

**NetApp Solution Deployment Guidelines**

**Thomson Reuters – cDOT Base Configuration**

**Synopsis:** This document details the NetApp clustered Data ONTAP (cDOT) base configuration used for various storage solutions within Thomson Reuters.

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**Document Version:** V4

**Date:** October 2013

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Contents

[1 Introduction 4](#_Toc370909108)

[1.1 Management Summary 4](#_Toc370909109)

[1.2 Assumptions 4](#_Toc370909110)

[1.3 Change History 4](#_Toc370909111)

[1.4 Distribution List 5](#_Toc370909112)

[1.5 Glossary 5](#_Toc370909113)

[2 Standards and Naming Conventions 6](#_Toc370909114)

[2.1 Networking 6](#_Toc370909115)

[2.1.1 Required network cabling 6](#_Toc370909116)

[2.1.2 Required IP addresses 6](#_Toc370909117)

[2.2 Naming Conventions 6](#_Toc370909118)

[2.2.1 Network interface group and failover group naming conventions 6](#_Toc370909119)

[2.2.2 Aggregate related naming conventions 6](#_Toc370909120)

[3 Cluster Network Configuration 7](#_Toc370909121)

[3.1 Default network ports by system model 7](#_Toc370909122)

[3.2 Single node clusters 7](#_Toc370909123)

[3.3 Two node switchless clusters 7](#_Toc370909124)

[3.4 CN1610 switched clusters 7](#_Toc370909125)

[4 Storage System Configuration 9](#_Toc370909126)

[4.1 Cluster setup 9](#_Toc370909127)

[4.1.1 Creating a new cluster 9](#_Toc370909128)

[4.1.2 Joining a cluster 9](#_Toc370909129)

[4.1.3 Two node switchless cluster considerations 9](#_Toc370909130)

[4.2 Aggregates 9](#_Toc370909131)

[4.2.1 Dedicated root aggregates 9](#_Toc370909132)

[4.2.2 Data aggregates 9](#_Toc370909133)

[4.3 Networking 10](#_Toc370909134)

[4.3.1 Physical network connections 10](#_Toc370909135)

[4.3.2 Logical interfaces (LIFs) 10](#_Toc370909136)

[4.3.3 Failover groups 11](#_Toc370909137)

[4.4 Vservers 11](#_Toc370909138)

[4.4.1 Node Vservers 11](#_Toc370909139)

[4.4.2 Cluster Vserver 11](#_Toc370909140)

[4.4.3 Data Vservers 11](#_Toc370909141)

[5 Clustered ONTAP configuration CLI examples 12](#_Toc370909142)

[5.1 CN1610 cluster switch configuration 12](#_Toc370909143)

[5.1.1 Set admin password and enable mode password 12](#_Toc370909144)

[5.1.2 Set management IP 12](#_Toc370909145)

[5.1.3 Configure SSH and disable telnet 12](#_Toc370909146)

[5.1.4 Set clock 12](#_Toc370909147)

[5.1.5 Set hostname 12](#_Toc370909148)

[5.1.6 Save configuration 12](#_Toc370909149)

[5.1.7 Check FastPath and RCF version 13](#_Toc370909150)

[5.1.8 Update RCF version 13](#_Toc370909151)

[5.1.9 Diagnostic commands 13](#_Toc370909152)

[5.2 Initial cluster setup 13](#_Toc370909153)

[5.2.1 Creating a new cluster on the first node 13](#_Toc370909154)

[5.2.2 Joining a cluster with additional nodes 13](#_Toc370909155)

[5.2.3 Configuration settings for two node switchless cluster 13](#_Toc370909156)

[5.2.4 Licensing 14](#_Toc370909157)

[5.3 Aggregate creation 14](#_Toc370909158)

[5.3.1 Root aggregate renaming 14](#_Toc370909159)

[5.3.2 Create a standard aggregate with free space reallocation 14](#_Toc370909160)

[5.3.3 Create a FlashPool aggregate with free space reallocation 14](#_Toc370909161)

[5.4 Network configuration 14](#_Toc370909162)

[5.4.1 Disabling Ethernet flowcontrol on data ports 14](#_Toc370909163)

[5.4.2 Creating a LACP IFGRP with data ports 15](#_Toc370909164)

[5.4.3 Adding a VLAN tag to an IFGRP of data ports 15](#_Toc370909165)

[5.4.4 Enabling jumbo frames on an IFGRP of data ports 15](#_Toc370909166)

[5.4.5 Creating a failover group for a data IFGRP with a VLAN tag 15](#_Toc370909167)

[5.4.6 Creating the failover group for management ports 15](#_Toc370909168)

[5.4.7 Applying the failover group for management ports 15](#_Toc370909169)

[5.4.8 Create Intercluster LIF with default route 16](#_Toc370909170)

[5.5 Miscellaneous cluster Vserver configuration 16](#_Toc370909171)

[5.5.1 DNS 16](#_Toc370909172)

[5.5.2 Autosupport 16](#_Toc370909173)

[5.5.3 Timezone configuration 16](#_Toc370909174)

[5.5.4 NTP configuration 16](#_Toc370909175)

[5.5.5 SNMP configuration 16](#_Toc370909176)

[5.5.6 Restricted account for wlstats 16](#_Toc370909177)

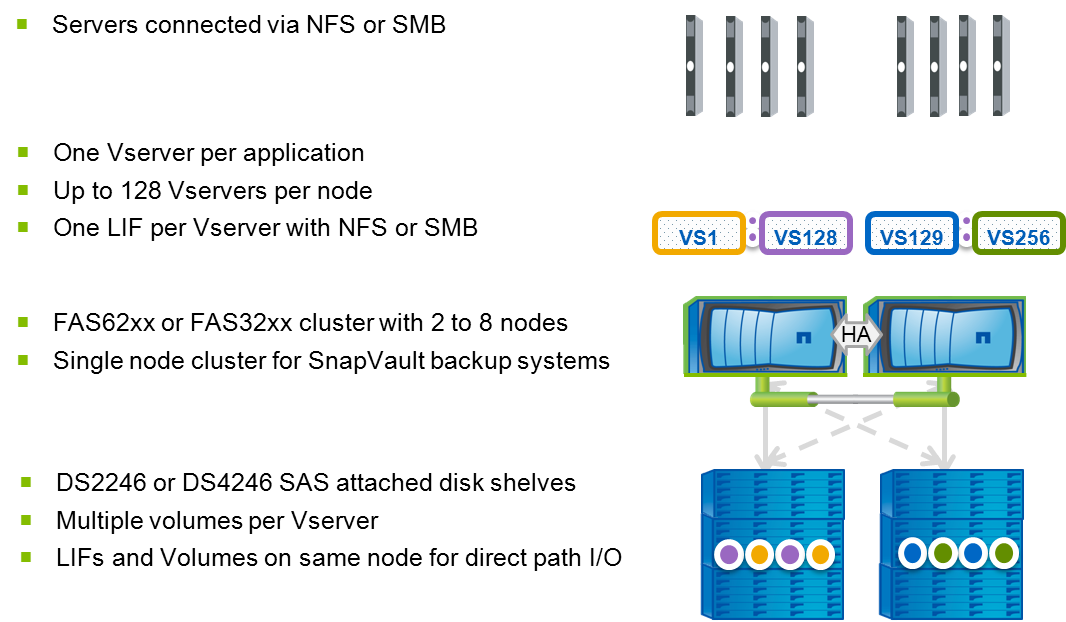
[5.5.7 SSH publickey authentication for cluster admin 17](#_Toc370909178)

[5.5.8 Cluster switch device monitoring commands 17](#_Toc370909179)

# Introduction

## Management Summary

This document details the NetApp clustered Data ONTAP (cDOT) base configuration used for various storage solutions within Thomson Reuters. The majority of the shared storage and dedicated cDOT solution deployments will be configured identically for a number of components, and those common configurations will be described in this document. A typical shared storage cDOT architecture is depicted below.



## Assumptions

It is assumed the person(s) reading this document are conversant with NetApp hardware and software. They will also be conversant with the Linux and Windows operating systems, NFS, iSCSI and CIFS protocols.

## Change History

|  |  |  |  |
| --- | --- | --- | --- |
| **Ver** | **Date** | **Author** | **Key Changes** |
| 1 | September 2013 | Michael Arndt | Initial Version |
| 2 | October 2013 | Michael Arndt | Added standards and naming conventions section, and other minor updates. |
| 3 | October 2013 | Michael Arndt | Minor corrections. |
| 4 | October 2013 | Michael Arndt | Added examples for CN1610 switch monitoring and RCF file updates. |

## Distribution List

|  |  |
| --- | --- |
| **Name** | **Role** |
| Brett Truhler | Customer |
| Stewart Bird | Customer |
| Shawn Carlson | Customer |
| Mitchell Vallone | Reviewer |
| Ken Zola | Reviewer |
| Ian Daniel | Reviewer |
| Riley Johnson | Reviewer |

## Glossary

|  |  |
| --- | --- |
| **Term** | **Definition** |
| cDOT | clustered Data ONTAP |
| Node | One storage controller in a cDOT system. |
| Cluster | A collection of one or more nodes that form a cDOT system. |
| **Vserver** | A logical storage virtual server, also known as a Storage Virtual Machine (SVM), which contains LIFs, Volumes, and configuration information. |
| Node Vserver | Each node in the cluster has a Vserver that can be used to manage the node. Each node Vserver has a node management LIF that does not failover to other nodes if that node is not operational. |
| Admin  Vserver | Each cluster has one cluster management Vserver. This Vserver is typically used to manage the entire cluster, and the LIF for the cluster Vserver is configured to failover to other nodes in the cluster if the node currently hosting the cluster Vserver LIF is not operational. |
| Data Vserver | Clients access data via standard protocols only on Data Vservers. |
| **Port** | A physical network interface on a cDOT system. |
| Node Management Port | The ports used by administrators to connect to and manage a node. Note that the node management LIF can also reside on a data port. |
| Cluster Port | The ports used for intracluster traffic only. By default, each node has two cluster ports on 10-GbE ports enabled for jumbo frames. |
| Data Port | The ports used for data traffic. These ports are accessed by NFS, CIFS, FC, FCoE, and iSCSI clients for data requests. Each node has a minimum of one data port. |
| Intercluster Port | The ports used for cross-cluster communication. An Intercluster LIF can also reside on a data port. |
| **LIF** | Logical Interface – a cDOT logical network interface with an IP address, assigned to a single Vserver. |
| Node-management LIF | The LIF that provides a dedicated IP address for managing a particular node and gets created at the time of creating or joining the cluster. These LIFs are used for system maintenance, for example, when a node becomes inaccessible from the cluster. Node-management LIFs can be configured on either node-management or data ports. |
| Cluster-management LIF | The LIF that is used for intracluster traffic. Cluster LIFs can be configured only on cluster ports. Cluster LIFs must always be created on 10Gb network ports. |
| Cluster LIF | The LIF that is used for intracluster traffic. Cluster LIFs can be configured only on cluster ports. |
| Data LIF | The LIF that is associated with a Vserver and is used for communicating with clients. Data LIFs can be configured only on data ports. |
| Intercluster LIF | The LIF that is used for cross-cluster communication, backup, and replication. Intercluster LIFs can be configured on data ports or intercluster ports. |

# Standards and Naming Conventions

## Networking

### Required network cabling

* Two 1Gb connections per node on the TR management network.
* Two 10Gb connections per node on the TR data network.
* Two 10Gb connections per node for to the private cluster switches, assuming that a switched cluster is being installed.
* Two 1Gb connections **per cluster** on the TR management network for the private cluster switches, assuming that a switched cluster is being installed.

### Required IP addresses

* One IP address per node on the 1Gb management network for the SP.
* One IP address per node on the 1Gb management network for node management.
* One IP address **per cluster** on the 1Gb management network for the cluster Vserver.
* One IP address per node on the 10Gb data network for the Intercluster LIF, assuming SnapVault or SnapMirror replication is required.
* Additional IP addresses on the 10Gb data network for data Vservers.

## Naming Conventions

### Network interface group and failover group naming conventions

* The first interface group on a node should be named *a0a*. Any additional interface groups that are required should be named *a1a*, *a2a*, etc.
* The failover group for the cluster\_mgmt LIF should be named *mgmt*.
* The failover group for the 10Gb data interfaces should be named *data-<vlan>* (for example, *data-2003*).

### Aggregate related naming conventions

* The dedicated root aggregate on each node should be named *<cluster>\_<node>\_root*. For example, *hive\_01\_root*.
* The data aggregate on each node should be named *<cluster>\_<node>\_aggr1*. For example, *hive\_01\_aggr1*. Additional aggregates would be named hive\_01\_aggr2, etc.

# Cluster Network Configuration

## Default network ports by system model

The cluster setup dialog will default to certain ports for the cluster and node management networks. While the cluster network ports can be changed during cluster setup, it is recommended to use the default ports for the sake of consistency in the environment. The following table lists the default 10Gb network ports used for the cluster network, by NetApp system model. The node management ports are also listed, but we will use the e0a port (which is a data port) for node management on all systems at Thomson Reuters.

| **Platform** | **Cluster ports** | **Node management port** | **Data ports** |
| --- | --- | --- | --- |
| 31xx,32xx | e1a, e2a | e0M (e0a data port used at TR) | All other Ethernet ports are data ports |
| 60xx | e5a, e6a | e0f (e0a data port used at TR) | All other Ethernet ports are data ports |
| 62xx | e0c, e0e | e0M (e0a data port used at TR) | All other Ethernet ports are data ports |

## Single node clusters

Single node clusters do not need any cluster network connections. While any of the 10Gb network ports could be used as data ports, it is recommended to leave the default cluster network ports free so that they can be used in the future if the system is ever converted into a multi-node cluster. The SnapVault secondary backup systems in the Thomson Reuters environment will start as single node clusters, and may grow to two node switchless or multi-node switched clusters as capacity requirements increase.

## Two node switchless clusters

Two node switchless clusters are used when a single HA pair forms a cluster, and there are no plans to grow the cluster with additional nodes. In this case, the 10Gb cluster network ports are simply directly connected to the same port on the other controller to form the cluster network. If there is a need to transition to a switched cluster, that can be accomplished with no disruption. The Log Backup solution at Thomson Reuters will typically be configured as two node switchless clusters. If smaller scale shared storage environments are used outside of the main datacenters, these systems may also be configured as two node switchless clusters.

## CN1610 switched clusters

Most of the standard shared storage cDOT environments in the main Thomson Reuters datacenters will be configured as switched clusters, using NetApp CN1610 10Gb switches. A typical cDOT shared storage cluster will initially consist of a high tier HA pair and a low tier HA pair. Based on the current cluster limits and the features used in the Thomson Reuters environment, a given cluster may grow up to 8 nodes.

The CN1610 switches have their configuration set by the NetApp Reference Configuration File (RCF). Each node in the cluster will have one connection to each of the two CN1610 switches used by the cluster. The following table describes the port assignments to be used.

|  |  |  |  |
| --- | --- | --- | --- |
| **CN1610 cluster switch A** | | **CN1610 cluster switch B** | |
| **Switch ports** | **Node/port usage** | **Switch ports** | **Node/port usage** |
| Serviceport/wrench | Management switch | Serviceport/wrench | Management switch |
| 1-8 | Nodes 1-8 cluster port 1 | 1-8 | Nodes 1-8 cluster port 2 |
| 13-16 | ISL to switch B ports 13-16 | 13-16 | ISL to switch A ports 13-16 |

Copper twinax cables up to 5 meters in length or optical LC-LC cables up to 300 meters in length may be used to connect from the cluster nodes to the CN1610 cluster switches. The CN1610 cluster switches should also have a 1Gb connection from the Serviceport (wrench port) to the management network so that any required configuration changes or RCF file updates can be performed over the network. The CN1610 switches are monitored by the nodes in the cluster, and Autosupport is used to notify NetApp support in the event that a CN1610 switch fails.

# Storage System Configuration

## ****Cluster setup****

### Creating a new cluster

You use the Cluster Setup wizard to create the cluster on the first node, via the console mode of the SP connection to the node. The wizard helps you to configure the cluster network that connects the nodes (if the cluster consists of two or more nodes), create the cluster admin Vserver, add feature license keys, and create the node management interface for the first node. To create the first node simply answer with “create” when prompted if you would like to create a new cluster during the cluster setup wizard.

### Joining a cluster

You also use the Cluster Setup wizard to add nodes to the cluster, again via the console mode of the SP connection to the new node. To add a node, simply answer with “join” when prompted if you would like to join an existing cluster during the cluster setup wizard. Note that the cluster network must be properly connected in order for a node to join an existing cluster.

### Two node switchless cluster considerations

If you have a two-node switchless configuration in which there is no cluster interconnect switch, you must ensure that the switchless-cluster-network option is enabled. This ensures proper cluster communication between the nodes. This configuration is performed on the first node of the cluster, prior to joining the second node in the two node switchless cluster.

## ****Aggregates****

### Dedicated root aggregates

Every node in the cluster must have a dedicated 3 disk RAID-DP aggregate for the root volume of the node. Under no circumstances should user data volumes be stored on the root aggregate. In order to maintain consistency and avoid accidental usage of the root aggregate, each root aggregate should be named *<cluster>\_<node>\_root*. For example, *hive\_01\_root*.

### Data aggregates

All non-root aggregates will be used to hold volumes for data Vservers. These aggregates should be configured with the *-free-space-realloc* setting enabled. This setting will cause the aggregate to automatically manage free space for optimal write performance over the life of the aggregate. With the exception of the free space reallocation setting and the use of FlashPool aggregates on some configurations, the aggregate setup on a clustered ONTAP system is very similar to how an aggregate setup was performed in 7 Mode. For most cDOT deployments, we will have a single data aggregate per node. The data aggregate on each node should be named *<cluster>\_<node>\_aggr1* (for example, *hive\_01\_aggr1)*. Additional aggregates would be named *hive\_01\_aggr2*, etc.

## Networking

### Physical network connections

The following table describes the physical network connections that are required for each clustered ONTAP system at Thomson Reuters.

|  |  |  |  |
| --- | --- | --- | --- |
| **Port Role** | **Quantity** | **Port Speed** | **Notes** |
| SP | 1 per node | 1Gb | While not an actual network port within cDOT, each node at TR will have a Service Processor connection on the TR management network. |
| data | 1 per node | 1Gb | The node management LIF will actually reside on a 1Gb data port (e0a) by convention at Thomson Reuters. |
| cluster | 2 per node | 10Gb | Each node must have two 10Gb cluster ports connected to the private cluster switches as described in section 3.1, unless it is a single node cluster. |
| data | 2 per node | 10Gb | Each node must have two 10Gb ports to be used as a data port. These two ports on each node will typically be configured as a LACP interface group and use VLAN tagging as required. If Intercluster LIFs are required for SnapMirror or SnapVault traffic, these will also reside on the 10Gb data port by convention at TR. |

### Logical interfaces (LIFs)

The following table describes the standard configuration of logical interfaces (LIFs) on a clustered ONTAP system at Thomson Reuters. Each LIF will require an IP address from the TR network to be assigned to it (except for the cluster LIFs, which are automatically selected by the system).

|  |  |  |  |
| --- | --- | --- | --- |
| **LIF Role** | **Quantity** | **Port Speed** | **Notes** |
| node-mgmt | 1 per node | 1Gb | Each node has a management LIF, used by the node Vserver, on the TR management network. |
| cluster | 2 per node | 10Gb | Each node must have two cluster LIFs to be used on the cluster network. The IP addresses for these LIFs are private IP addresses that are automatically configured on the system. |
| cluster-mgmt | 1 per cluster | 1Gb | The cluster management LIF requires an IP address on the Thomson Reuters management network. This LIF will float from node to node as required, and is to be used by the cluster Vserver for cluster management. |
| intercluster | 1 per node | 10Gb | Intercluster LIFs are required for SnapMirror or SnapVault traffic and will require an IP address on the TR data nework. |
| data | At least one per Vserver | 10Gb | Each data Vserver will have at least one LIF (and typically only one LIF when serving NFS or CIFS) that requires an IP address on the TR data network for serving data to clients. |

### Failover groups

LIF failover refers to the automatic migration of a LIF in response to a link failure on the LIF's current network port. When such a port failure is detected, the LIF is migrated to a working port. A failover group contains a set of network ports (physical, VLANs, and interface groups) on one or more nodes. A LIF can subscribe to a failover group. The network ports that are present in the failover group define the failover targets for the LIF.

The following table describes the failover groups that must be configured on a clustered ONTAP system at Thomson Reuters.

|  |  |  |  |
| --- | --- | --- | --- |
| **Failover Group Name** | **Ports** | **Port Speeds** | **Notes** |
| mgmt | The e0a port on all nodes | 1Gb | By convention at TR, we will configure the cluster management LIF on the cluster Vserver to be part of a failover group named *mgmt*, which will consist of all the e0a ports in the cluster. |
| data-<vlan> | The a0a-<vlan> ports on all nodes | 10Gb | By convention at TR, we will configure each Vserver data LIF to be part of a failover group named *data-<vlan>*, where *<vlan>* reflects the VLAN id used on a given interface group. As new Vservers and new LIFs are created, they will need to be properly assigned to this failover group. |

In addition to the custom failover groups that we will configure at Thomson Reuters, there is a default failover group named “system-defined”, which is used on LIFs that are not designed to failover between nodes (such as node management LIFs, cluster LIFs, and Intercluster LIFs).

## Vservers

### Node Vservers

Each node has a Vserver that can be used to manage the entire cluster by connecting to a certain node. The node Vserver exists only to provide a management interface in the event that the cluster Vserver is not accessible. Normal day to day management should be performed using the cluster Vserver.

### Cluster Vserver

Each cluster has the concept of one cluster Vserver, which is used to manage the cluster. The cluster Vserver LIF will be configured to automatically failover between nodes in the cluster in the event that the node currently holding the LIF is unavailable. In addition to cluster management, the cluster Vserver is used for support operations such as AutoSupport.

### Data Vservers

All volumes that store end user data are associated with one data Vserver per volume. Multiple data Vservers will typically be configured in a cluster. Each data Vserver must have at least one LIF, and by convention at TR we will typically have only one LIF per Vserver when serving NFS and CIFS traffic on the Vserver.

# Clustered ONTAP configuration CLI examples

## ****CN1610 cluster switch configuration****

### Set admin password and enable mode password

password

enable password <new password>

### Set management IP

serviceport protocol none

network protocol none

serviceport ip <ip addr> <netmask> <gateway>

### Configure SSH and disable telnet

ip ssh protocol 2

config

crypto key generate rsa

crypto key generate dsa

exit

ip ssh server enable

no ip telnet server enable

### Set clock

config

clock set <mm/dd/yyyy>

clock set <hh:mm:ss>

exit

show clock

### Set hostname

hostname <new switch name>

### Save configuration

write memory

### Check FastPath and RCF version

show version

show bootvar

show running-config

### Update RCF version

en

show running-config running-config-<MM-DD-YY>.scr

copy tftp://<tftp\_server\_ip>/CN1610\_CS\_RCF\_v<version>.scr nvram:script CN1610\_CS\_RCF\_v<version>.scr

script list

script apply CN1610\_CS\_RCF\_v<version>.scr

write memory

show running-config

### Diagnostic commands

enable

show port all

show interface <slot/port>

## ****Initial cluster setup****

### Creating a new cluster on the first node

Do you want to create a new cluster or join an existing cluster? {create, join}: create

cluster show

### Joining a cluster with additional nodes

Do you want to create a new cluster or join an existing cluster? {create, join}: join

cluster show

### Configuration settings for two node switchless cluster

set -privilege advanced

network options switchless-cluster modify -enabled true

cluster ha modify -configured true

network options switchless-cluster show

cluster ha show

### Licensing

system license add

system license show

## ****Aggregate creation****

### Root aggregate renaming

storage aggregate rename <root\_aggr> <node>\_root

storage aggregate show

### Create a standard aggregate with free space reallocation

storage aggregate create -aggregate <node>\_aggr1 -nodes <node> -diskcount <diskcount> -raidtype raid\_dp -maxraidsize <raidsize>

storage aggregate modify -aggregate <node>\_aggr1 -free-space-realloc on

storage disk show

storage aggregate show

storage aggregate show –instance

### Create a FlashPool aggregate with free space reallocation

storage aggregate create -aggregate <node>\_aggr1 -nodes <node> -diskcount <diskcount> -raidtype raid\_dp -maxraidsize <raidsize>

storage aggregate modify -aggregate <node>\_aggr1 -free-space-realloc on

storage aggregate modify -aggregate <node>\_aggr1 -hybrid\_enabled true

storage aggregate add-disks -aggregate <node>\_aggr1 -disktype SSD -raidtype raid\_dp -diskcount <count>

## ****Network configuration****

### Disabling Ethernet flowcontrol on data ports

network port modify -node <node> -port <port> -flowcontrol-admin none

network port show -instance

### Creating a LACP IFGRP with data ports

network port ifgrp create -node <node> -ifgrp a0a -mode multimode\_lacp -distr\_func ip

network port ifgrp add-port -node <node> -ifgrp a0a -port <port1>

network port ifgrp add-port -node <node> -ifgrp a0a -port <port2>

network port ifgrp show

### Adding a VLAN tag to an IFGRP of data ports

network port vlan create -node <node> -port a0a -vlan-id <vlan>

network port vlan show

### Enabling jumbo frames on an IFGRP of data ports

network port modify -node <node> -port a0a -mtu 9000

network port show

### Creating a failover group for a data IFGRP with a VLAN tag

network interface failover-groups create -failover-group data-<vlan> -node <node1> -port a0a-<vlan>

network interface failover-groups create -failover-group data-<vlan> -node <node2> -port a0a-<vlan>

network interface failover-groups show

network interface show –failover

### Creating the failover group for management ports

network interface failover-groups create mgmt -node <node1> -port e0a

network interface failover-groups create mgmt -node <node2> -port e0a

network interface failover-groups show

network interface show –failover

### Applying the failover group for management ports

network interface modify -vserver <cluster\_vserver> -lif cluster\_mgmt -failover-group mgmt

network interface show –failover

### Create Intercluster LIF with default route

network interface create -vserver <node\_vserver> -lif <node>\_icl\_lif -role intercluster -home-node <node> -home-port a0a-<vlan> -address <ip> -netmask <netmask>

network routing-groups route create -vserver <node\_vserver> -routing-group d<network>/<mask> -destination 0.0.0.0/0 -gateway <gateway>

network interface show

## ****Miscellaneous cluster Vserver configuration****

### DNS

vserver services dns create -vserver <cluster\_vserver> -domains <domainname> -name-servers <comma\_separated\_IP\_addresses>

vserver services dns show

### Autosupport

system node autosupport modify -node <node> -transport https -proxy-url <proxy:port>

system autosupport show –node <node>

### Timezone configuration

timezone -timezone <timezone>

date

### NTP configuration

system services ntp server create -node <node> -server <ntpserver1>

system services ntp server create -node <node> -server <ntpserver2>

system services ntp server show

### SNMP configuration

snmp community add ro public

snmp

### Restricted account for wlstats

security login role create -role wlstats -cmddirname statistics -access all -vserver <cluster\_vserver>

security login role create -role wlstats -cmddirname version -access all -vserver <cluster\_vserver>

security login create -username wlstats -application ontapi -authmethod password -role wlstats -vserver <cluster\_vserver>

security login show

security login role show

security login role show-ontapi

### SSH publickey authentication for cluster admin

security login create -username admin –vserver <cluster\_vserver> -application ssh -authmethod publickey –role admin

security login publickey create -username admin -vserver <cluster\_vserver> -publickey “<ssh\_publickey>”

security login show

security login publickey show

### Cluster switch device monitoring commands

set advanced

cluster ping-cluster <node>

system health cluster-switch delete -device <switch\_name>

system health cluster-switch create -device <switch\_name> -address <ip> -snmp-version SNMPv2c -community cshm1! -model CN1610 -type cluster-network -disable-monitoring no

system health cluster-switch show