

Evaluation of the EMC® CLARiiON® AX4 Storage System

Report prepared under contract with EMC Corporation

Introduction

EMC Corporation commissioned Demartek to perform a hands-on evaluation of EMC's new entry-level CLARiiON AX4 iSCSI storage system. This evaluation included installing and deploying the AX4 in the Demartek lab facilities and reviewing several features including system installation configuration, provisioning storage to hosts, capacity expansion, data migration within the system, and creation of snapshot copies. All features evaluated by Demartek are included with the base CLARiiON AX4 system.

This report shows the actual steps taken to install and use the AX4 storage system. Screen shots are included.

Evaluation Summary

We found that the AX4 is easy to configure and use. In our opinion, it is an ideal choice for customers consolidating storage for the first time. It provides a strong set of storage management features in an entry-level system, offers a great growth path, and is competitively priced.

Overview of the EMC CLARiiON AX4

The CLARiiON AX4 is EMC's entry-level iSCSI storage system for new installations or consolidated applications. Storage capacities start with as little as 600 gigabytes (GB) and can scale up to 45 TB now and up to 60 TB of raw capacity when 1 TB disk drives are supported later in the first calendar quarter of 2008. This type of solution is suitable for block-oriented applications such as Microsoft Exchange, Microsoft SQL Server, and backup and recovery.

The CLARiiON AX4 is available in either single or dual controller models. The combination of the CLARiiON AX4 architecture, based on Intel Xeon processors, and the CLARiiON FLARE operating environment enable the system to scale from as few as 4 drives up to as many as 60 drives within the system (up to four optional Disk Array Enclosures). The combination of Intel's advanced multiprocessor capability and high degree of data path protection, complement the strengths of FLARE. Such scalability (in both power and capacity) in an entry-level system is rare, and offers a solid growth path for end-users.



These enclosures can be populated with Serial-Attached-SCSI (SAS) disk drives for performance-sensitive applications and SATA disk drives that provide large capacity for applications such as backup-to-disk. For those installations needing multiple tiers of storage, the disk drive types can be mixed SATA and SAS, even on the same shelf, as they were for this evaluation. SATA disk drives are available in capacities of 750 GB, with 1 TB SATA drive support coming in Q1'08. SAS disk drives are available in 146GB and 400 GB capacities.

The iSCSI version of the AX4 has a total of four iSCSI host data interfaces, two per storage processor. There is also a version of the AX4 with four Fibre-Channel host data interfaces. This report focuses on the iSCSI version only. Aside from the host interfaces, these two versions of the AX4 are nearly identical.

The CLARiiON AX4 base system comes with an impressive suite of software features. Software capabilities that ship with the system include: wizard-driven installation utilities, simple configuration and management, path management and failover, online capacity expansion, non-disruptive data migration, and local snapshot replication for backup operations.

Installation of the EMC CLARiiON AX4

The installation of the AX4 can be organized into the following general steps.

1. AX4 hardware installation and system initialization
2. Host server installation of PowerPath software and iSCSI session configuration

Hardware Installation

EMC has designed the AX4 to be installed by customers. A “placemat” showing all the hardware installation steps comes with the unit. In this evaluation, Demartek required less than an hour to unpack the boxes, load the unit into the racks, connect all the cables, turn on power to the system and get ready to perform the initial configuration of the system.

System Initialization

The basic steps to the system initialization are:

1. Discover the array
2. Set the management port network settings
3. Set the iSCSI data port network settings
4. Set the administrative username and password

The Navisphere Storage System Initialization utility can be run directly from the CDROM or installed on a host server. This utility scans for, and automatically detects, the AX4 systems on the same subnet as the host server. After detection, the administrator can enter the desired IP addresses for the management ports and the iSCSI data ports. The administrator also sets the username and password for the administrative access to the system. This process required approximately 10 minutes. We believe that any administrator generally familiar with IP networking concepts will have no trouble configuring the AX4 iSCSI storage system.





After setting the IP addresses for the AX4 management ports, the IP addresses and other network configuration parameters are needed for the four iSCSI data ports.

Following the network parameter settings, the only remaining initialization task is to set the administrator username and password.



A final summary checklist is displayed, with the opportunity to go back and change any of the previous settings, if necessary.

After the AX4 has been installed and initialized, the host servers that will access the iSCSI storage need to be prepared. The servers in the Demartek lab have server-class NICs installed suitable for iSCSI traffic and the Microsoft iSCSI software initiator already installed.

The host server installation steps include the following:

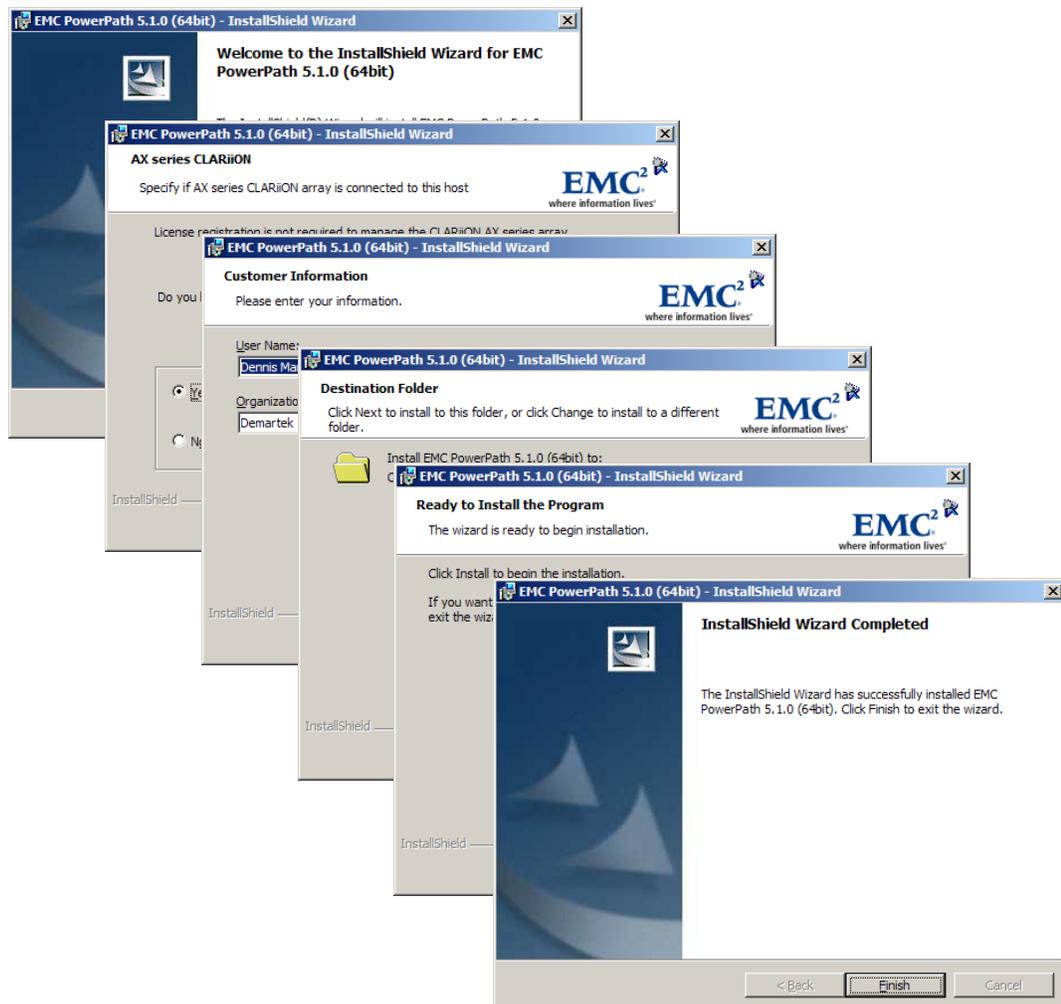
1. PowerPath Installation

2. Configure Host Sessions

PowerPath Installation

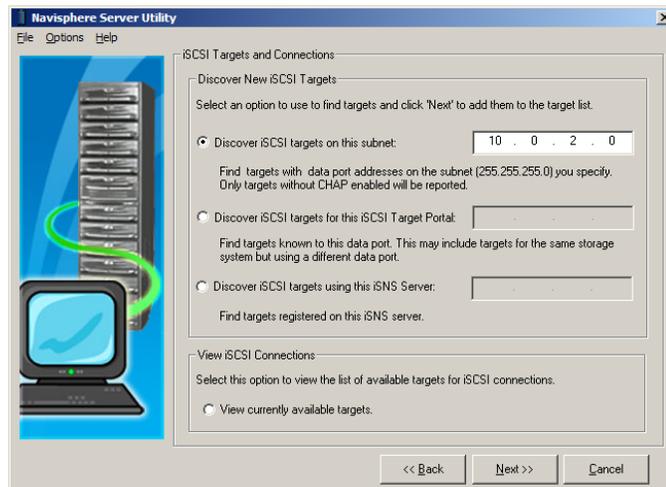
The AX4 comes with EMC PowerPath at no additional charge, and is required to provide the proper management as well as load balancing and path failover for highly available connectivity to the AX4. In the Microsoft Windows environment, PowerPath works with the Microsoft iSCSI initiator. PowerPath must be installed on each host server that will use the iSCSI storage of the AX4. For this evaluation, three servers in the Demartek lab were used, running Windows Server 2003 R2 Enterprise x64 Edition.

Installing PowerPath is a very straightforward process, simply following the prompts. This process required less than five minutes per host server. A reboot of the host server is required in order to complete the installation. After PowerPath is installed, very little user interaction with PowerPath is required for basic operation of the AX4.

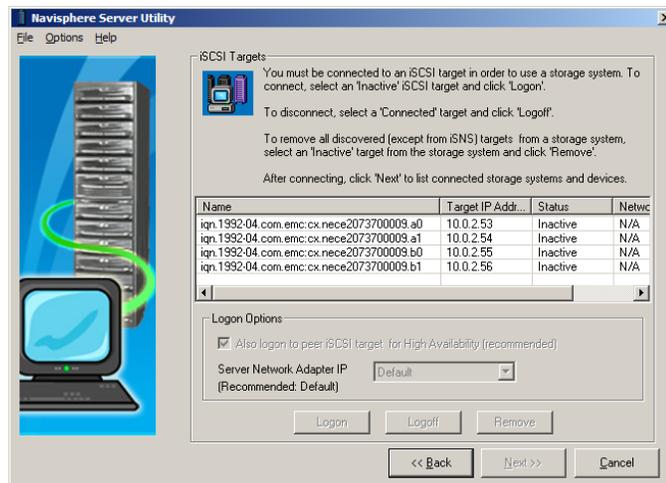


Host Session

The Navisphere Server Utility steps through the process of establishing a session between a host server and the AX4 system. Just a few clicks are required to create and logon to an iSCSI session between the host server and the AX4. This process took less than ten minutes per host server.



The iSCSI Target and Connections step will discover all iSCSI storage visible to the host. At the time of this installation, only the AX4 iSCSI storage was visible to the three host servers.



The Navisphere Server Utility can logon and establish the iSCSI session using all available host ports and connect to all available iSCSI target ports. If the logon option is chosen, it will immediately logon to the AX4 IQN (iSCSI Qualified Name) that is selected and its pair partner. In this example, the IQN that ends with “a0” and “b0” are considered partners and “a1” and “b1” are

considered partners. The logon is also established as a persistent iSCSI connection, so that whenever the host server is rebooted, the iSCSI session is automatically reestablished at system startup without user intervention.

The overall installation process was simple and straightforward. We believe that any administrator familiar with basic IP networking concepts would have no trouble installing an AX4 system.

Managing the CLARiiON AX4 Using Navisphere Express

EMC provides the Navisphere Express software to manage the AX4. The Navisphere Express provides wizards to assist with many of the functions, making them easy to perform. The basic functions include:

1. System administration settings
2. Host server information
3. Storage configuration

The first time Navisphere Express is launched, a few items that need attention will be highlighted and these items can serve as a checklist for some logical first steps for the administrator to insure high availability and the best use of the AX4. The configuration of these items is explained below.

System Administration Configuration

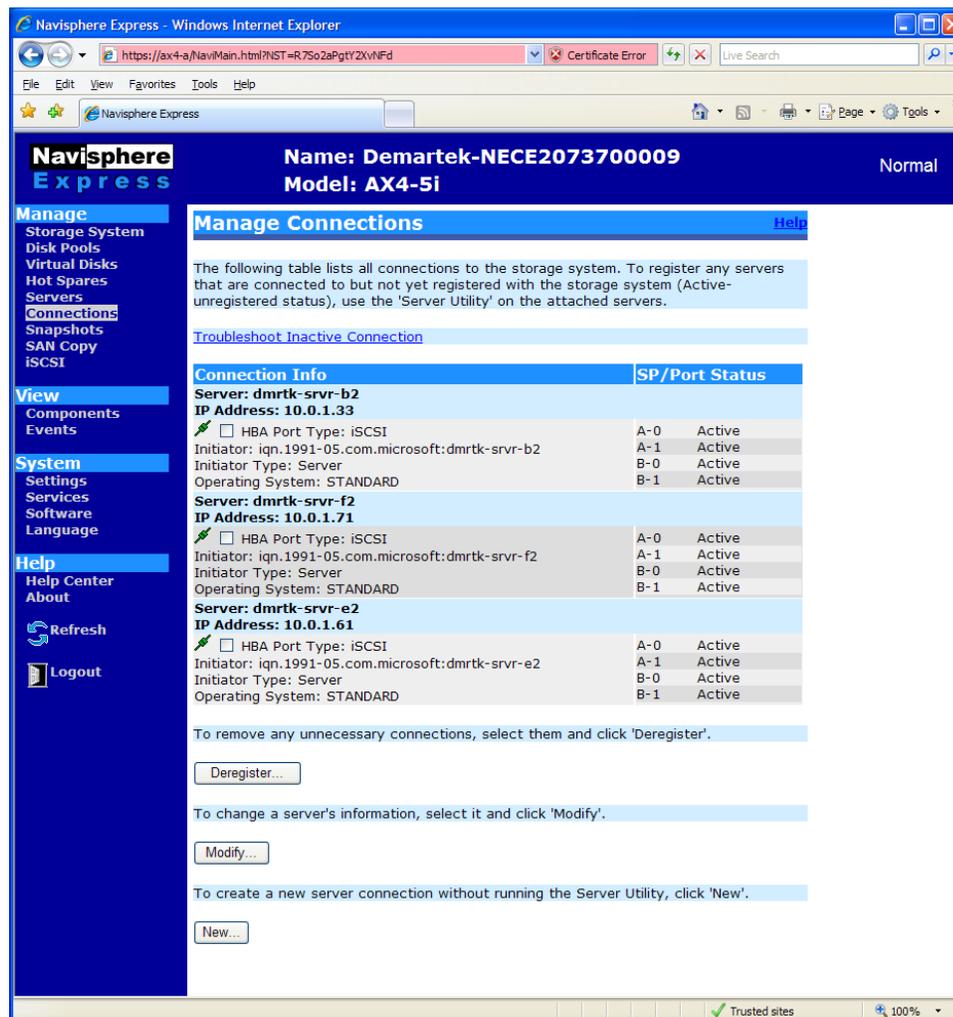
To begin our configuration, we changed the name of the system, specified an email address to use for AX4 system notifications and set the AX4 system time.

Host Server Configuration

Clicking on the “Connections” menu item allows the administrator to configure a host server connection. Four pieces of information are required to complete this step:

1. The IQN of the host server
2. The operating system type
3. The name of the host server
4. The IP address of the host server

This series of steps is repeated for each desired server connection. The connections are configured to use all available active iSCSI ports. Here we see the results of configuring three host servers.

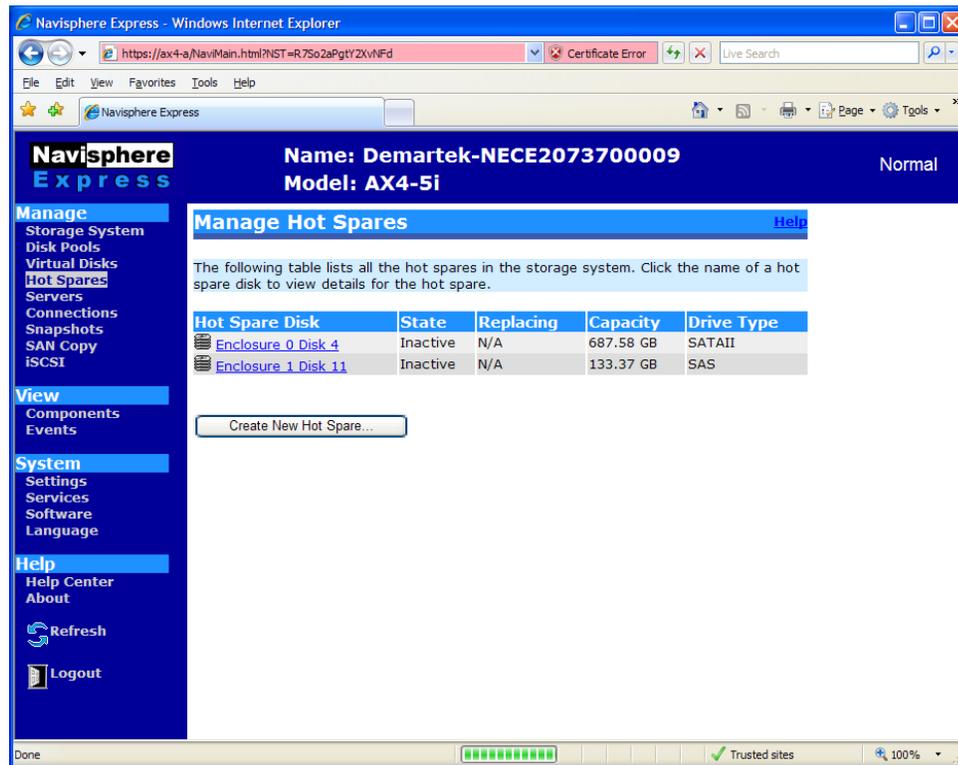


Up to 128 iSCSI initiators (64 high availability hosts) can be configured. These can be physical hosts or hosts in a virtual server environment such as VMware®.

Storage Configuration

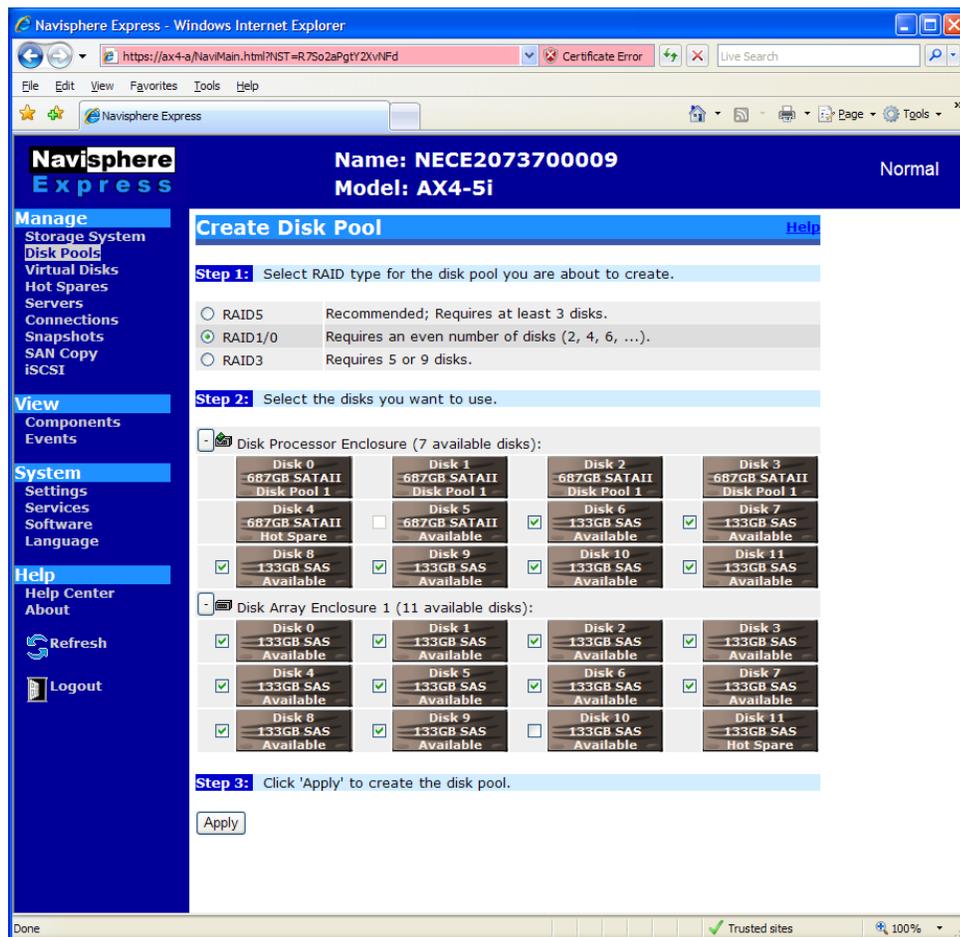
For the storage configuration, the disk pools need to be created, and hot spares need to be assigned. After creating disk pools, virtual disks are created that can be assigned to host servers. If the host servers have already been configured, then the virtual disk can be assigned to specific host servers when they are created. If the host servers have not been configured, the virtual disks can be assigned later.

Because the evaluation unit included both SATA and SAS disk drives, we configured one hot spare of each type before configuring the disk pools. In this example we see that one SATA and one SAS disk drive are listed as a "Hot Spare" disk.

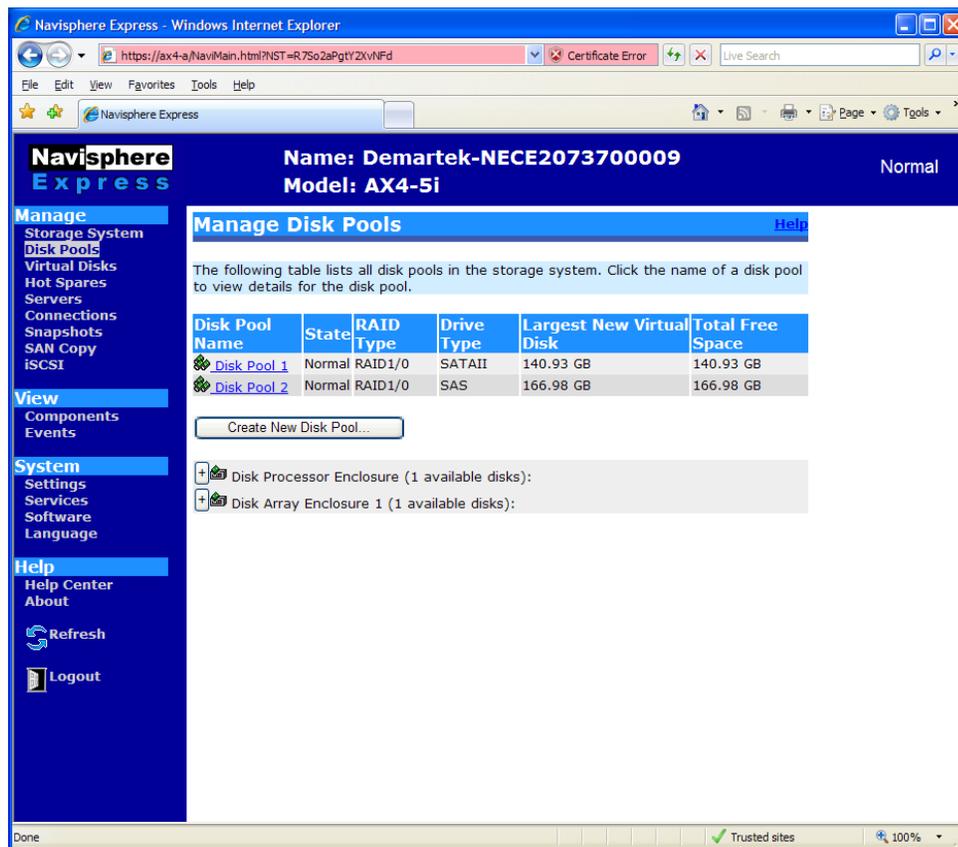


We configured two disk pools, one for each type of disk. This allows us to create a two-tier storage system.

The SAS disk pool spans enclosures. Disk pools can span enclosures and can have up to 16 disk drives per pool.



After creating these disk pools, we configured the remaining available disk drives as hot spares.



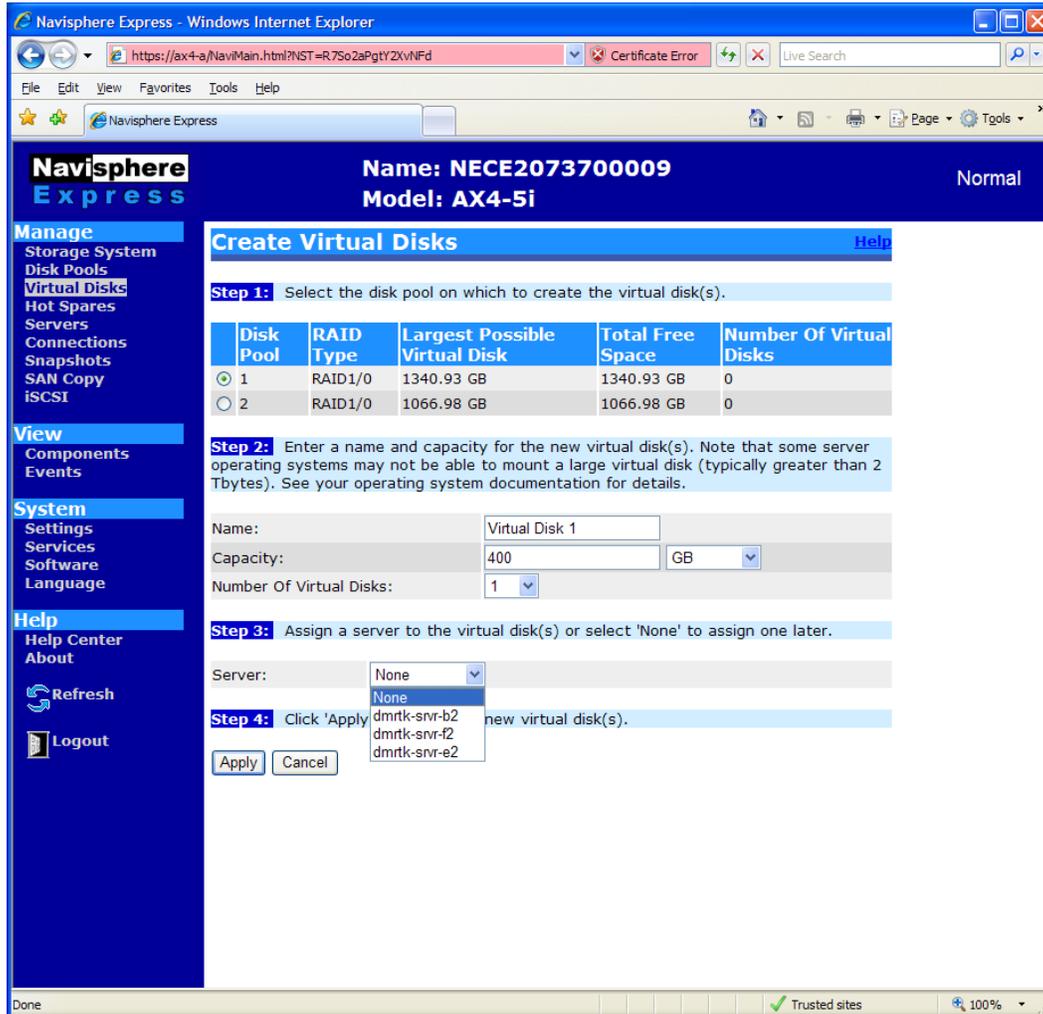
There is no limit to the number of disk pools that can be created. The physical number of disks and the type of RAID grouping are the limiting factors.

After creating disk pools, virtual disks are created and assigned to specific hosts. The virtual disk creation process is straightforward, requiring the following pieces of information:

1. Disk pool from which to create the virtual disk
2. Name, capacity and number of virtual disks to create
3. Server to assign the virtual disk when completed.

Virtual disks can be created one-at-a-time or can be created in groups to expedite the process. If more than one virtual disk of the same size is needed, the size and the number of virtual disks can be specified with no server initially assigned. The host servers can be assigned to virtual disks later.

A total of 512 virtual disks can be created with a maximum of 128 virtual disks per disk pool. A single initiator could have up to 256 virtual disks assigned to it. A dual-connected host, such as in our configuration, can have up to 512 virtual disks assigned to it.



Navisphere Express - Windows Internet Explorer

https://ax4-a/NavMain.html?NST=R7So2aPgtY2XvNFd

File Edit View Favorites Tools Help

Navisphere Express

Navisphere Express Name: **NECE2073700009** Model: **AX4-5i** Normal

Manage

- Storage System
- Disk Pools
- Virtual Disks**
- Hot Spares
- Servers
- Connections
- Snapshots
- SAN Copy
- iSCSI

View

- Components
- Events

System

- Settings
- Services
- Software
- Language

Help

- Help Center
- About
- Refresh
- Logout

Create Virtual Disks [Help](#)

Step 1: Select the disk pool on which to create the virtual disk(s).

Disk Pool	RAID Type	Largest Possible Virtual Disk	Total Free Space	Number Of Virtual Disks
<input checked="" type="radio"/> 1	RAID1/0	1340.93 GB	1340.93 GB	0
<input type="radio"/> 2	RAID1/0	1066.98 GB	1066.98 GB	0

Step 2: Enter a name and capacity for the new virtual disk(s). Note that some server operating systems may not be able to mount a large virtual disk (typically greater than 2 Tbytes). See your operating system documentation for details.

Name:

Capacity:

Number Of Virtual Disks:

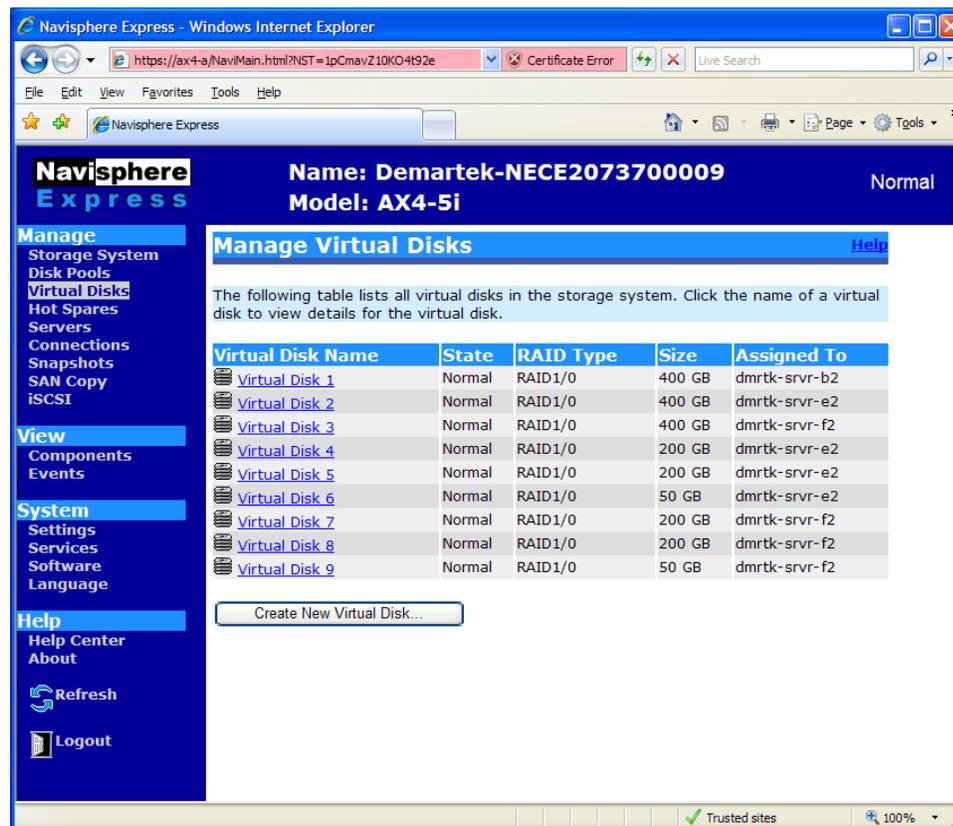
Step 3: Assign a server to the virtual disk(s) or select 'None' to assign one later.

Server:

Step 4: Click 'Apply' to create the new virtual disk(s).

Server dropdown options: None, dmtk-svr-b2, dmtk-svr-f2, dmtk-svr-e2

Done Trusted sites 100%

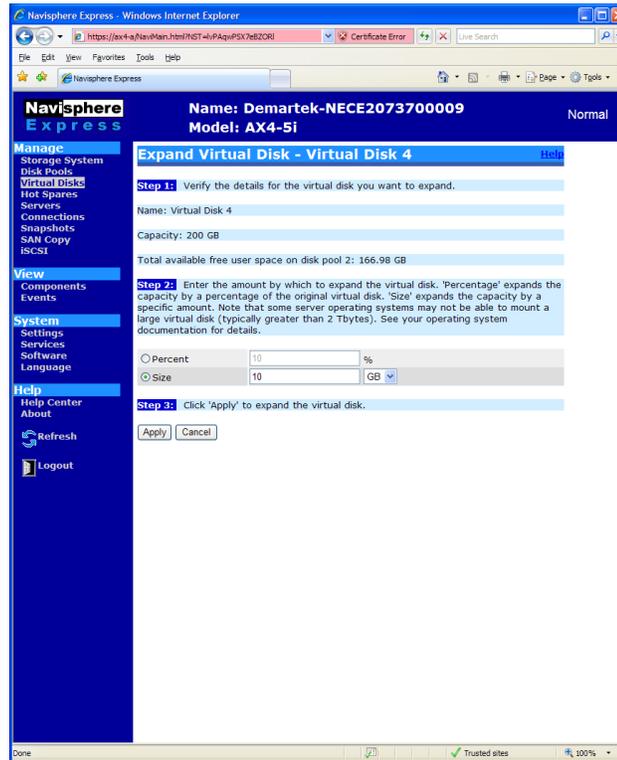


The creation of virtual disks is simple and easy, with all the information needed available on one screen. The virtual disks must complete their initialization before the host servers can access the storage. This initialization time depends on the size of the virtual disk and the type of disks (SATA or SAS) on which the virtual disks have been created.

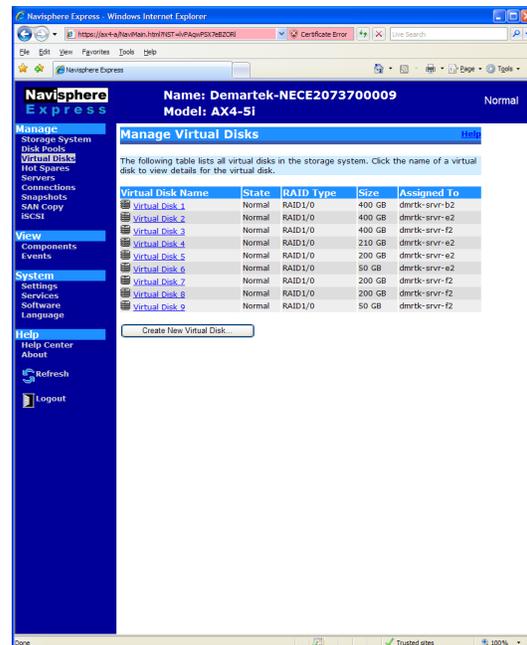
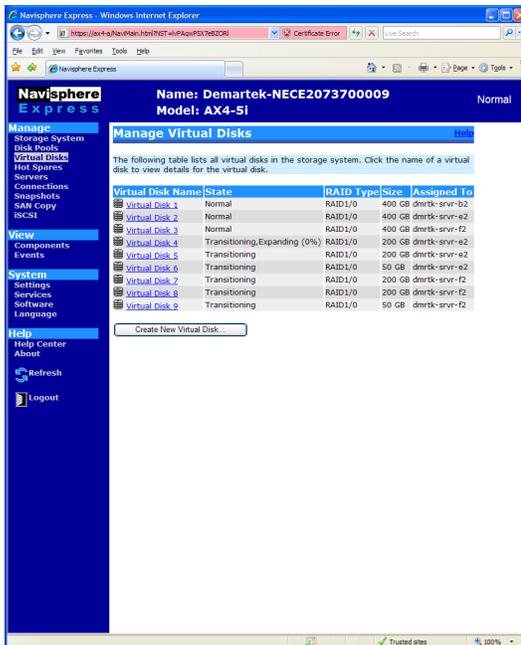
After the virtual disks have completed the AX4 system initialization, they are ready for use by the host servers. The host servers follow normal procedures for creating partitions and formatting as with any other disk storage.

Online Capacity Expansion

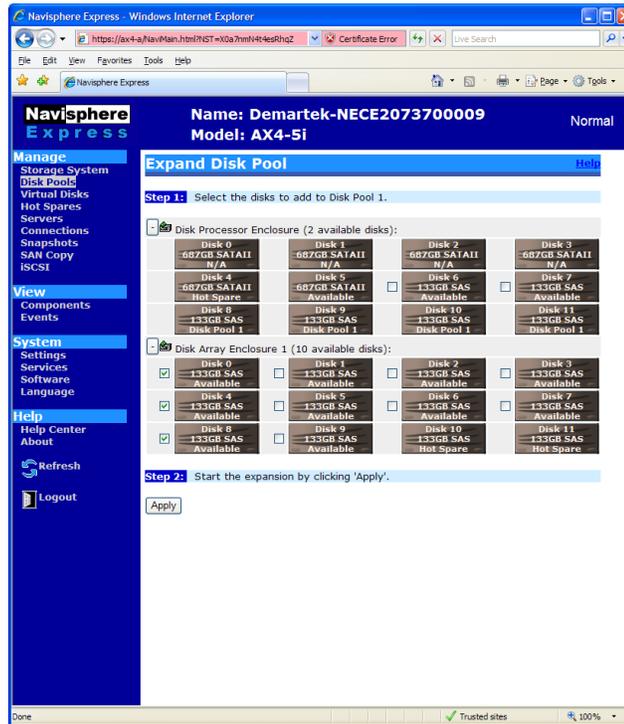
Storage environments generally are not static and over time individual storage volumes often need to be expanded. The AX4 provides a non-disruptive expansion function for virtual disks. If there is unallocated capacity in a disk pool, a virtual disk can be expanded very easily. The virtual disk expansion function allows for growth either by a percentage or specific amount of storage. The administrator selects the amount and presses “apply”. In this example, a 200 GB virtual disk is expanded by 10 GB.



For a few minutes, while the virtual disk is expanding, its status is displayed. When the expansion is complete, the host can then use standard commands to expand the volume into the new space. In the Windows environment, this step is accomplished by the "DISKPART" command.



Disk pools can also be expanded easily and non-disruptively. The process is similar to the virtual disk expansion process. In this example, we began with a fresh RAID-5 disk pool that was originally configured with four disk drives and expanded the pool to add three more drives, from the second enclosure, to the pool.



“In-the-box” Data Migration

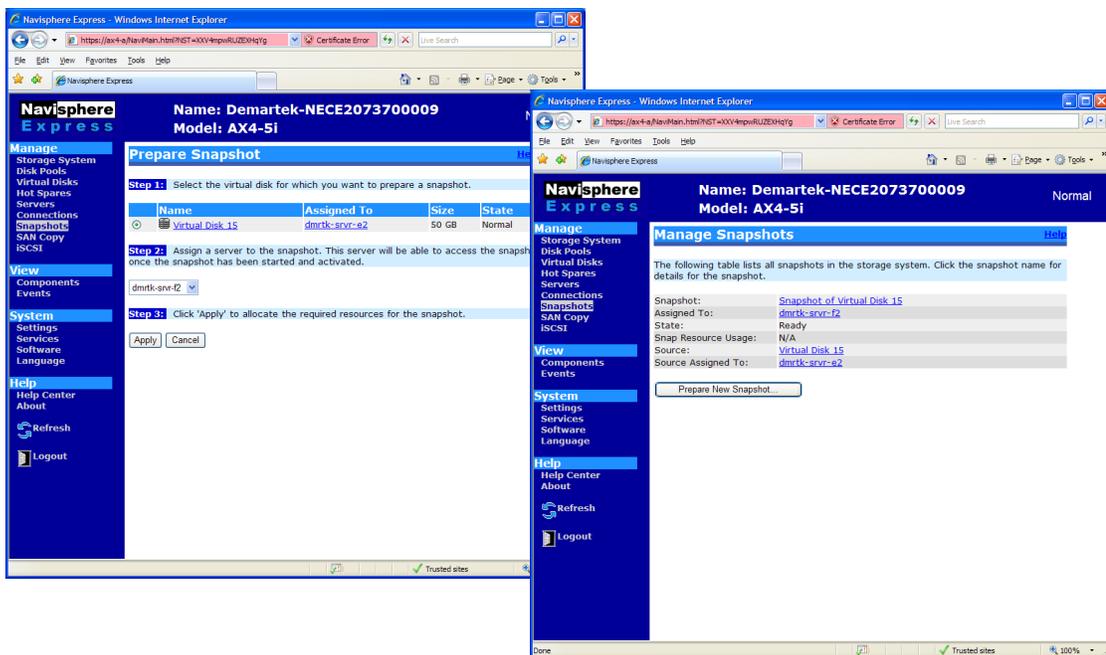
On some occasions, it will be advantageous to move a virtual disk from one disk pool to another disk pool. This may be due to changing performance requirements or to better utilize capacity. This process is also easy to perform. In this example, we migrated virtual disk 9, from disk pool 2 to disk pool 1. This process for migrating the data from SAS drives to SATA drives was accomplished from the AX4 platform, without any intervention required from the host server, and while the volume was mounted by the host server. This “in-the-box” data migration feature is extremely valuable for end-users deploying a mix of SAS and SATA drives within the same system.



Snapshot Local Replication

There are many occasions where it is advantageous to have a “point-in-time” copy of a virtual disk, known as a “snapshot” on the AX4. Snapshots can be used for creating backup copies of data, test copies of data or any other similar purpose. A snapshot copy can be allocated to a secondary server without damaging the source data. The second server has access to data and can read or write to the snapshot copy. Up to 16 snapshots can be created per AX4, with one snapshot per virtual disk.

In this example, we use a 50 GB virtual disk allocated to one server. Using the snapshot feature, we make a copy of this virtual disk and allocate it to a second server. The process is simple and straightforward.



On the hosts, the Navisphere Server Utility is then used to prepare the snapshot on the first server and to allow access to it from the second server.

Summary and Conclusion

As initially stated in the Evaluation Summary, we would like to confirm that the EMC AX4:

- ◆ Is an easy-to-use storage platform
- ◆ Is ideal for customers consolidating storage for the first time
- ◆ Is competitively priced, especially considering the software features included with the base system
- ◆ System scalability and Optional/Advanced software capabilities offers great growth path for end-users.

The AX4 is an easy to configure and easy to use iSCSI storage solution. It provides flexibility for mixing disk drive types in the same system to facilitate storage tiering; as well as easy migration of virtual disks (host volumes) from one type of disk to another and easy expansion of disk pools and virtual disks. Replication using the AX4-based snapshot feature is simple and easy to perform.

With the included PowerPath software, multi-path configurations are straightforward.

Customers who are looking for an entry-level storage consolidation solution should strongly consider the CLARiiON AX4.

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Appendix – Technical Specifications

This report was prepared by Demartek at the Demartek lab facilities in Arvada, Colorado. The AX4 storage system was installed at the Demartek lab and connected to three Demartek servers using an existing Gigabit Ethernet infrastructure.

AX4 Technical Specifications

- ◆ 1 GB memory per SP, write caching only available on dual SP models.
- ◆ 4Gb/sec FC front end or 1 Gb/sec iSCSI front end
- ◆ 2U in height.
- ◆ 2 550W hot swappable power supply/blower modules.

The AX4 installed at the Demartek lab included:

- ◆ Dual-SP
- ◆ iSCSI model with four iSCSI host ports
- ◆ Two disk enclosures
- ◆ 24 disk drives (6 x 750 GB SATA, 18 x 146 GB SAS)