Linux called ***disk1***)

   c. ***mount /dev/sdb /disk1*** (mounts the drive ***sdb*** to the directory ***disk1***)

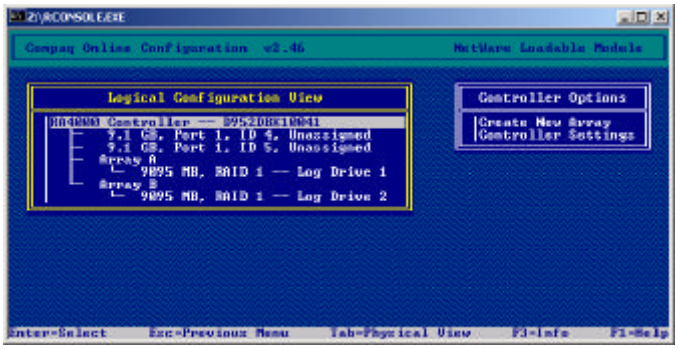
NetWare 5.1

In the NetWare 5.1 environment, CPQONLIN is used to configure the drive array. The procedure is the same as described in the first configuration scenario.

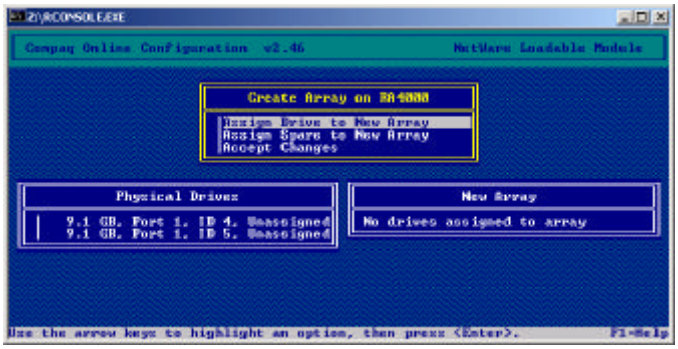
1. At the NetWare 5.1 Console, type “CPQONLIN”.
2. Select the correct Compaq RA4000 controller. In this configuration it is D952DBX10041.



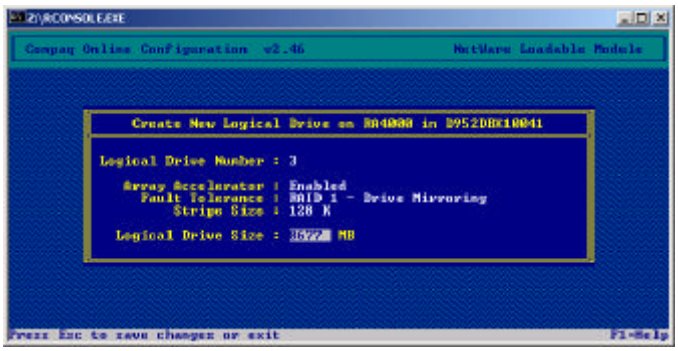
3. In the “Logical Configuration View”, there should be two arrays that have already been created and two remaining 9.1 GB drives. The two existing arrays belong to the Red Hat Linux 7.0 server and the Windows 2000 Advanced Server.



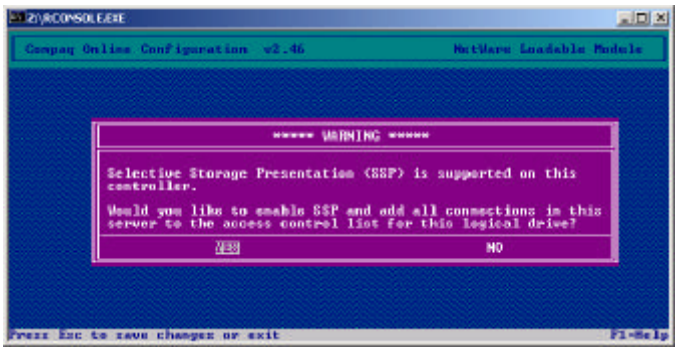
4. Press “Enter” to move the cursor to the “Controller Options” page and select “Create New Array”. Use all the available drives to create a RAID 1 array.



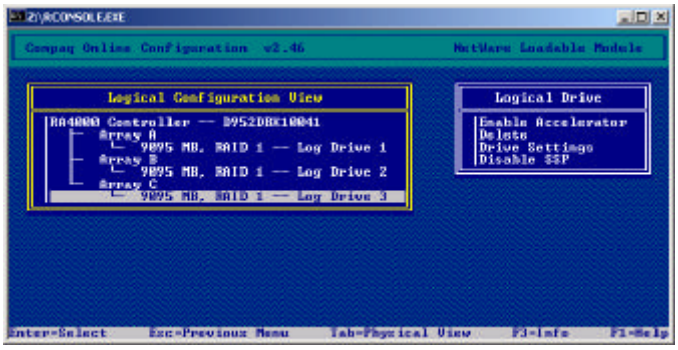
5. Confirm the creation of the RAID 1 array and press “Esc” to save the changes.



6. Once the logical drive has been created, the ACU will give you the option of running the SSP for this controller. Make sure the cursor is on “Yes” and press “ESC” to allow the SSP to run on this controller.



7. In the CPQONLIN main configuration page, the newly created array “Array C” is 9095MB.



8. Once the array is created, use “NWCONFIG” to create NetWare Volume.

Now the configuration of the three stand-alone servers is finished. Each operating system can only access the array that is assigned to it. The SSP will manage the access rules behind the scenes.

ACU and SSP in Windows NT Server Enterprise Edition

Windows NT Server Enterprise Edition cluster is formed by two servers and one storage subsystem.

1. MW360NT1
2. MW360NT2
3. RA4000 controller ID D952DBX10063 (three 9.1GB drives attached)
    a. 100MB logical drive for the quorum
    b. 10000MB logical drive
    c. 7251MB logical drive

The configuration procedures of the ACU and the SSP in this scenario are exactly the same as the Windows 2000 Advanced Server procedures.

Note: Refer to the **"ACU and SSP in Windows 2000 Advanced Server"** section.

Here are the steps for this configuration:

1. Access the ACU through server MW360NT1.
2. Select the RA4000 controller with ID D952DBX10063 from the Controller Selection Menu.
3. Create one array using all three 9.1GB drives.
4. Create three logical drives under the array you have just created.
5. Select the first logical drive and modify the logical drive to grant access only to the connection local to server MW360NT1.
6. Rename the connection to MW360NT1.
7. Repeat steps 5 and 6 for the remaining two logical drives.
8. Save the configuration and exit the ACU.
9. Access the ACU the through server MW360NT2.
10. Select the RA4000 Controller with ID D952DBX10063.
11. There should be three logical drives listed on this controller. Modify the Host Access of the first logical drive to grant access only to the connection local to server MW360NT2.
12. Rename the connection to MW360NT2.
13. Repeat steps 11 and 12 for the remaining two logical drives.
14. Save the configuration and exit the ACU.

Install MSCS

Open Disk Manager in Windows NT Server Enterprise Edition. There should be three un-partitioned drives listed. Partition and format each drive accordingly. Then install MSCS. Use the first logical drive, which has a 100MB capacity, as the quorum drive. This cluster should own two logical drives. After MSCS is successfully installed, reapply Windows NT Service Pack 6a.

Redundant Configuration

The redundant configuration, as describe in the previous section, consists of two FC-AL Switch 8s and two HBAs in each server. The ACU configuration procedures are the same as the previous section. Since there are two HBAs in each system, the location section of SSP should detect 2 HBAs as local.

Redundant Configuration

- Windows NT Server Enterprise Edition MSCS
- NetWare 5.1 NCS
- Stand-alone Windows NT 4.0 Server

Pre-configuration assumptions:

1. Before installing the OS on the servers, all of the Compaq StorageWorks RA4000/4100 that belong to this configuration should be powered up. Then power on each system to install the OS.
2. Each server has two HBAs and two Compaq StorageWorks FC-AL Switch 8 connected correctly.
3. Windows NT Server Enterprise Edition is properly installed, NTSSD, Compaq Redundancy Manager, and Service Pack 6a have been applied to three servers (MW360NT1, MW360NT2, MW360NT3).
4. NetWare 5.1 is properly installed, the Compaq Novell NetWare SSD and Service Pack 1 have been applied to both servers (MW360NW1, MW360NW2).
5. The five servers are attached to port 1 through 5 of the Compaq StorageWorks FC-AL Switch 8.
6. All the StorageWorks RA4000/4100s and the Compaq StorageWorks FC-AL Switch 8 w/PEM should be flashed with the latest firmware. If any previous configurations exist, use the Compaq ACU to delete any configuration on the array controllers.
7. No cluster software is installed on any of the servers.

Note: For more information about Compaq Redundancy Manger, refer to the online documentation CPQDXCFG.HLP included in the CD or the *"Compaq ProLiant Cluster HA/F100 and HA/F200 Administrator Guide"*

Redefine Port Policy

In this configuration, there are a total of five servers and five StorageWorks RA4000/4100s. Access the "Compaq StorageWorks FC-AL Switch 8 Management Utility" through Internet Explorer 5.0 or later. Make sure the browser is properly set up.

Note: Please refer to the settings procedure for the browser in the **"Multi-Cluster Non-Redundant Configuration"** section.

At the address bar, type the IP address of the FC-AL Switch 8. Login as “user” and use “ADMIN” as password. Enter “public” for the read community and “private” for the write community.

Click on the “FC-AL Switch” icon at the left panel. Select the “FC-AL Switch Port Detail” tab. Set the LIP propagation of port 1 to 5 to “Disabled” and port 6 to 8 to “Enabled”. In the PEM (3 Port Expansion Module), “Enabled” LIP propagation for all three ports.

In the redundant configuration, there are two Compaq StorageWorks FC-AL Switch 8. Configure the second switch using Internet Explorer 5.0 or later. Set the LIP propagation of port 1 to 5 to “Disabled” and port 6 to 8 to “Enablde”. In the PEM (3 Port Expansion Module), “Enabled” the LIP propagation for all three ports.

ACU and SSP in Windows NT Server Enterprise Edition

The Windows NT Server Enterprise Edition cluster is formed by two servers and three storage subsystems.

a. Server MW360NT1

b. Server MW360NT2

c. Three Compaq StorageWorks RA4000/4100 with ID

D952DBX10041 (three 9.1GB drives attached)

1. 100MB logical drive for the quorum
2. One logical drive

D952DBX10063 (three 9.1GB drives attached)

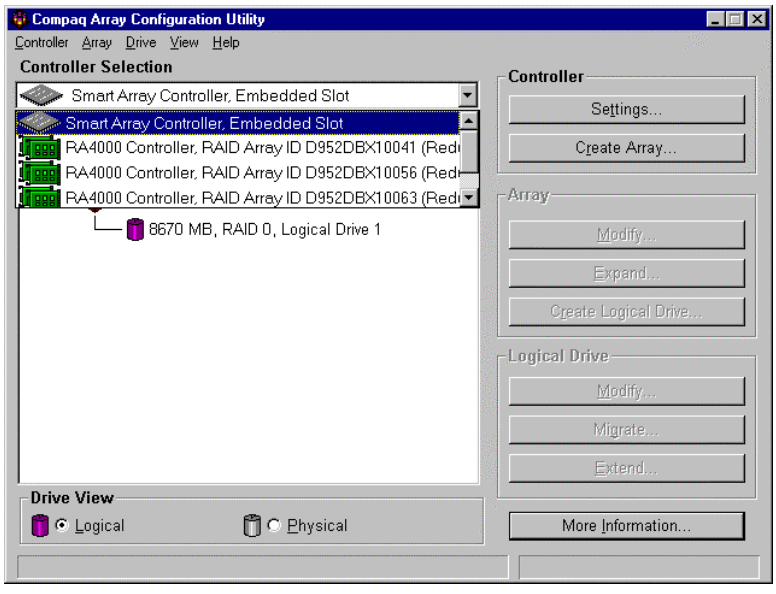
1. One logic al drive

D952DBX10056 (three 9.1GB drives attached)

1. One logical drive

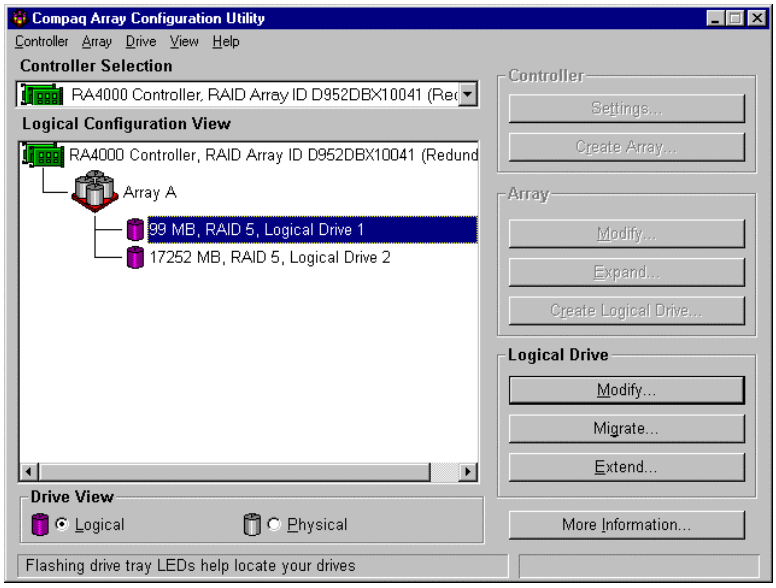
In this scenario two HBAs in each of the servers. The redundant configuration steps are the same with all the Windows NT Server Enterprise Edition systems. The only difference is in the "Logical Drive Host Access" page in the SSP, which will show two Adapter IDs as Local. The following steps are used to configure the ACU and SSP in the Windows NT Server Enterprise Edition configuration:

1. Access the ACU through server MW360NT1. Three RA4000 Controllers are listed. As shown in the "Controller Selection" section, all three controllers are marked as "Redundant".

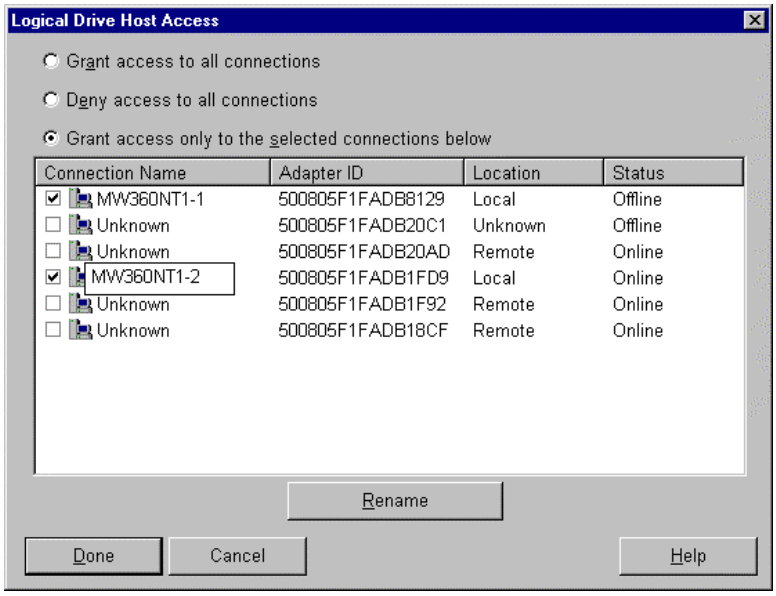


2. Select RA4000 Array ID D952DBX10041.

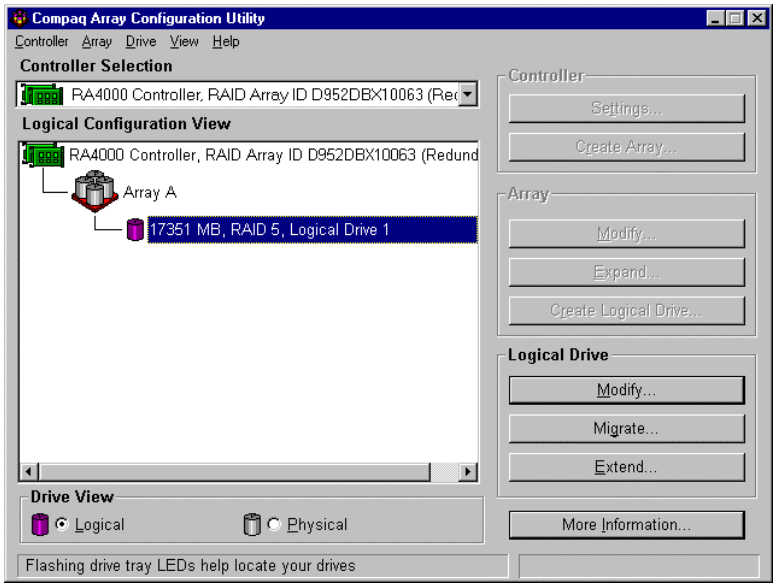
3. Create one RAID 5 array using all three 9.1GB drives.
4. Create two logical drives under the Array A.
    a. 100 MB logical drive for quorum
    b. One additional logical drive



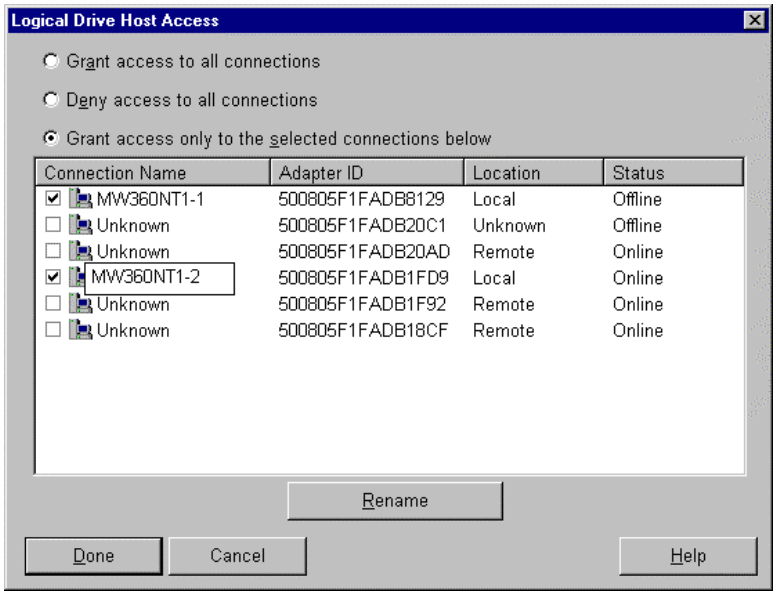
5. Select the first logical drive and modify the logical drive to grant access only to the connections that are local to server MW360NT1.
6. In the “Logical Drive Host Access” page there are two local adapters listed in the “Location” section of the page. That is because there are two HBAs in MW360NT1. In a redundant configuration one HBA is active and the other HBA is standby. In the “Status” section of the following screen, the active HBA will be listed as “Online” the Standby HBA will be listed as “Offline”. There should be two HBAs marked as “Local” in the “Logical Drive Host Access” page. Grant access only to those two HBAs and change the connection names to MW360NT1-1, MW360NT1-2. Save the setting and exit to the main configuration page of the ACU.



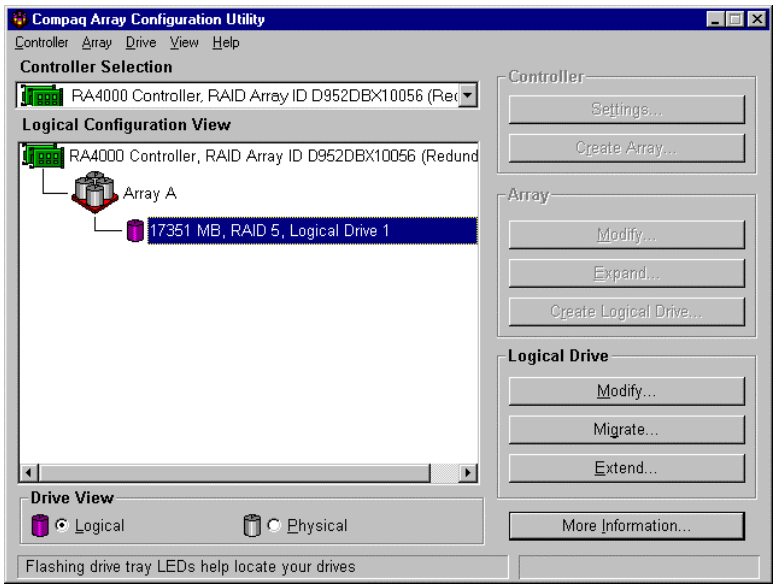
7. Repeat steps 5 and 6 for the second logical drive in this array.
8. At the main ACU screen, select the second RA4000 Controller ID D952DBX10063. Create one RAID 5 array using all three physical drives. Then created one logical drive.



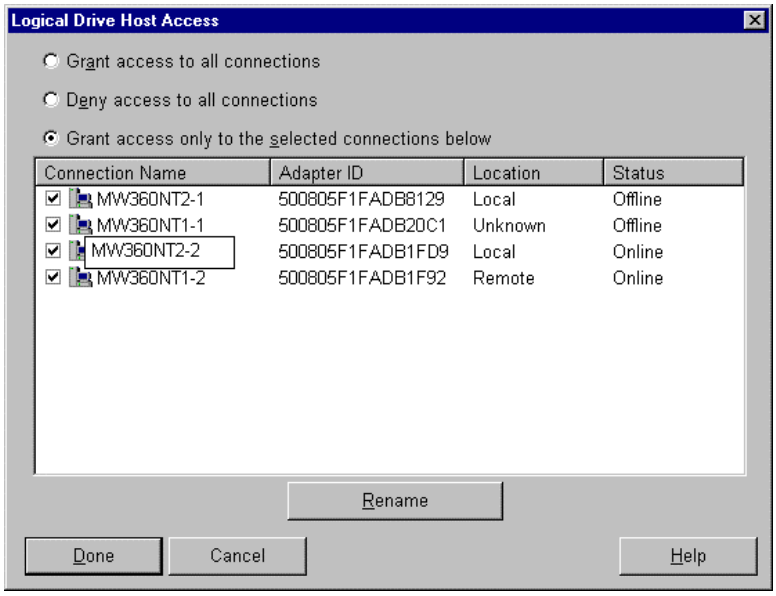
9. Open the “Logical Drive Host Access” of the logical drive that was created on the RA4000 Controller with ID D952DBX10063. There should be two HBAs marked as “Local” in the “Logical Drive Host Access” page. Grant access only to those two HBAs and change the connection names to MW360NT1-1, MW360NT1-2. Save the setting and exit to the main configuration page of the ACU.



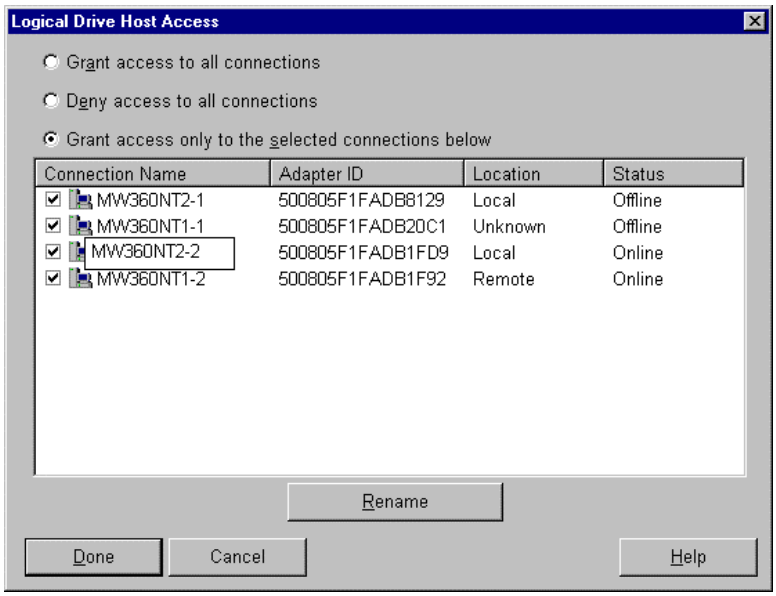
10. Select the third RA4000 Controller with ID D952DBX10056. Create one RAID 5 array using all three drives. Then create one logical drive.



11. Grant access to server MW360NT1 with the new connection names MW360NT1-1, MW360NT1-2.
12. Save the configuration and exit the ACU in server MW360NT1.
13. Access the ACU through server MW360NT2.
14. Select the RA4000 Controller with ID D952DBX10041
15. There are two logical drives, which have been created through the ACU on server MW360NT1. In the “Logical Drive Host Access” page, grant access to server MW360NT2. There are two HBAs listed as “Local”. These are the HBAs in server MW360NT2.
16. Rename the connections to MW360NT2-1, WM360NT2-2. Save the configuration.



17. Select the controller ID D952DBX10063 from the ACU, grant access only to server MW360NT2. Rename the connections to MW360NT2-1 and MW360NT2-2.



18. Select the controller ID D952DBX10056 from the ACU, grant access only to MW360NT2. Rename the connections to MW360NT2-1 and MW360NT2-2.
19. Save the configuration and exit the ACU in server MW360NT2.

Install MSCS

Open Disk Manager in Windows NT Server Enterprise Edition. There should be four un-partitioned drives listed. Partition and format each drive accordingly. Then install MSCS. Use the first logical drive, which has a 100MB capacity, as the quorum drive. This cluster should own three logical drives. After MSCS is successfully installed, reapply Windows NT Service Pack 6a.

ACU and SSP in NetWare 5.1

The NetWare 5.1 NCS is formed by two servers and one storage subsystem.

a. Server MW360NW1

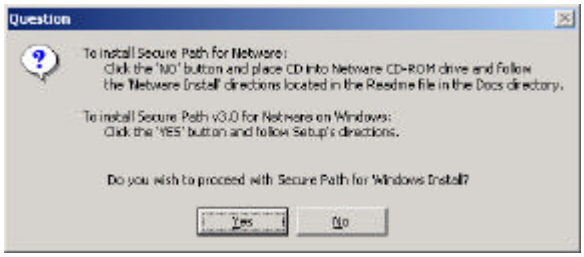
b. Server MW360NW2

c. Compaq StorageWorks RA4000/4100 ID D931DBX10140 (three 18.1GB drives attached)

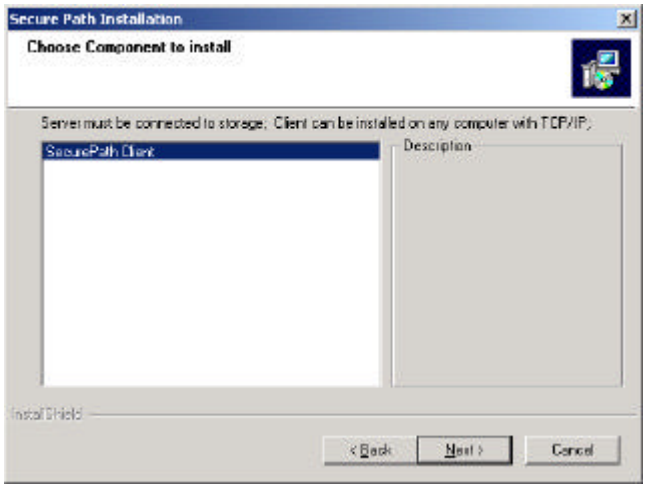
1. One logical drive

Compaq SANworks Secure Path is used to manage the redundant configuration in NetWare. The Secure Path Client will be installed on a Windows 2000 client to monitor and manage the paths. Secure Path Agent will be installed on both NetWare Servers. A summary of the installation and configuration process is as follows:

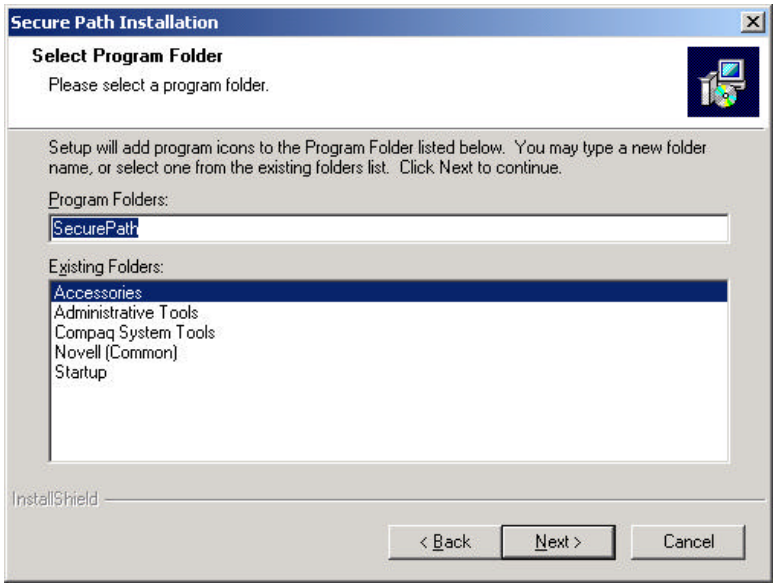
1. Logon on to NetWare 5.1 from a Window 2000 client that has NetWare Client installed.
2. Install the Secure Path Client by inserting the Secure Path CD. The “Secure Path Manager for NetWare on Windows 2000” program will start automatically. Click “Yes” to continue.



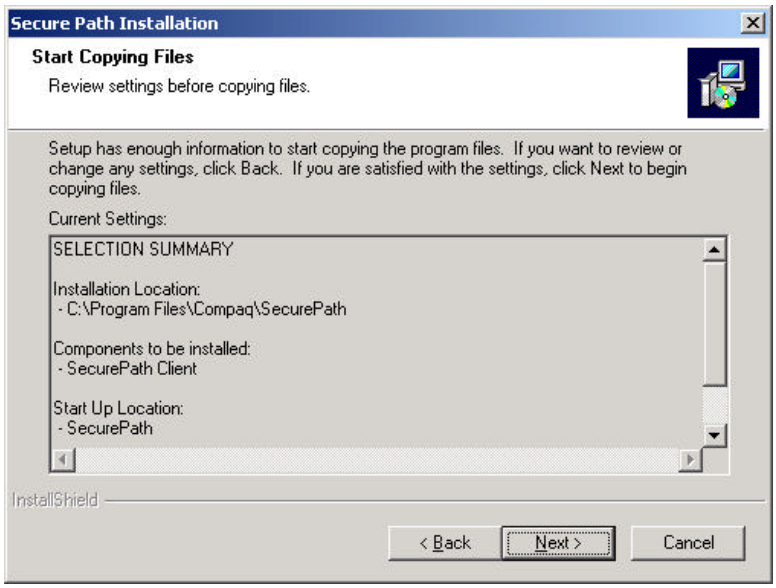
3. Following the setup instructions. Accept the license agreement. Make sure you only install the “Secure Path Client”. Click “Next” to continue.



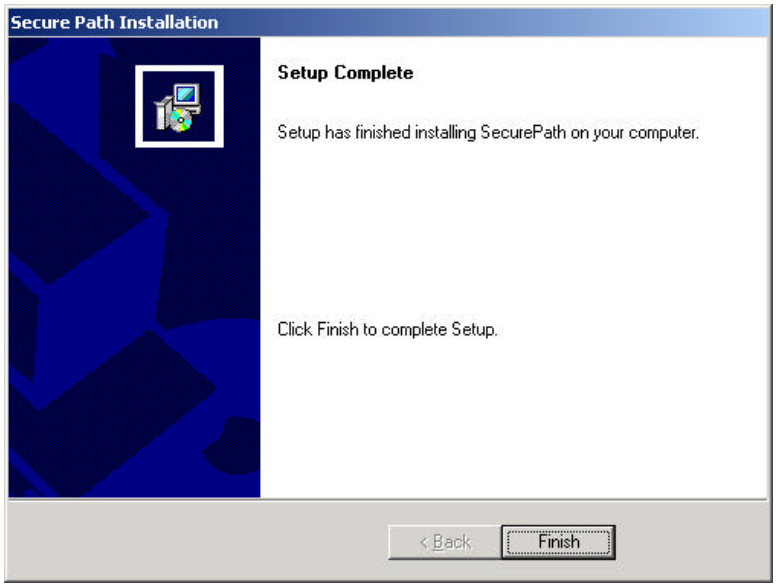
4. Accept the default program folder. Click on “Next” to continue.



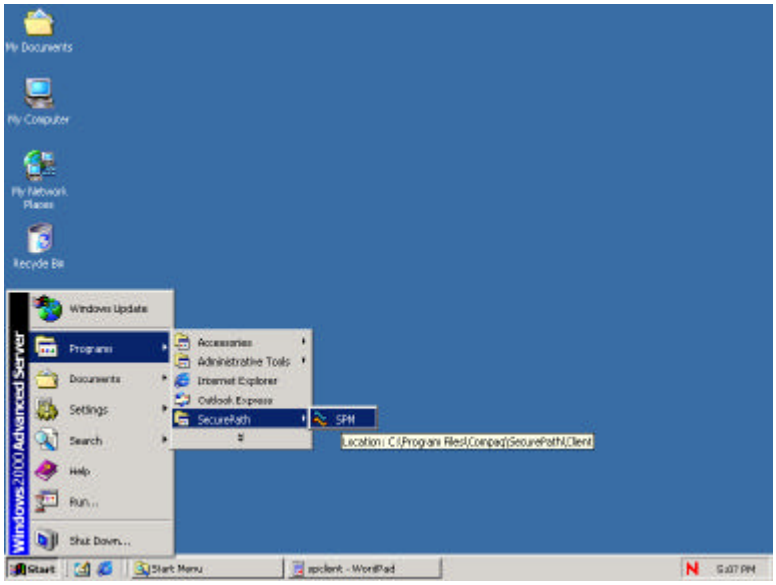
5. Secure Path summarizes the settings before it starts to copy files. Click “Next” to start the process.



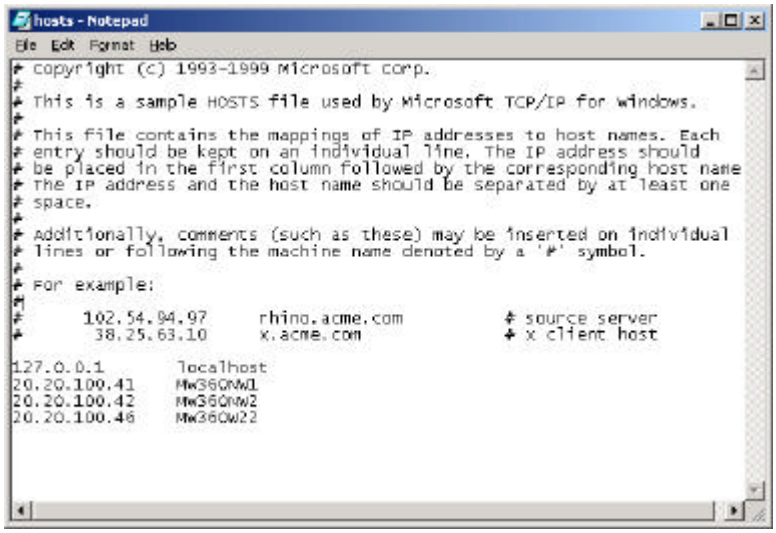
6. Once files have been successfully copied, click “Finish” to complete the Secure Path Client setup.



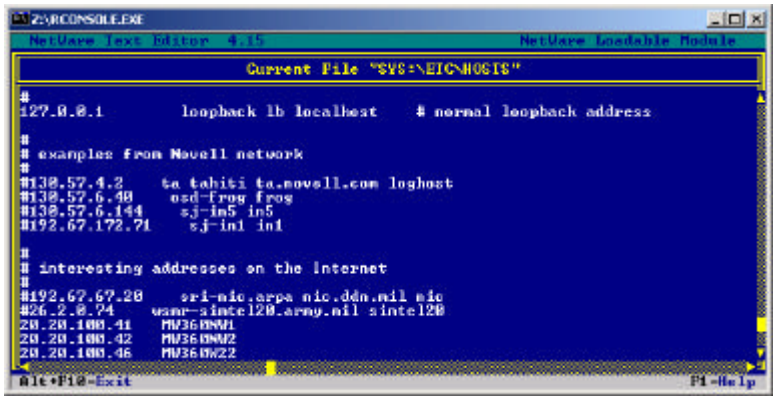
7. The Secure Path Manager (SPM) will appear on the Programs Menu.



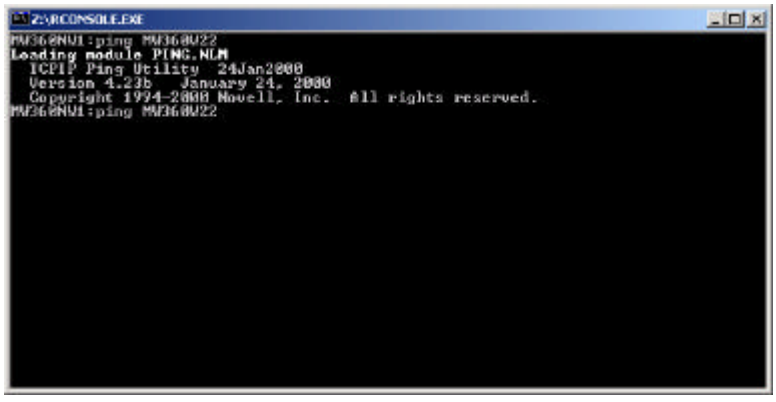
8. Before the administrator installs Secure Path Agent to the NetWare 5.1, edit the hosts file on the Secure Path Client system and both NetWare 5.1 systems. Open the hosts file on the Windows 2000 client and add MW360W22, MW360NW1 and MW360NW2 into the hosts file. Save the file and exit.



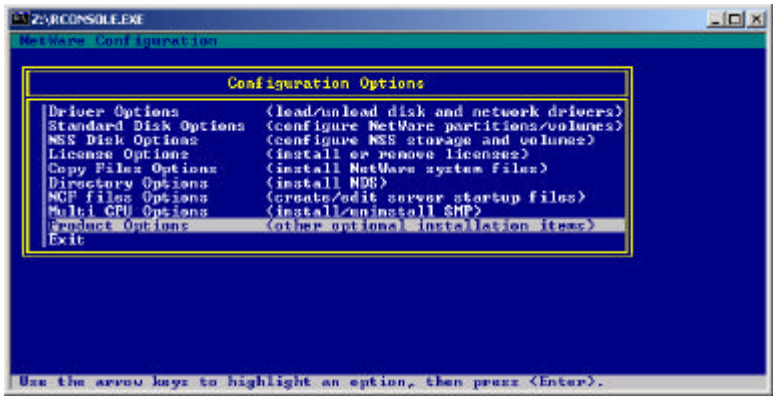
9. On both NetWare 5.1 systems, edit the host file using the “edit” command. At the NetWare Server Console type “**edit sys:\etc\hosts**” to edit the host file. NetWare is case sensitive; the server names must be exactly the same as shown in the NetWare Server Console. Add IP resolution for MW360NW1, MW360NW2 and client system MW360W22 to the hosts file.



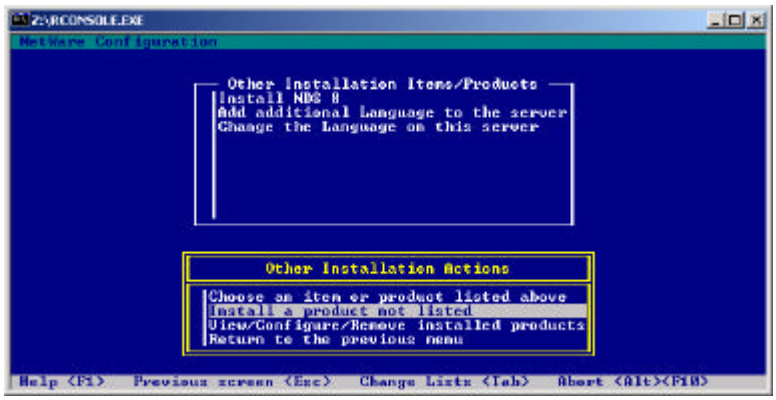
10. Use the “ping” command at NetWare Server console to verify that name/IP resolution works. At the NetWare Server Console, type, “ping MW360W22”. NetWare is case sensitive. Type exactly the same names that the administrator added in the NetWare Server hosts file.



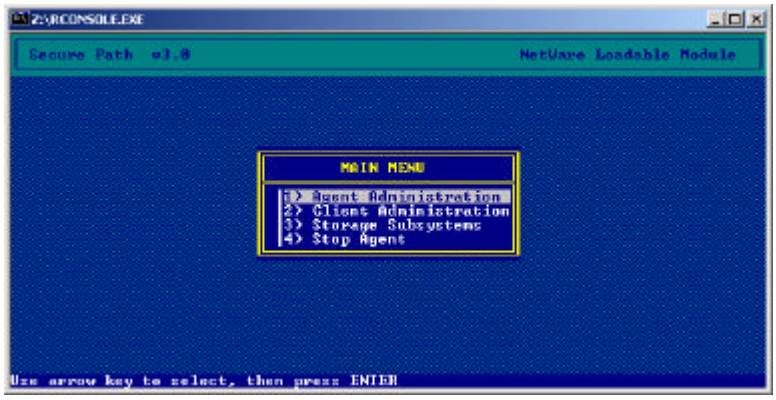
11. After the name/IP resolution has been established, the installation of the Secure Path Agent can start. Insert the Secure Path CD into server MW360NW1. Mount the CDROM for server MW360NW1. Once the CDROM is successfully mounted, type “NWCONFIG” at NetWare Console and select ”Product Option”.



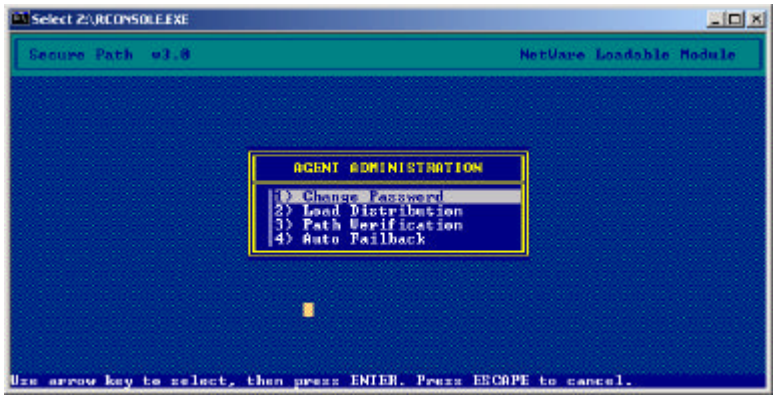
12. Select the “Install a product not listed” from “Other Installation Action”.



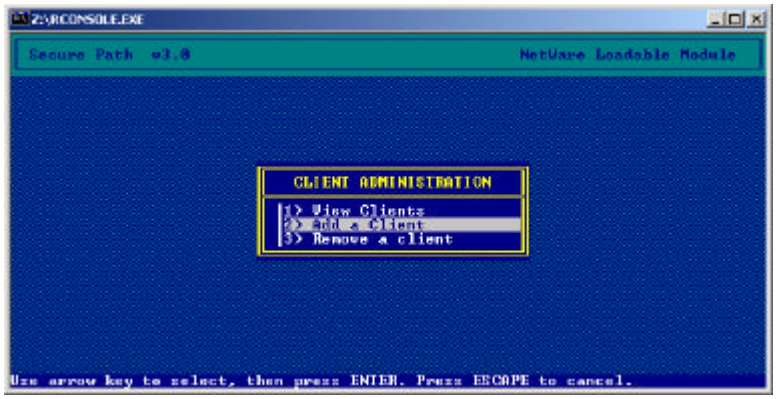
13. Use the F3 key to specify the path to the Secure Path Agent installation files and press “Enter”. The Secure Path Agent installation process will start. After the installation, the Secure Path configuration page will come up. Select the “Agent Administration”.



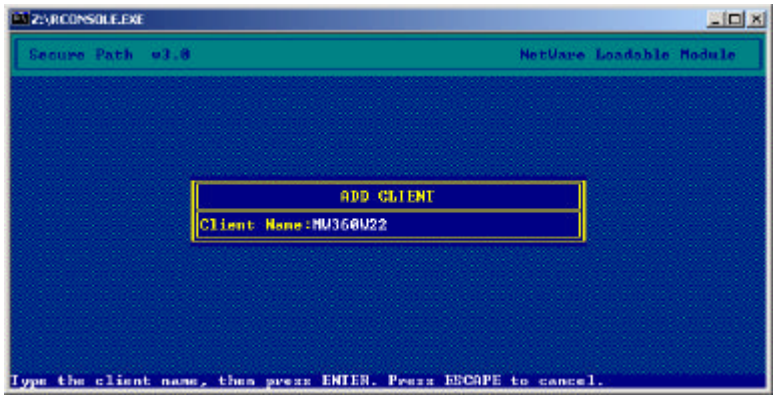
14. To set the password for Secure Path Client access; select “Change Password”. A dialogue box will appear. Enter the password. The system will prompt you to re-enter the password. The password is case sensitive. Use the “Esc” key to leave the agent administration.



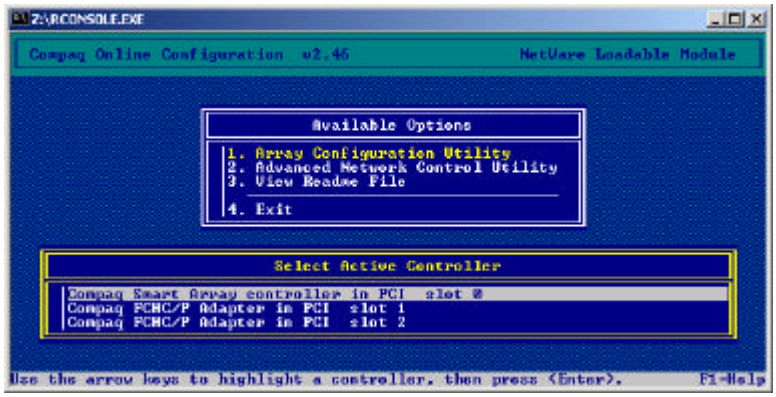
15. From the “Main Menu” of Secure Path select “Client Administration” to configure the Secure Path Client. Select “Add a Client”.



16. Enter the client name that has the Secure Path Client installed. In this configuration the client name is MW360W22. This process will let server MW360W22 have access to NetWare to manage and monitor the activities of Secure Path.

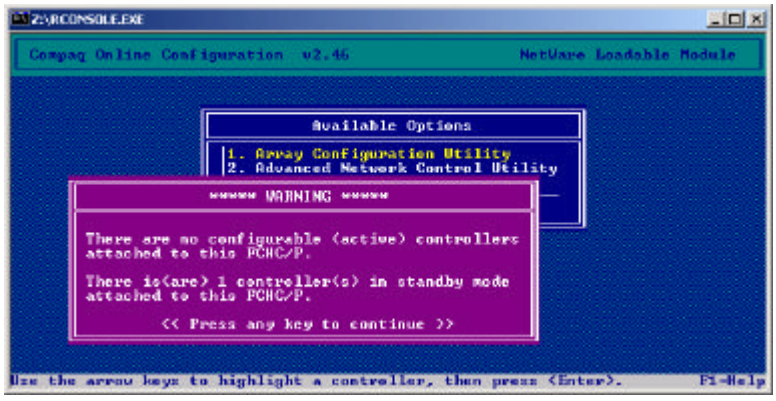


17. Restart the NetWare 5.1 server, MW360NW1, after installing and configuring the Secure Path Agent.
18. Repeat steps 9 through 17 for NetWare 5.1 server MW360NW2.
19. After both NetWare Servers reboot, from the NetWare Server Console of MW360NW1, start the CPQONLIN utility to enable the SSP.

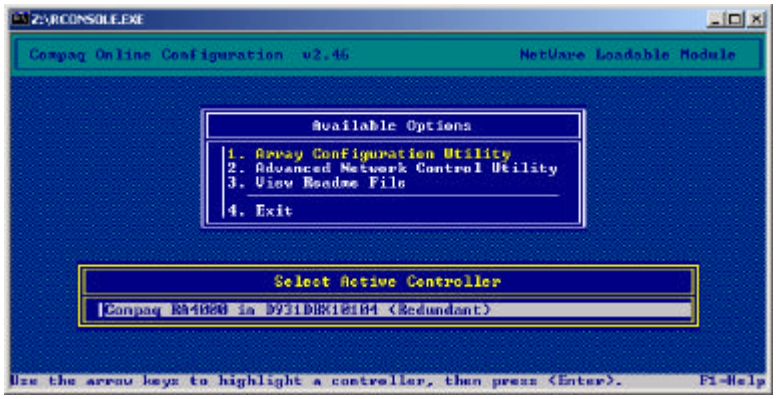


20. There are two HBAs in each of the NetWare 5.1 servers. The CPQONLIN utility detects two Compaq HBAs and the local smart array controller. By default, Secure Path Agent sets one of the HBAs to "Active" and the other is set to "Standby".

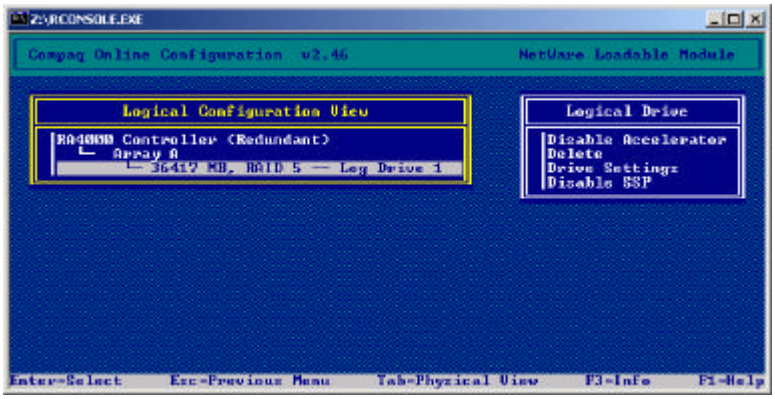
    Select the first HBA in the box. If following message appears this HBA is in the "Standby" mode. Press any key to exit.



21. Select the other Compaq HBA, which will be in "Active" mode. In the "Select Active Controller" section, the controller with ID D931DBX10104 is listed and is marked as "Redundant". Select this controller and create a RAID 5 Array using all three drives that are attached to the controller.

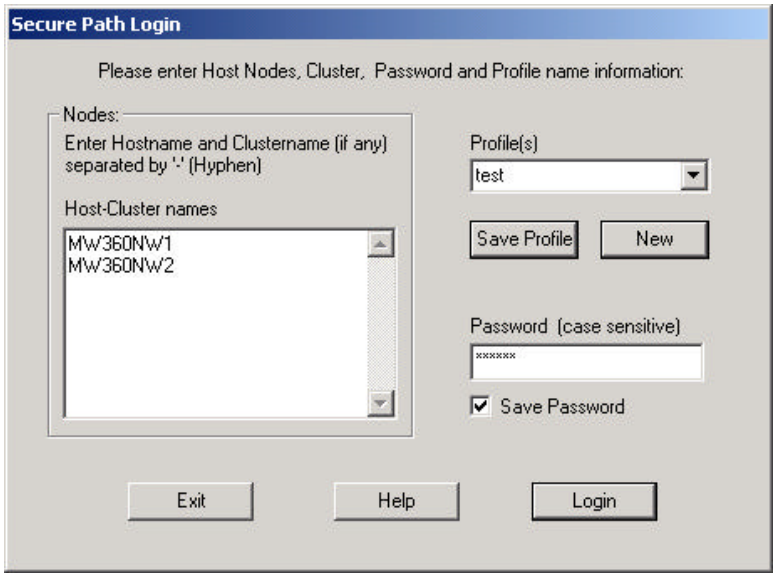


22. Enable the SSP for the logical drive. Exit the CPQONLIN utility and reboot the server.

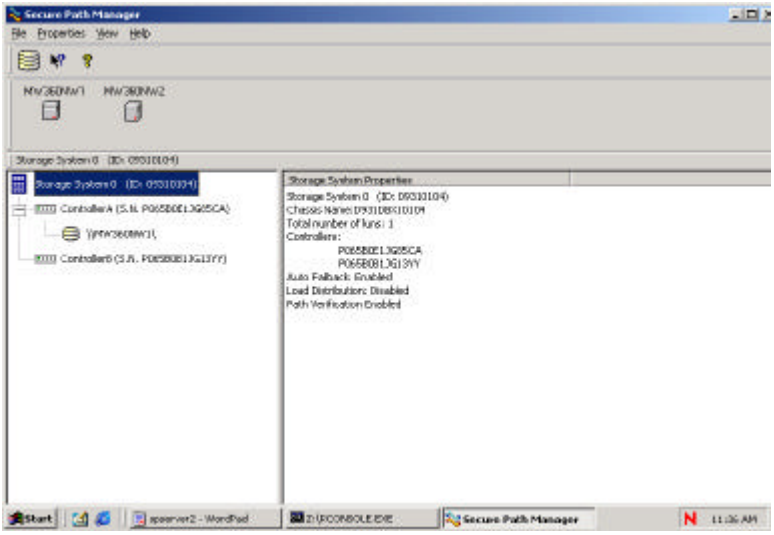


23. To enable the SSP in MW360NW2, type CPQONLIN in the NetWare 5.1 Server Console. In the “Available Options” select the HBA that is marked as “Active”. Enable the SSP. Exit the CPQONLIN and reboot the server.

Secure Path for NetWare has been successfully installed. From the Secure Path Client open the Secure Path Manager from the Program menu. Type the names of two NetWare Servers and the password that was set in the configuration process of the Secure Path Agent. Give a profile name for this setting and save the profile. Then click “Login”.



As shown in the following screen, there are two Array Controllers in one Compaq StorageWorks RA4000/4100. There is one logical drive. Detailed information about the hardware settings are listed in the right panel.



NOTE: For more information regarding Compaq SANworks Secure Path for NetWare, please refer to the documentation AA-RN72A-TE in Secure Path CD NWSPV30.

Install NCS

Use the "NWCONFIG" utility to create NetWare Volumes before installing NCS. After successfully installing NCS, reapply the latest Support Pack for NetWare 5.1.

Standalone Windows 4.0 NT Server

The Window NT 4.0 stand-alone server with one StorageWorks RA4000/4100 storage subsystem.

a. Server MW360NT3

b. RA4000 controller with ID D952DBX10030 (three 9.1GB drives attached)

The configuration steps are the same as non-redundant configuration step except in the SSP.

A summary for this scenario follows:

1. Access the ACU through server MW360NT3
2. Select the RA4000 controller ID D952DBX10030 from the Controller Selection Menu.
3. Create one array using all three 9.1GB drives.
4. Create one logical drive under the array just created.
5. Select the logical drive and modify the logical drive to grant access only to the connection local to server MW360NT3.
6. Rename the connection to MW360NT3.
7. Save the configuration and exit ACU in server MW360NT1.

Conclusion

The StorageWorks RA4100 SAN delivers a uniquely affordable SAN that simplifies storage management, tames explosive data growth and reduces business down time. It's scalable architecture and broad range of OS, ProLiant and industry standard x86 platform support allows for re-deployment or reconfiguration of storage as computing environments change. With centralized management, storage consolidation and dynamic storage allocation and access control, the RA4100 SAN truly delivers business flexibility, increased service levels and operational efficiencies at a price point unmatched in the industry today.