Domain Management with EMC Unisphere for VNX
EMC Unified Storage Solutions

Abstract

EMC® Unisphere® software manages EMC VNX®, EMC Celerra®, and EMC CLARiiON® storage systems. This paper discusses how to use Unisphere 1.3 to configure and manage EMC storage systems in single domains and multi-domains. This paper also discusses domain configurations for different environments and requirements.

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Executive Summary

As storage systems play a greater role in improving application performance, supporting round-the-clock operations, and ensuring business continuity, simplified, secure, and efficient management of these systems becomes critical. EMC® VNX® storage systems address this need using Unisphere 1.3 software. EMC Unisphere® simplifies data manageability of VNX storage systems, as well as legacy (such as CLARiiON®) systems. It also optimizes staff resources by allowing centralized control of multiple storage systems.

Unisphere uses a browser-based user interface (UI) that runs on any operating system that supports the Java Runtime Environment. It provides authorization based on user roles and authentication based on username and password. Unisphere 1.3 allows you to centrally manage several VNX systems using domains. It also allows you to centrally manage VNX and legacy systems using multi domains.

This paper discusses the Unisphere storage domain and multi-domain features and explains how to set up domains and multi-domain connections in different storage environments.

Introduction

EMC Unisphere for VNX is a storage-system-based software that helps you monitor and manage EMC’s VNX, CLARiiON, and Celerra® systems. This paper addresses the features, configuration, and usage of the storage domain feature. It discusses the Unisphere Client and Server software and how these can be leveraged in domain configurations. This paper also provides guidelines on how to set up domains and multi-domain connections depending on the type and location of storage systems.

More information on Unisphere 1.3 security can be found in the Security Configuration Guide for VNX available on EMC Online Support1.

Audience

This whitepaper is intended for customers, systems engineers, EMC partners, members of the EMC and partners professional services community, and anyone interested in learning how to configure and manage domains and multi-domains using Unisphere 1.3 software. It is assumed that the audience has at least a basic understanding of how to manage a VNX system using the Unisphere software.

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1EMC Online Support at http://support.emc.com
**Terminology**

**Domain** – A group of EMC systems that are centrally administered.

**Legacy storage system** – CLARiiON storage system running release 23 and later and Celerra systems running DART 6.0.

**Legacy domain** – A domain composed of legacy systems.

**VNX domain** – A domain composed of VNX systems.

**Domain-of-one** – A domain with one system.

**Multi-domain** – A connection between two or more domains that allows you to manage the domains from one location.

**Local domain** – The domain you are logged in to.

**Remote domain** – A domain that is connected to the local domain through a gateway system.

**Gateway system** – The name and/or IP address of the gateway storage system in a remote domain. The gateway storage system provides the connection between the remote domain and the other domains in a multi-domain configuration.

**Node** – A Storage Processor (SP), off array management station, or Control Station.

**Domain master node** – A node used to distribute and handle global domain operations and settings.

**Role** – The user’s role defines which views and controls are accessible to the user.

**Scope: Global and Local**– There are two scopes: global and local. A global user has access to the entire domain. A local user has access to a single system in the domain

**NTP services** – Network Time Protocol (NTP) sets and synchronizes system time domain wide. Synchronizing timestamps across storage, switches and servers is particularly important when troubleshooting requires access to multiple logs.

**LDAP services** – LDAP users have an account in the LDAP directory, and can access any system that uses the LDAP server to authenticate users.

**Unisphere Client** – Software installed on a Windows server that you can use to manage VNX, CLARiiON and Celerra systems.

**Unisphere Server** – Software installed on a Windows server that emulates a VNX management server. When configured correctly, the Windows server can join VNX domains, and serve as a domain master node. The Unisphere Server can be installed with the Unisphere Client as off array management stations.

**On-demand login** – When a global user does not have identical credentials (scope, username and password) in a remote domain, they gain access to the remote domain through an on-demand login. On-demand login can be used for security reasons, to control the impact of managing distant systems, or minimize management overhead.
Overview of Domains and Multi-Domains

*Domains* were introduced in EMC Navisphere 6.0 in 2001. Domains are user-defined groups of EMC storage systems that facilitate centralized management and easy installations. Each domain is defined by a set of attributes that is stored on each system in the domain. When a new system is added to an existing domain, it automatically inherits the attributes of that domain.

**Legacy domains, VNX domains, and multi-domains**

*Legacy domains* are comprised of CLARiiON systems running FLARE® releases as old as Release 23, and Celerra systems running DART™ 6.0. VNX domains are comprised of VNX systems.

Legacy domains support different user roles and have a different structure to their domain database. For this reason, VNX systems cannot join legacy domains and legacy systems cannot join VNX domains.

However, you can create a *multi-domain*, which is comprised of both legacy and VNX domains.

**Using a single UI to manage the storage systems in domains**

You can manage all of the storage systems in a domain through a single UI (User Interface) that runs on a web browser on your workstation. To access this UI, enter the IP address of a *node* in the domain. (The node can be a Storage Processor or Control Station for any storage system in the domain.)

After you enter the node IP address, a UI applet is downloaded from the node’s storage system to your workstation. Using this UI, you can update domain-wide settings and global-user permissions for the systems in your domain. (Local users are not included in the domain attributes because they are restricted to a particular system.) This process is shown in Figure 1 and Figure 2.
Figure 1: The UI applet is downloaded from a storage system to your workstation

Figure 2: The downloaded UI allows you to communicate with all storage systems in the domain

Using a single UI to manage the systems in multi-domains

Multi-domains allow groups of systems to be viewed in the Unisphere UI as a single list. All of the systems that a user is logged in to appear in the System List and System dropdown menu.
Domain Attributes

Nodes and master nodes

The Storage Processors and the primary Control Station\(^2\) of the systems in a domain are all nodes in the domain. When you configure a domain, you create a *master node*. The master node stores the master copy of the domain administrative data. The master node processes and distributes updated domain database information from and to the other nodes in the domain. If the master node is not available, the other nodes are still able to operate, be managed, and support applications. However, the domain database cannot be updated until either the master node becomes available or a new master node is appointed.

Any Storage Processors in the domain can be the master node\(^3\), there is no release level requirement and any VNX system can be added to a domain even if it is running a higher release or patch level than the domain master. Certain features may be restricted based on the release levels of nodes in the domain, always check release notes.

![Selecting a domain master node](image)

**Figure 3**: Selecting a domain master node

Global users

Global users are users with domain-wide access. Global users are administered on a domain basis. Each domain must have at least one global administrator or security administrator. VNX systems must be in a domain to be configured. When a VNX

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\(^2\) In the case of dual Control Station systems, only the Control Station acting as the primary is a node in the domain.

\(^3\) Control Station nodes cannot be the master node of a domain.
system is removed from a domain, any global administrator or security administrator users are retained. All other global users are erased.

**DNS services**
Configure DNS services at the domain level for all nodes in the local domain. Nodes joining the domain inherit these settings.

**NTP services**
NTP sets and synchronizes system time for systems in the local domain. Synchronizing timestamps across storage, switches, and servers is particularly important when troubleshooting requires access to multiple logs. NTP settings are propagated to all systems in the domain.

**LDAP services**
LDAP services allow user logins to be redirected to Active Directory or LDAP services. User access to the domain can be controlled using these services rather than manually updating global or local users on a domain or system basis. With Unisphere 1.3, LDAP services are configured at the domain level and are propagated to all nodes as a part of the domain database.

**Gateways**
Gateways are the multi-domain connections from the local domain to other domains. These connections are unidirectional.

**Local users**
Local users are administered at the system level. You must be logged in to the system to add or remove local users. Local users persist if the system is removed or added to another domain.

**Configuring Domains**
Configure a domain using the Unisphere UI or Secure CLI™. Domain configuration is a required step in establishing system security. Setting global security as part of the installation procedure creates a domain-of-one. This is now required prior to configuring the resources of a VNX system.

When you add a new system to a domain, it will inherit the attributes of that Domain including all global users, NTP, and LDAP settings.

Alternately, you can create a global administrator or security administrator user to a new unsecure system and make one of the system nodes the domain master and that system will become a domain-of-one. After a system is in a domain, it is secure; only authorized users can manage the system.

When a domain-of-one system is added to another domain, its domain attributes are wiped clean (not local users) and it inherits the settings of the new domain.
If a system is removed from a domain, it defaults to a global administrator and local users and is still secure. However, a domain master node must be appointed before you can add global users. One of the Storage Processors can be promoted to act as a domain master in real time.

**Using Unisphere to configure domains**

Configuring domains is simple; follow these steps to create a domain-of-one for a single system:

1. In your web browser, enter the IP address of a node. (The node can be a Storage Processor or Control Station for one of the systems you want in the domain.)
2. Click **Yes** when a message appears asking if you want to configure global security now. (You must set up global security to configure a VNX system.)
3. Create at least one global administrator or security administrator.
4. Enter any other global or local users.
5. Set the NTP services if required.
6. Set the LDAP services if required.
7. Add other systems to the domain by entering the IP address of a node in that system.

If you select a system that is currently a member of another domain (most systems will initially be in a domain-of-one), you will be prompted to log in to that system to pull that system in to the current domain. Domain attributes will be applied to the new member. Global users in the local domain gain access to any systems that are successfully added to the domain. Any users with a local scope will be retained and available in the new domain.

![Image](image-url)

**Figure 4:** Adding or removing members from the domain
Using Secure CLI to configure domains

VNX systems and domains can be fully configured using Secure CLI. For information on syntax and how to use Secure CLI commands refer to the *EMC VNX for Block Command Line Interface (CLI) Reference*.

To configure domains using Secure CLI, follow these steps:

1. Install the latest version of the Secure CLI Client on the client station.
2. Use the `domain –setmaster` commands to assign a Storage Processor as the master node.
3. Add other members to the domain using the `domain –add` command. The node selected cannot be a member of any other domain. You must remove a node (using the `domain -remove` command) before you can add it to another domain.
Configuring Multi-Domains

Multi-domains allow groups of systems to be viewed in Unisphere as a single list. Multi-domains are the only way to use single pane of glass management of legacy CLARiiON, Celerra, and VNX systems from the Unisphere interface. All the systems that a user is logged in to appear in the System List and the System dropdown list, as shown in Figure 8.

![Figure 8: Multi-domain management](image)

Administrators can set up user credentials to support automatic logins or on-demand logins to remote domains.
Multi-domains allow you to manage multiple domains from a single UI. Multi-domains support a number of important management use cases including:

- Centralizing management of VNX and legacy domains
- Managing replication applications across domains
- Bridging domains of different system types
- Bridging geographic distance
- Compartmentalizing management overhead
- Compartmentalizing systems for security reasons

Appendix B: Multi-Domain Use Cases provides additional examples.

Multi-domains are formed around a local domain. In the local domain, you set up domain connections from the local domain to remote domains. Setting up multi-domain connections is a simple process:

1. Log in to the local domain. Select Manage Multi-Domain Configuration to display the Multi-Domain Management dialog box, as shown in Figure 9.
2. Enter the IP address of a node that resides in the domain to which you would like to connect. (The system that includes this node is the gateway system.)
3. Add a name for the connection.

The gateway permits users with access to the remote domain to connect to and manage all systems in the multi-domain.

The organization of the domains and member systems of each domain are shown in the Domains section of the Enterprise Dashboard. You can non-disruptively set up or change multi-domain connections at any time.
Remember that the version of the UI you are using is determined by the first storage system or client you log in to. Always log in to a system with a Unisphere UI version that is equal to or higher than the highest release of Unisphere running within the multi-domain.

Multi-domain connections are hierarchical. This means that users who have logged in to the local domain can view the remote domains, but not vice versa. Bidirectional multi-domain connections are supported. In this configuration, domains are geographically separated and users in either domain are able to manage all systems. Multi-domain views only extend over a single connection or hop.

**User Attributes and Domains**

In multi-domains, user attributes are an important tool for controlling access to domains and allowing domain members to achieve business objectives. There are three important user attributes:

1. **Credentials** – username and password.
2. **Scope** – local, global, or LDAP
   a. A global user has access to all the storage systems in the domain.
   b. A local user only has access to one system.
   c. If the user has an account in the LDAP directory, this user can access any system that uses the LDAP server to authenticate users.
3. **Roles** – Unisphere authorizes user activity based on the role of the user. Unisphere roles include eight main roles (Operator, Network Administrator, NAS Administrator, SAN Administrator, Storage Administrator, Administrator, Security Administrator, and VM Administrator), and three Data Protection roles (Local Data Protection, Data Protection, and Data Recovery).

Users are managed independently in each domain. A user name may be used in many domains with identical or different attributes.

When the user first logs in to a domain (the local domain), the user scope and role determine what view and which systems the UI presents. For example, if the user is a global user, Unisphere shows the local domain and all of the remote domains in the multi-domain. If the user is a local user, Unisphere only shows the system that this user is logged in to.

If the user has identical credentials and scope in the local domain and a remote domain, the contents of the remote domain are visible to the user after login. This is an **auto login**.

However, if the user scope, username, or password for the local domain is not the same as the credentials for a remote domain in the multi-domain, the remote domain is not visible to the user. Instead, the user must log in to the remote domain before the remote domain appears. This is called an **on-demand** login (Figure 10).
Figure 10: On-demand login

After an on-demand login, if the user is a local user in the remote domain, that user will only see one system in the remote domain. If the user is a global user in the remote domain, that user will see all of the systems in the remote domain.

All of the systems that the user has currently logged into are shown in the Enterprise Dashboard. When the user selects a system, the UI displays a view for that system; the contents of the view are based on the role of the user for the system’s domain. The version of the UI used to view any system remains the version from the initial local domain login.

Table 1: How Scopes and Credentials Affect What the User Sees

<table>
<thead>
<tr>
<th>Local domain scope</th>
<th>Remote domain scope</th>
<th>User credentials</th>
<th>Visibility in the local domain</th>
<th>Visibility in the remote domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>One system only</td>
<td>None</td>
</tr>
<tr>
<td>Global</td>
<td>Global</td>
<td>Identical</td>
<td>All local systems at login</td>
<td>All remote systems at login</td>
</tr>
<tr>
<td>Global</td>
<td>Global</td>
<td>Unique</td>
<td>All local systems at login</td>
<td>All remote systems at login</td>
</tr>
<tr>
<td>Global</td>
<td>Local</td>
<td>Identical or unique</td>
<td>All local systems at login</td>
<td>One system only on demand</td>
</tr>
</tbody>
</table>
Unisphere Client and Server

You can install Unisphere Client and Server on Windows servers to provide a variety of services. The Unisphere Client and Server replace the Off Array Navisphere UI and Server.

The Unisphere Client is essentially the applet that is launched from the management port. Once downloaded and started, you can point it at a Storage Processor or Control Station that is used to manage legacy systems or VNX systems that are not running the latest version of Unisphere. The Client is also useful in reducing startup times when managing geographically distant systems.

The Unisphere Server provides many of the management services that normally run on the storage system. Unisphere Server (versions 1.1.25 and later) can serve as a VNX domain member or master, or as a freestanding management station that performs offline analysis of Analyzer archives. Since it does not support user data, it is easy to update the freestanding management station with the latest version of Unisphere Client and Server code. Domain configurations will persist through upgrades.

Conclusion

Domains and multi-domain connections allow you to associate groups of systems in flexible configurations that meet business needs for security or geographic separation, while maintaining the inherent ease of use of centralized management. Systems can be grouped and regrouped according to function, geography, or security concerns.

Users can be granted access to one or more systems in one or more domains depending on the user’s responsibilities. Domains provide global administration as well as an easy way to manage unified systems.

Multi-domains are a simple but effective way to support a diverse set of configurations. Combined with Domains, multi-domain connections enable efficient and secure management of storage resources throughout the enterprise.

The Unisphere Enterprise Dashboard provides an easy way for a user to access all the systems to which the user has privileges. This carefully-designed dashboard provides an intuitive interface that makes it simple and efficient to manage all of the systems in your environment using a simple interface.
Appendix A: Domain Support for Different Systems

Domain Support for VNX Domains running Unisphere 1.2 or later

Unisphere 1.2.0 introduced Unified Network Services. Unified Network Services incorporates DNS, NTP, and LDAP/AD settings into the Domain Database and apply to Storage Processor nodes and all primary Control Station nodes in the domain. Once set, these services are propagated to any system in the Domain running Unisphere 1.2.0 or later. These settings are inherited if the system is added to a Domain and are erased if the system is removed from a Domain.

Domain Support for VNX systems running Unisphere 1.1.0

Unisphere 1.1.0 was included in the first release of the VNX Operating Environment. Systems running Unisphere 1.1.0 can only be configured as a domain-of-one, and they cannot join other VNX domains. However, they can be used as gateways to VNX domains running Unisphere 1.1.25 and later.

Domain Support for VNX Gateways

VNX Gateways (not to be confused with domain gateways) are only equipped with Control Stations. The domain database does not yet reside on the Control Station; therefore, VNX Gateways cannot form or join a domain.

Domain Support for AX Series storage systems

AX series storage systems can run either Navisphere Express or Navisphere Manager. Navisphere Express is the factory default. Navisphere Manager is an optional upgrade. Navisphere Express is an abbreviated version of Navisphere Manager. It simplifies many tasks without involving the user in the details of the implementation—including domain management operations.

AX series storage systems running Navisphere Express:
- Are automatically configured as a domain-of-one.
- Cannot join domains.
- Can be connected to a Unisphere or Navisphere domain using multi-domains.

AX series systems running Navisphere Manager:
- Are not automatically configured as domains-of-one.
- Can form and join domains. Much like a CX system including over multi-domain connections.
Appendix B: Multi-Domain Use Cases

Using a multi-domain to manage VNX and CLARiiON systems

In this example, assume that you are a business that wishes to centralize management for your onsite VNX and CLARiiON storage systems. You cannot achieve this by creating a single domain with both VNX and CLARiiON systems, because VNX and CLARiiON systems cannot be in the same domain. The solution is to create a multi-domain.

In this example, there are at least two domains: one for the legacy CLARiiON storage systems and one for the VNX systems. To create the multi-domain:

1. Log in to the VNX domain as an administrator.
2. Establish a multi-domain connection from the VNX to the CLARiiON domain.
3. Give the users in both domains identical credentials.
4. Repeat this process for each domain you want to include in the multi-domain.

After you create the multi-domain, you can manage all of the systems in the VNX domain and the CLARiiON domain through one UI. To manage all the systems, you must log in to the VNX domain. Also, it is important to remember to always launch the latest version of Unisphere.
**Using a multi-domain to manage geographically-dispersed systems**

In this example, assume you are a business with systems at two sites that are some distance from each other. In this case, placing all of the systems in a single domain network could adversely affect management response time. To avoid this problem, create domains in both locations, and connect the domains with multi-domain connections in either direction.

If you are careful when you set up credentials, scope, and roles in each domain, the administrator can tune access privileges to meet varying business requirements.

**Figure 12: Geographically dispersed domains**

**Managing replication across domains**

Using multi-domains, you can use replication applications (such as SAN Copy™) to replicate between storage systems in different domains. You have the flexibility to create domains that meet the needs of each geographic location or business unit, while still being able to replicate between these domains.

In this example, assume you are an enterprise with several storage systems in three locations: Los Angeles, Boston, and London. You have a different storage administrator in each location. You wish to use SAN Copy to replicate data from a storage system in one location to a storage system in another location.

The solution is to create a multi-domain:

1. Configure domains in each location.
2. Establish multi-domain connections between the main data center (in this example Boston) and the two satellite offices (Los Angeles and London).
3. Establish a local SAN Copy user account target in your Boston facility.
After you create the multi-domain, users in Los Angeles and London can log in to their local domains, and then log in to the SAN Copy system in Boston. They can do this whenever they need to control both sides of the connection.

There is no need to grant access to all the systems in the main data center. If the satellite offices are geographically remote, the user can control when to invoke the distant connection.

Figure 13: SAN Copy scenario
Appendix C: Domain Enhancements by Release

**Release 26**
LDAP scope and LDAP connectivity added to CX

**Release 30**
Domain management using Secure CLI

**Release 31/7.0**
VNX Domains – VNX Storage Processors and Control Stations are nodes. Global Security must be initialized to configure a VNX. Global Security is retained on removal from a Domain.

**Release 32/7.1**
Unified Network Services NTP, DNS, and LDAP/AD settings for all systems in the VNX Domain are now storage domain database attributes. These settings will be inherited by any system running Unisphere 1.2.0 or later that joins the VNX Domain.