EMC® VNX® Series

Release 8.1

Configuring and Managing Network High Availability on VNX®

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EMC Corporation
Corporate Headquarters:
Hopkinton, MA 01748-9103
1-508-435-1000
www.EMC.com

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Preface

As part of an effort to improve and enhance the performance and capabilities of its product lines, EMC periodically releases revisions of its hardware and software. Therefore, some functions described in this document may not be supported by all versions of the software or hardware currently in use. For the most up-to-date information on product features, refer to your product release notes.

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1 Introduction

This document provides information about network high availability by using three types of virtual devices:

- Fail-Safe Network (FSN) devices
- Ethernet channels
- Link aggregations

This document is part of the VNX information set and is intended for use by network administrators responsible for configuring and maintaining a file storage and network retrieval infrastructure.

Topics included are:

- System requirements on page 8
- Restrictions on page 8
- Cautions on page 8
- User interface choices on page 8
- Related information on page 9

System requirements

Table 1 on page 8 describes the EMC® VNX® software, hardware, network, and storage configurations.

Table 1. System requirements

Software	VNX version 8.1.
Hardware	The network high availability tasks that apply to your system depend on your specific network hardware, such as the network interface cards in the Data Movers and the switches used in your network.
Network	Your switch must support IEEE standard Ethernet, Fast Ethernet, or Gigabit Ethernet and guarantee that packets from a single TCP connection always go through the same link in a single direction. To use link aggregation, the switch requires IEEE 802.3ad protocol support.
Storage	No specific storage requirements.

Restrictions

To convert an Ethernet channel to a link aggregation, first delete the Ethernet channel and then create the link aggregation.

Cautions

If any of this information is unclear, contact your EMC Customer Support Representative for assistance.

⚠ CAUTION EMC does not recommend using the -force option to the server_sysconfig command because this option deletes all interfaces that use the virtual device.

User interface choices

The VNX offers flexibility in managing networked storage based on your support environment and interface preferences. This document describes how to configure VNX network high availability by using the command line interface (CLI). You can also perform most of these tasks by using one of the VNX management applications:

- EMC Unisphere®
- Microsoft Management Console (MMC) snap-ins
- Active Directory Users and Computers (ADUC) extensions

The following documents provide additional information about managing your VNX:

- Unisphere online help
- Application's online help system in the VNX Documentation on EMC Online Support

Installing Management Applications on VNX for File includes instructions on launching Unisphere, and on installing the MMC snap-ins and the ADUC extensions.

Related information

Specific information related to the features and functionality described in this document is included in:

- *Configuring and Managing Networking on VNX*
- *EMC VNX Command Line Interface Reference for File*
- *Parameters Guide for VNX*
- VNX for File man pages

EMC VNX documentation on EMC Online Support

The complete set of EMC VNX series customer publications is available on EMC Online Support. To search for technical documentation, go to http://Support.EMC.com. After logging in to the website, click **Support by Product** and type **VNX series** in the Find a Product text box. Then search for the specific feature required.

VNX wizards

Unisphere software provides wizards for performing setup and configuration tasks. The Unisphere online help provides more details on the wizards.

2 Concepts

The VNX provides network high availability or redundancy by using three types of virtual devices that deal with the problem of link or switch failure:

- FSNs that extend link failover out into the network by providing switch-level redundancy.
- Ethernet channels that enable multiple active Ethernet connections to the same switch to appear as a single link.
- Link aggregation that allows Ethernet ports with similar characteristics to the same switch to be combined into a single virtual device or link.

Topics included are:

- Virtual devices on page 12
- Ethernet channels on page 12
- Link aggregation on page 13
- Switch characteristics of trunking devices on page 14
- Statistical load balancing on page 14
- Comparison of Ethernet channel and link aggregation on page 14
- Fail-Safe Networks on page 15

Virtual devices

A virtual device combines one or more devices on the same Data Mover into a single and logical device, addressable as a unit. FSNs, Ethernet channels, and link aggregations are virtual devices. Ethernet channels and link aggregations are trunking devices. Table 2 on page 12 shows the characteristics of these virtual devices.

Table 2. Virtual device characteristics

Type of virtual device	Component devices	Device prefix
Ethernet channel	Physical devices (port)	trk
Link aggregation[1]	Physical devices (port)	trk
Fail-Safe Network (FSN)	Physical devices (port), Ethernet channels, link aggregations, or any combination of the three	fsn

Ethernet channels

An Ethernet channel is a high-availability feature that enables multiple active Ethernet connections to the same switch to appear as a single link with a single MAC address and potentially multiple IP addresses. Ethernet channels can combine two, four, or eight (must be in multiples of two) Ethernet ports into a single virtual device. If a link is lost in the Ethernet channel, the link fails over to another link within the channel. All traffic on the channel is then distributed across the remaining active links.

While it is possible to obtain higher aggregate data rates within an Ethernet channel than that which can be obtained from a single port, the primary purpose of an Ethernet channel is high availability. Ethernet channels will not increase the bandwidth for a single client-server connection.

Table 3 on page 12 summarizes the Ethernet channel features that the VNX supports.

Table 3. Supported Ethernet channel features

Feature	Description
Ethernet	10/100/1000Base-TX
Fast Ethernet	100Base-TX
Gigabit Ethernet	1000Base-SX
Port bundling	2, 4, or 8 NIC ports can be bundled and treated as a single channel with a single IP address

[1] Uses LACP (802.3ad) protocol.

Table 3. Supported Ethernet channel features *(continued)*

Feature	Description
Internet Protocol (IP) support	Complies with the IP standard

Link aggregation

A link aggregation resembles an Ethernet channel, but uses the Link Aggregation Control Protocol (LACP) IEEE 802.3ad standard. The major goals of the LACP are as follows:

- Flexible configuration — Unlike Ethernet channels, the number of links in a link aggregation is need not be a multiple of two. It can be any number greater than one, up to a maximum of 12.
- Increased availability — The loss of a link within an aggregation reduces the overall bandwidth, but data flow is uninterrupted. LACP monitors the health of each link and can detect types of failures unlike an Ethernet channel.
- Link control configuration — The protocol identifies wrongly connected links, marks them as down, and uses only correctly configured links.
- Deterministic behavior — The protocol has several state machines for each link, ensuring deterministic behavior.
- Transparency — The aggregation appears to be another Ethernet link.
- Industry standard — Link aggregation is defined by the IEEE 802.3ad standard.

The IEEE 802.3ad standard supports link aggregation with one or more ports. If the aggregation uses one port, then the port should be full duplex. If the aggregation uses more than one port, all the ports must have the same speed and be full duplex. If a link with a different speed or a half-duplex link is configured into an aggregated link, it is not allowed to participate in the aggregation. Instead, it is marked as down and not used. For example, if one link is 100 megabits per second and the other three links are 10 megabits per second, the 100 megabits per second link is marked as down. In this case, the link aggregation uses the larger number of slower links. Because the goal of link aggregation is availability, rather than increased bandwidth, the protocol uses the largest number of links with a common speed rather than the links with the fastest speed.

Note: The VNX does not reject establishing an aggregated link that includes ports from both Fast Ethernet and Gigabit Ethernet cards or a combination of copper and optical ports. It configures the aggregated link, but allows only the majority of links of whichever type to participate in the aggregation.

Although link aggregations provide more overall bandwidth than a single port, the connection to any single client runs through one physical port and is therefore limited by the port's bandwidth. If the connection to one port fails, the switch automatically switches traffic to the remaining ports, when applicable. When the connection is restored, the switch automatically resumes by using the port as part of the aggregated link.

Switch characteristics of trunking devices

To use Ethernet channels and link aggregations, a complimentary configuration on the switch is required. The switch must support:

- IEEE standard Ethernet, Fast Ethernet, or Gigabit Ethernet
- IEEE 802.3ad Link Aggregation protocol

Ensure that the switch's trunking implementation guarantees packets from a single TCP connection that always go through the same link in a single direction. Switches might support a number of switching algorithms, that includes IP, TCP, and MAC. Out-of-order packet delivery in a single direction is prevented because of the deterministic nature of frame distribution within switches.

The VNX determines outgoing traffic, while the switch determines incoming traffic. Therefore, neither incoming nor outgoing traffic need to be on the same link.

Note: Consult the documentation accompanying your switch to determine the device's configuration requirements and whether your model supports Ethernet channels and link aggregations. For example, the Ethernet channel implemented in the VNX works in conjunction with the EtherChannel paradigm developed by Cisco Systems. The VNX requires statically configured EtherChannels and does not support the Port Aggregation Protocol (PAgP) from Cisco Systems.

Statistical load balancing

The VNX uses load balancing to distribute frames across links in Ethernet channels and aggregated links. Load balancing works by using a portion of the source and destination MAC addresses to select one of the links. If the same source and destination addresses are used, the same link within the channel or aggregated link is used.

You can configure statistical load balancing by using IP addresses, TCP ports and IP addresses, or MAC addresses. The default method of load balancing is by using IP addresses.

Comparison of Ethernet channel and link aggregation

The information in Table 4 on page 15 will help you determine when to use an Ethernet channel or link aggregation.

Table 4. Comparison of Ethernet channel and link aggregation

Feature	Ethernet channel	Link aggregation
Switch support	The switch must use IEEE standard Ethernet, Fast Ethernet, or Gigabit Ethernet. Ensure that the switches trunking implementation guarantees that the packets from a single TCP connection always go through the same link in a single direction.	The switch must support the IEEE 802.3ad Link Aggregation protocol.
Switch mode	On.	Active.
Link speeds	Allows links of different speeds.	Disables links with a different speed than the majority.
Duplex	Full or half duplex.	Full duplex.
Number of ports	Two, four, or eight ports, up to a maximum of eight. Must be an exponent of two.	Any number of ports greater than 1, up to a maximum of 12.
Availability	No keep-alive mechanism exists to handle broken links physically marked as up.	Better Link Control: LACPDU frames are transmitted on each link in the aggregation to ensure that they are unbroken.
Load balancing	IP (default), TCP, or MAC.	IP (default), TCP, or MAC.

Fail-Safe Networks

A Fail-Safe Network (FSN) is a high-availability feature that extends link failover into the network by providing switch-level redundancy. A FSN appears as a single link with a single MAC address and potentially multiple IP addresses. A FSN can be a port, an Ethernet channel, a link aggregation, or any combination of the three. Each port, Ethernet channel, or link aggregation is considered as a single connection. Only one connection in a FSN is active at a time. All the connections making up the FSN share a single hardware (MAC) address. If the Data Mover detects that the active connection fails, the Data Mover automatically switches to the standby connection in the FSN, and that connection assumes the network identity of the failed connection. To ensure connectivity in the event of a hardware failure, create FSN devices on multiple NICs. The FSN components are connected to different switches. If the switch for the active connection fails, the FSN fails over to a connection by using a different switch, thus extending link failover out into the network.

You can optionally configure one of the connections as primary in a FSN. The Data Mover always uses the primary connection, if available. If the primary connection fails, the Data Mover automatically switches to one of the standby connections. When the primary is again available, the FSN automatically switches back to the primary connection. This is desirable if the primary device is a higher-speed connection or if you prefer a particular device. However, if the primary device becomes unstable, automatically switching back to the primary device might cause the FSN to toggle between the primary device and the standby device.

The Data Mover uses the next standby connection if you do not configure a primary connection. If the active connection fails, the Data Mover switches to the standby connection and continues to use that connection until it fails.

There is no requirement that the connections making up a FSN be the same type, or that the connections be made to the same network switch. For example, a FSN might have a single Gigabit Ethernet port and an Ethernet channel made up of four 100-megabit Ethernet ports.

If a FSN uses an Ethernet channel or link aggregation as a connection, the FSN fails over only when the entire channel or aggregation fails. For example, if one port in a four-port Ethernet channel fails, the switch redirects traffic to the remaining three ports. From the Data Mover's perspective, the channel is still available, so the FSN does not fail over to another connection.

Note: If you want to include either Ethernet channels or link aggregations in FSN devices, configure them before creating the FSN.

Unlike Ethernet channels and link aggregations, FSNs can maintain full bandwidth during a failover.

When the Data Mover detects the loss of the active communications link to the FSN, the connection automatically fails over to an operational standby component of the FSN device. This action is independent of any channel or switch features. If a link within the FSN device goes down, the link fails over to a surviving link, if any, specified in the FSN configuration.

FSN examples

Figure 1 on page 16 shows a FSN device that consists of two NIC ports (A and B) on the same Data Mover connected to the network across different switches.

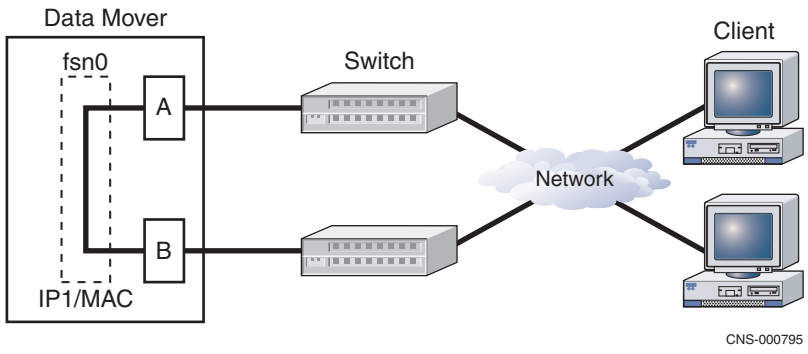

Figure 1. FSN device example

The operation is as follows:

1. If NIC port A is the active connection, then all traffic through the FSN device flows through that port and its switch to the network.

2. If the link signal fails (for example, because of a physical hardware disconnection), the link automatically fails over to the next NIC port in the FSN device (in this example, port B), that uses the same IP and MAC address combination. All traffic then flows through port B and its switch.

Note: If the link port fails, but the link signal is uninterrupted, no failover occurs. This might occur, for example, if the software driver fails but the physical connection continues to function.

Figure 2 on page 17 shows a FSN device consisting of an Ethernet channel comprising the four ports of an Ethernet NIC and one Gigabit Ethernet port. The Gigabit Ethernet port (fge0) is the primary device.

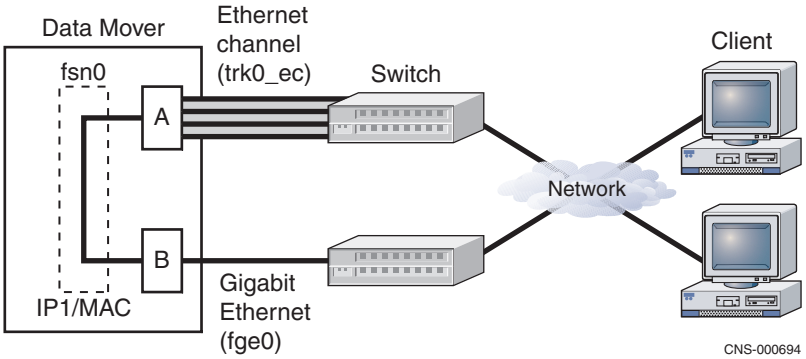

Figure 2. FSN with an Ethernet channel component

The operation is similar to the one in the previous example.

The examples in this section are generic examples of FSN device use and are not definitive. Contact your EMC Customer Support Representative for a detailed analysis of your application's FSN device requirements.

The features of a FSN device are as follows:

- FSN component devices do not have to be the same device type. A single FSN device can include Fast Ethernet devices, Gigabit Ethernet devices, Ethernet channel devices, link aggregations, or a combination of these types, all on the same Data Mover.
- There can be a maximum of four devices in a FSN.
- Only one component device of a FSN device is active at a time.
- All ports in a FSN device share the same IP address and MAC address. The network infrastructure must handle IP and MAC addresses that move from one switch port to another if the active link fails. It is important that all Data Mover ports immediately switch from blocking to forwarding state within the spanning tree. For Cisco switches, enable portfast to Data Mover ports.
- Components of a FSN might be connected to different switches. This is the recommended configuration and prevents the switch from becoming a single point of

failure for the FSN. Optimize your entire network spanning tree according to your switch vendor's recommendations.

- The FSN does not rely on any switch functionality, and therefore, works with switches from any vendor.
- When a port in a FSN device fails, an operational standby device in the same FSN device on the same Data Mover takes over:
  - No primary device specified: The FSN continues by using the secondary connection until it fails.
  - Primary device specified: The FSN automatically switches back to the primary connection when the primary is available again. This configuration can cause a toggle effect if the primary device has intermittent link loss.
- If all the connections in a FSN device fail, the link is down.

Note: If you are using port-based virtual local area networks (VLANs), all the switch ports that the FSN members are connected to must be in the same VLAN. For more information about VLANs, refer *Configuring and Managing Networking on VNX*.

---

3 Configuring

The tasks to configure network high availability are:

- Configure an Ethernet channel on page 20
- Configure link aggregation on page 25
- Configure a FSN device on page 29

Configure an Ethernet channel

If you plan to use an Ethernet channel in a FSN device, do not configure IP addresses for the Ethernet channel here. Doing so makes those interfaces unavailable for use in the FSN device and results in an error message when trying to configure them as part of a FSN device. Assign the IP addresses to the FSN device later when you configure the FSN device.

Configure an Ethernet channel with two Ethernet ports — Example 1

1. Configure the switches in your network to support Ethernet channels. The documentation provided with your switch provides the proper procedure to configure the switches.

   Note: Configure the same mode (set to on) for all ports in the Ethernet channel on the switch. Configuring the ports with different Ethernet channel modes may produce unpredictable results.

2. Ensure that the physical devices to be combined into the Ethernet channel match the speed and duplex settings of the switch. View the speed and duplex settings of the devices on the Data Mover by using this command syntax:

   ```
   $ server_sysconfig <movername> -pci
   ```

   where:

   <movername> = name of the Data Mover on which you plan to configure the Ethernet channel

   Compare the information displayed by this command to the settings on your switch or router.

   Note: Typically, all the physical devices in a channel use the same speed and duplex settings, but if the switch allows a mixture of these settings, the channel must match the requirements of the switch.

   Example:

   ```
   $ server_sysconfig server_2 -pci
   ```

   Output:

```
server_2 : PCI DEVICES:

On Board:
  Agilent Fibre Channel Controller
    0:  fcp-0  IRQ: 22 addr: 50060160306006d1
    0:  fcp-1  IRQ: 21 addr: 50060161306006d1
    0:  fcp-2  IRQ: 18 addr: 50060162306006d1
    0:  fcp-3  IRQ: 20 addr: 50060163306006d1 Broadcom Gigabit Ethernet
 Controller
    0:  fge0  IRQ: 24
    linkneg=enable txflowctl=disable rxflowctl=disable
    0:  fge1  IRQ: 23
    linkneg=enable txflowctl=disable rxflowctl=disable
    0:  cge0  IRQ: 24
    speed=auto duplex=auto txflowctl=disable rxflowctl=disable
    0:  cge1  IRQ: 23
    speed=auto duplex=auto txflowctl=disable rxflowctl=disable
    0:  cge2  IRQ: 26
    speed=auto duplex=auto txflowctl=disable rxflowctl=disable
    0:  cge3  IRQ: 25
    speed=auto duplex=auto txflowctl=disable rxflowctl=disable
    0:  cge4  IRQ: 28
    speed=auto duplex=auto txflowctl=disable rxflowctl=disable
    0:  cge5  IRQ: 27
    speed=auto duplex=auto txflowctl=disable rxflowctl=disable
    0:  cge6  IRQ: 29
    speed=auto duplex=auto txflowctl=disable rxflowctl=disable
```

3. Configure an Ethernet channel that uses statistical load balancing for TCP (the default is IP) on the Data Mover by configuring a virtual device by using this command syntax:

   $ **server_sysconfig** *<movername>* **-virtual -name** *<virtual_device_name>* **-create trk -option "device=***<device>,<device>...* **lb={mac|ip|tcp}"**

   where:

   <movername> = name of the Data Mover on which you are configuring the channel

   <virtual_device_name> = name for the new Ethernet channel

   <device>,<device>... = list of ports to include in the Ethernet channel

   Note: Enclose the devices string, that includes any other specified options in double quotes. Separate the device names using commas and define them in sequence without intervening spaces.

   Example:

   Configure an Ethernet channel called trk0_ec that consists of two Ethernet ports, cge0 and cge1, on server_2 by typing:

   $ **server_sysconfig server_2 -virtual -name trk0_ec -create trk -option "device=cge0,cge1 lb=tcp"**

   Output:

   ```
   server_2 : done
   ```

   This example configures an Ethernet channel called trk0_ec that consists of two Ethernet ports, cge0 and cge1, on server_2. Statistical load balancing is configured to TCP, hich means that it is based on TCP ports and IP addresses. Configure statistical load balancing

on a Data Mover on page 41 provides information about configuring load balancing on a Data Mover.

4. Verify the statistical load balancing by typing:

   $ **server_sysconfig server_2 -virtual -info trk0_ec**

   Output:

```
server_2 :
*** Trunk trk0_ec: Link is Up ***
*** Trunk trk0_ec: Statistical Load Balancing is TCP ***
Device     Link   Duplex  Speed
-------------------------------------------------------
cge0       Up       Full   100 Mbs
cge1       Up       Full  1000 Mbs
```

5. If you use this Ethernet channel as part of a FSN device, stop and go to steps 3 and 4 of Configure a FSN device on page 29.

   Otherwise, assign one or more IP addresses to the Ethernet channel by using this command syntax:

   $ **server_ifconfig** *<movername>* **-create -Device** *<virtual_device_name>* **-name** *<interface_name>* **-protocol IP** *<ipaddr> <ipmask> <ipbroadcast>*

   where:

   <movername> = name of the Data Mover on which you plan to configure the interface (the Data Mover on which you configured the Ethernet channel)

   <virtual_device_name> = Ethernet channel to which you assign an IP address

   <interface_name> = name to use for the interface you configure with this command

   <ipaddr> = IP address to assign to the Ethernet channel

   <ipmask> = subnet address for the Ethernet channel

   <ipbroadcast> = broadcast address for the Ethernet channel

   Example:

   Assign one or more IP addresses to the Ethernet channel, trk0_ec, by typing:

   $ **server_ifconfig server_2 -create -Device trk0_ec -name trk0_ec -protocol IP 10.172.128.114 255.255.255.0 10.172.128.255**

   Output:

```
server_2 : done
```

   Assign one or more IPv6 addresses to the Ethernet channel by using this command syntax:

   $ **server_ifconfig** *<movername>* **-create -Device** *<virtual_device_name>* **-name** *<interface_name>* **-protocol IP6** *<ipv6_ipaddr>[/PrefixLength]*

   where:

<movername> = name of the Data Mover on which you plan to configure the interface (the Data Mover on which you configured the aggregated link)

<virtual_device_name> = aggregated link to which you assign an IPv6 address

<interface_name> = name to use for the interface you configure with this command

<ipv6_addr> = IPv6 address to assign to the aggregated link

[/PrefixLength] = prefix length of the IPv6 address. When prefix length is not specified, the default value of 64 is used.

Example:

Assign one or more IPv6 addresses to the Ethernet channel, trk0_ec, by typing:

```
$ server_ifconfig server_2 -create -Device trk0_ec -name trk0_ec  -protocol IP6
2620:0:170:6973:6e75:6d62:6572:1
```

Output:

```
server_2 : done
```

6. Verify the IP addresses assigned to the Ethernet channel by typing:

```
$ server_ifconfig server_2 trk0_ec
```

Output:

```
server_2 :
trk0_ec protocol=IP device=trk0_ec
  inet=10.172.128.114 netmask=255.255.255.0
broadcast=10.172.128.255
  UP, ethernet, mtu=1500, vlan=0, macaddr=0:60:16:4:33:14
```

Verify the IPv6 addresses assigned to the Ethernet channel by typing:

```
$ server_ifconfig server_2 trk0_ec
```

Output:

```
server_2 :
      trk0_ec protocol=IP6 device=trk0_ec
      inet=2620:0:170:6973:6e75:6d62:6572:1 prefix=64
      UP, ethernet, mtu=1500, vlan=0, macaddr=0:60:16:4:33:14
```

Ethernet channel examples

Table 5 on page 23 shows the server_sysconfig commands used to configure an Ethernet channel on a Data Mover. These examples use the default NIC interface names. If you modified the interface names in your configuration, modify these commands accordingly.

Table 5. Ethernet channel examples

NIC type	Command
Fast Ethernet, single NIC (4-port)	`server_sysconfig server_2 -virtual -n trk0_ec-create trk -option "device=ana0,ana1,ana2,ana3"`

Table 5. Ethernet channel examples *(continued)*

NIC type	Command
Fast Ethernet, dual NICs (4 ports each with 8 ports total)	`server_sysconfig server_2 -virtual -n trk0_ec-create trk -option "device=ana0,ana1,ana2,ana3,ana4,ana5,ana6,ana7"`
Optimal Fast Ethernet, dual NICs (4 ports each with 8 ports total)	`server_sysconfig server_2 -virtual -n trk0_ec-create trk -option "device=ana0,ana1,ana4,ana5"server_sysconfig server_2 -virtual -n trk1_ec-create trk -option "device=ana2,ana3,ana6,ana7"`

Configure two, two-port Ethernet channels — Example 2

In this example, the Data Mover, server_3, has a single, four-port Ethernet interface. Configure two, two-port Ethernet channels as follows: ports cge0 and cge1 in one channel and ports cge2 and cge3 in the second channel.

1. Configure the first Ethernet channel, trk0_ec, on Data Mover server_3 to include Fast Ethernet ports cge0 and cge1 by typing:

   $ **`server_sysconfig server_3 -virtual -name trk0_ec -create trk -option "device=cge0,cge1"`**

   Output:

   ```
   server_3 : done
   ```

2. Configure the second Ethernet channel, trk1_ec, on Data Mover server_3 to include Fast Ethernet ports cge2 and cge3 by typing:

   $ **`server_sysconfig server_3 -virtual -name trk1_ec -create trk -option "device=cge2,cge3"`**

   Output:

   ```
   server_3 : done
   ```

3. Assign an IP address to the first Ethernet channel, trk0_ec, by typing:

   $ **`server_ifconfig server_3 -create -Device trk0_ec -name trk0_ec -protocol IP 192.168.21.206 255.255.255.0 192.168.21.255`**

   Output:

   ```
   server_3 : done
   ```

   Assign an IPv6 address to the first Ethernet channel, trk0_ec, by typing:

   $ **`server_ifconfig server_3 -create -Device trk0_ec -name trk -protocol IP6 2620:0:170:6973:6e75:6d62:6572:1`**

   Output:

```
server_3 : done
```

4. Assign an IP address to the second Ethernet channel, trk1_ec, by typing:

   $ **server_ifconfig server_3 -create -Device trk1_ec -name trk1_ec -protocol IP 192.168.21.207 255.255.255.0 192.168.21.255**

   Output:

   ```
   server_3 : done
   ```

   Assign an IPv6 address to the first Ethernet channel, trk1_ec, by typing:

   $ **server_ifconfig server_3 -create -Device trk1_ec -name trk -protocol IP6 2720:100:001:001:a:b:c:d/64**

   Output:

   ```
   server_3 : done
   ```

Configure link aggregation

If you plan to use link aggregation in a FSN device, do not configure IP addresses for the link aggregation here. Doing so makes those interfaces unavailable for use in the FSN device and results in an error message when trying to configure them as part of a FSN device. Assign the IP addresses to the FSN device later when you configure the FSN device.

1. Configure the switches in your network to support link aggregation. The switch must support the link aggregation protocol, IEEE 802.3ad. Consult the documentation provided with your switch for the proper procedure.

   Note: Configure the same mode (set to active) for all ports in the link aggregation on the switch. Configuring the ports with different modes can produce unpredictable results.

   EMC recommends that the peer switch is set to active mode. According to the 802.3ad protocol, active mode is the only fully compliant mode. In active mode, if there is a change, both sides can synchronize quickly. In addition, there are cases when a fault might be discovered only when both sides are active (the Data Mover side is always active). Therefore, using passive mode might compromise high availability.

2. Verify that the physical devices to be combined into the link aggregation use the same speed and are either full-duplex or auto (default). Also verify that the settings match those of the switch. View the speed and duplex settings of the devices on the Data Mover by using this command syntax:

   $ **server_sysconfig** *<movername>* **-pci**

   where:

   <movername> = name of the Data Mover on which you plan to configure the link aggregation

   Example:

   View the speed and duplex settings of the devices on the Data Mover server_2 by typing:

$ **server_sysconfig server_2 -pci**

Output:

```
server_2 : PCI DEVICES:

On Board:
  Agilent Fibre Channel Controller
    0:  fcp-0  IRQ: 22 addr: 50060160306006d1
    0:  fcp-1  IRQ: 21 addr: 50060161306006d1
    0:  fcp-2  IRQ: 18 addr: 50060162306006d1
    0:  fcp-3  IRQ: 20 addr: 50060163306006d1
  Broadcom Gigabit Ethernet Controller
    0:  fge0  IRQ: 24
    linkneg=enable txflowctl=disable rxflowctl=disable
    0:  fge1  IRQ: 23
    linkneg=enable txflowctl=disable rxflowctl=disable
    0:  cge0  IRQ: 24
    speed=auto duplex=auto txflowctl=disable rxflowctl=disable
    0:  cge1  IRQ: 23
    speed=auto duplex=auto txflowctl=disable rxflowctl=disable
    0:  cge2  IRQ: 26
    speed=auto duplex=auto txflowctl=disable rxflowctl=disable
    0:  cge3  IRQ: 25
    speed=auto duplex=auto txflowctl=disable rxflowctl=disable
    0:  cge4  IRQ: 28
    speed=auto duplex=auto txflowctl=disable rxflowctl=disable
    0:  cge5  IRQ: 27
    speed=auto duplex=auto txflowctl=disable rxflowctl=disable
    0:  cge6  IRQ: 29
    speed=auto duplex=auto txflowctl=disable rxflowctl=disable
```

3. Configure an aggregated link that uses statistical load balancing for TCP (the default is IP) on the Data Mover by using this command syntax:

   $ **server_sysconfig** *<movername>* **-virtual -name** *<aggr_name>* **-create trk -option "device=***<device>,<device>...* **protocol=lacp lb={mac|ip|tcp}"**

   where:

   <movername> = name of the Data Mover on which you plan to configure the link aggregation

   <aggr_name> = name for the new link aggregation

   <device>,<device>... = list of ports to include in the link aggregation

   Note: Enclose the devices string, that includes any other specified options in double quotes. Separate the device names by using commas and define them in sequence without intervening spaces. If double quotes are not used, the command appears to execute, but does not pick up any options that are not contained within the double quotes.

   Example 1:

   Configure the link aggregation named trk0 that uses one port of the Ethernet NIC on server_2 by typing:

   $ **server_sysconfig server_2 -virtual -name trk0 -create trk -option "device=cge0 protocol=lacp"**

Output:

```
server_2 : done
```

In example 1, only one port of the Ethernet NIC on server_2 forms the link aggregation named trk0.

Example 2:

Configure the link aggregation named trk0_la that uses the three ports of the Ethernet NIC on server_2 by typing:

```
$ server_sysconfig server_2 -virtual -name trk0_la -create trk  -option
"device=cge2,cge3,cge4 protocol=lacp lb=tcp"
```

Output:

```
server_2 : done
```

In example 2, three ports of the Ethernet NIC on server_2 are included in the link aggregation named trk0_la and statistical load balancing is configured to TCP.

Configure statistical load balancing on a Data Mover on page 41 provides information about configuring load balancing on a Data Mover.

4. Verify the statistical load balancing, for example 2, by typing:

   ```
   $ server_sysconfig server_2 -virtual -info trk0_la
   ```

   Output:

   ```
   server_2 :
   *** Trunk trk0_la: Link is Up ***
   *** Trunk trk0_la: Timeout is Short ***
   *** Trunk trk0_la: Statistical Load Balancing is TCP ***
   Device     Local Grp   Remote Grp Link  LACP Duplex   Speed
   -----------------------------------------------------------------
   cge2       10000       6400       Up    Up   Full     1000 Mbs
   cge3       10000       6400       Up    Up   Full     1000 Mbs
   cge4       10000       6400       Up    Up   Full     1000 Mbs
   ```

5. To use this link aggregation as part of a FSN device, stop and go to steps 3 and 4 of Configure a FSN device on page 29.

   Assign one or more IP addresses to the link aggregation by using this command syntax:

   ```
   $ server_ifconfig <movername> -create -Device <virtual_device_name> -name
   <interface_name> -protocol IP <ipaddr> <ipmask> <ipbroadcast>
   ```

   where:

   <movername> = name of the Data Mover on which you plan to configure the interface (the Data Mover on which you configured the aggregated link)

   <virtual_device_name> = aggregated link to which you assign an IP address

   <interface_name> = name to use for the interface you configure with this command

   <ipaddr> = IP address to assign to the aggregated link

   <ipmask> = subnet address for the aggregated link

<ipbroadcast> = broadcast address for the aggregated link

Example:

Assign one or more IP addresses to the link aggregation by typing:

```
$ server_ifconfig server_2 -create -Device trk0_la -name trk0_la-protocol IP
10.172.128.116 255.255.255.0 10.172.128.255
```

Output:

```
server_2 : done
```

Assign one or more IPv6 addresses to the link aggregation by using this command syntax:

$ **server_ifconfig** *<movername>* **-create -Device** *<virtual_device_name>* **-name** *<interface_name>* **-protocol IP6** *<ipv6_ipaddr>[/PrefixLength]*

where:

<movername> = name of the Data Mover on which you plan to configure the interface (the Data Mover on which you configured the aggregated link)

<virtual_device_name> = aggregated link to which you assign an IPv6 address

Assign one or more IPv6 addresses to the link aggregation by using this command syntax:

<interface_name> = name to use for the interface you configure with this command

<ipv6_addr> = IPv6 address to assign to the aggregated link

[/PrefixLength] = prefix length of the IPv6 address. When prefix length is not specified, the default value of 64 is used.

Example:

Assign one or more IPv6 addresses to the link aggregation by typing:

```
$ server_ifconfig server_2 -create -Device trk0_la -name trk0_la  -protocol IP6
2620:0:170:6973:6e75:6d62:6572:1
```

Output:

```
server_2 : done
```

6. Verify the IP addresses assigned to the link aggregation by typing:

```
$ server_ifconfig server_2 trk0_la
```

Output:

```
server_2 :
trk0_la protocol=IP device=trk0_la
  inet=10.172.128.116 netmask=255.255.255.0
    broadcast=10.172.128.255
  UP, ethernet, mtu=1500, vlan=0, macaddr=0:60:16:4:35:2f
```

Verify the IPv6 addresses assigned to the link aggregation by typing:

```
$ server_ifconfig server_2 trk0_la
```

Output:

```
server_2 :
      trk0_la protocol=IP6 device=trk0_la
      inet=2620:0:170:6973:6e75:6d62:6572:1 prefix=64
      UP, ethernet, mtu=1500, vlan=0, macaddr=0:60:16:4:35:2f
```

Configure a FSN device

A FSN can be a port, an Ethernet channel, a link aggregation, or any combination of the three.

Configure a FSN using Ethernet ports — Example 1

1. Configure the switches in your network to support the Data Mover connections. You can connect the devices that constitute the FSN device to different switches. Consult the documentation provided with your switch for the proper procedure.

   FSN adds no additional requirements to those of the component devices. For example, a single port configured in a FSN is configured at the switch in the same way as a single port unused in a FSN.

2. Include any Ethernet channels or link aggregations in the FSN by configuring them first using the procedure in Configure an Ethernet channel on page 20 or Configure link aggregation on page 25.

   Note: Do not configure IP addresses for interfaces on the devices to be included in the FSN device prior to configuring the virtual device. This makes those interfaces unavailable for use in the FSN device and results in an error message when you try to configure them as part of a FSN device.

3. Configure the FSN device by using this command syntax:

   ```
   $ server_sysconfig <movername> -virtual -name <fsn_device_name> -create fsn
   -option "[primary=<primary_device>] device=<device>,<standby_device>... [,...]"
   ```

   Note: Enclose the devices string, that includes any other specified options in double quotes. Separate the device names by using commas and define them in sequence with no intervening spaces.

   where:

   <movername> = name of the Data Mover on which to configure the FSN

   <fsn_devicename> = name of the new FSN device

   <primary_device> = name of the primary device

   <standby_device>,... = list of devices to use as standby devices

Note: Do not use "fsn" as the <fsn_device_name>; it is a restricted name.

Example:

To configure the FSN device named fsn0 from the devices cge5 (primary) and cge6 (standby) on Data Mover server_2, type:

```
$ server_sysconfig server_2 -virtual -name fsn0 -create fsn -option "primary=cge5 device=cge6"
```

Output:

```
server_2 : done
```

4. Assign one or more IP addresses to the FSN device by using this command syntax:

   $ **server_ifconfig** *<movername>* **-create -Device** *<fsn_device_name>* **-name** *<interface_name>* **-protocol IP** *<ipaddr> <ipmask> <ipbroadcast>*

   where:

   <movername> = name of the Data Mover on which you plan to configure the interface (the Data Mover on which you configured the FSN device)

   <fsn_device_name> = FSN device to which you are assign an IP address

   <interface_name> = name to use for the interface you are configuring with this command

   <ipaddr> = IP address to assign to the FSN device

   <ipmask> = subnet address for the FSN device

   <ipbroadcast> = broadcast address for the FSN device

   Example:

   Assign the IP address 192.168.21.201 to the FSN device fsn0 by typing:

   ```
   $ server_ifconfig server_2 -create -Device fsn0 -name fsn0 -protocol IP 10.172.128.117 255.255.255.0 10.172.128.255
   ```

   Output:

   ```
   server_2 : done
   ```

   Assign one or more IPv6 addresses to the FSN device by using this command syntax:

   $ **server_ifconfig** *<movername>* **-create -Device** *<fsn_device_name>* **-name** *<interface_name>* **-protocol IP6** *<ipv6_ipaddr>[/PrefixLength]*

   where:

   <movername> = name of the Data Mover on which you plan to configure the interface (the Data Mover on which you configured the aggregated link)

   <fsn_device_name> = FSN device to which you assign an IPv6 address

   <interface_name> = name to use for the interface you configure with this command

   <ipv6_addr> = IPv6 address to assign to the aggregated link

[/PrefixLength] = prefix length of the IPv6 address. When prefix length is not specified, the default value of 64 is used.

Example:

Assign the IPv6 address 3ffe:0000:3c4d:0015:0435:0200:0300:00aa to the FSN device fsn0 by typing:

```
$ server_ifconfig server_2 -create -Device fsn0 -name fsn0  -protocol IP6
3ffe:0000:3c4d:0015:0435:0200:0300:00aa
```

Output:

```
server_2 : done
```

5. Verify the link status and devices assigned to the FSN device by typing:

```
$ server_sysconfig server_2 -virtual -info fsn0
```

Output:

```
server_2 :
*** FSN fsn0: Link is Up ***
active=cge5 primary=cge5 standby=cge6
```

Configure a FSN using an Ethernet channel and an Ethernet port — Example 2

In the example shown in Figure 3 on page 31, the FSN device, fsn0, on the Data Mover, server_4, consists of four ports of a four-port Ethernet NIC, configured as an Ethernet channel, and one Gigabit Ethernet port. The Gigabit Ethernet port (fge0) is the primary device.

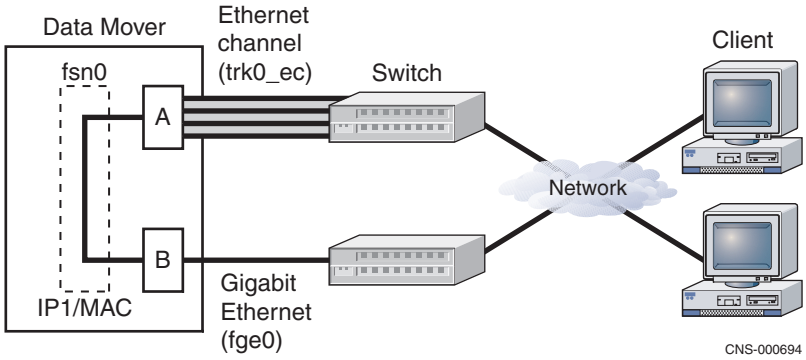

Figure 3. FSN device with Ethernet channel component device

1. Configure the switches in your network to support the Data Mover connections. You can connect the elements of the FSN device to different switches.

Note: The components of an Ethernet channel (or link aggregation) must always connect to the same switch and possibly to a specific group of ports on the switch.

Consult the documentation provided with your switch for the proper procedure.

2. Configure the Ethernet channel virtual device on server_4 from four Ethernet ports by using this command syntax:

```
$ server_sysconfig <movername> -virtual -name <virtual_device_name> -create
trk -option "device=<device>,<device>... lb={mac|ip|tcp}"
```

where:

<movername> = name of the Data Mover on which you plan to configure the channel

<virtual_device_name> = name for the new Ethernet channel

<device>... = list of ports to include in the Ethernet channel

Note: Enclose the devices string, that includes any other specified options in double quotes. Separate the device names by using commas and define them in sequence without intervening spaces.

Example:

Configure the Ethernet channel virtual device on server_4 by typing:

```
$ server_sysconfig server_4 -virtual -name trk0_ec -create trk  -option
"device=cge1,cge2,cge3,cge4 lb=tcp"
```

Output:

```
server_4 : done
```

3. Verify the configuration by typing:

```
$ server_sysconfig server_4 -virtual -info trk0_ec
```

Output:

```
server_4 :
*** Trunk trk0_ec: Link is Up ***
*** Trunk trk0_ec: Statistical Load Balancing is TCP ***
Device     Link Duplex Speed
-----------------------------------------------------------
cge1       Up     Full     1000 Mbs
cge2       Up     Full     1000 Mbs
cge3       Up     Full     1000 Mbs
cge4       Up     Full     1000 Mbs
```

Note: Configure an Ethernet channel on page 20 provides more information.

4. Configure the FSN device fsn0 as a virtual device on the Data Mover server_4 from the Ethernet channel configured in step 2 (trk0_ec) and a Gigabit Ethernet port (ace0) by using this command syntax:

   $ **server_sysconfig** *<movername>* **-virtual -name** *<fsn_device_name>* **-create fsn -option** "[**primary=***<primary_device>*] **device=***<device>*,*<standby_device>*... [,...]"

   where:

   <movername> = name of the Data Mover on which you plan to configure the FSN

   <fsn_device_name> = name of the new FSN device

   <primary_device> = name of the primary device

   <standby_device> = list of devices to use as standby devices

   Note: Enclose the devices string, that includes any other specified options in double quotes. Separate the device names by using commas and define them in sequence without intervening spaces.

   Example:

   Configure a FSN device named fsn0 from the devices fge5 (primary) and trk0_ec (standby) on server_4 by typing:

   $ **server_sysconfig server_4 -virtual -name fsn0 -create fsn -option "primary=fge0 device=trk0_ec"**

   Output:

   ```
   server_4 : done
   ```

5. Assign an IP address to the newly configured virtual device by using this command syntax:

   $ **server_ifconfig** *<movername>* **-create -Device** *<fsn_device_name>* **-name** *<interface_name>* **-protocol IP** *<ipaddr> <ipmask> <ipbroadcast>*

   where:

   <movername> = name of the Data Mover on which you plan to configure the interface (the Data Mover on which you configured the FSN device)

   <fsn_device_name> = FSN device to which you assign an IP address

   <interface_name> = name for the interface you configure with this command

   <ipaddr> = IP address to assign to the FSN device

   <ipmask> = subnet address for the FSN device

   <ipbroadcast> = broadcast address for the FSN device

   Example:

   $ **server_ifconfig server_4 -create -Device fsn0 -name fsn0 -protocol IP 10.172.128.118 255.255.255.0 10.172.128.255**

   Output:

```
server_4 : done
```

Assign an IPv6 address to the newly configured virtual device by using this command syntax:

```
$ server_ifconfig <movername> -create -Device <fsn_device_name> -name <inter
face_name> -protocol IP6 <ipv6_ipaddr>[/PrefixLength]
```

where:

<movername> = name of the Data Mover on which you plan to configure the interface (the Data Mover on which you configured the aggregated link)

<fsn_device_name> = FSN device to which you assign an IPv6 address

<interface_name> = name to use for the interface you configure with this command

<ipv6_addr> = IPv6 address to assign to the aggregated link

[/PrefixLength] = prefix length of the IPv6 address. When prefix length is not specified, the default value of 64 is used

Example:

```
$ server_ifconfig server_4 -create -Device fsn0 -name fsn0  -protocol IP6
3ffe:0000:3c4d:0015:0435:0200:0300:00aa
```

Output:

```
server_2 : done
```

6. Verify the link status and devices assigned to the FSN device by typing:

```
$ server_sysconfig server_4 -virtual -info fsn0
```

Output:

```
server_4 :
*** FSN fsn0: Link is Up ***
active=fge0 primary=fge0 standby=trk0_ec
```

4 Managing

The tasks to manage network high availability are as follows:

- View all virtual devices on a Data Mover on page 36
- View information about a specific virtual device on page 36
- Remove a FSN device on page 38
- Remove an Ethernet channel on page 39
- Remove a link aggregation on page 40
- Configure statistical load balancing on a Data Mover on page 41

View all virtual devices on a Data Mover

Action

To list all virtual devices on a Data Mover, use this command syntax:
`$ server_sysconfig <movername> -virtual`
where:
`<movername>` = name of the Data Mover
Example:
To list all virtual devices on server_2, type:
`$ server_sysconfig server_2 -virtual`

Output

```
server_2 :
Virtual devices:

fsn0    active=cge5 primary=cge5 standby=cge6
trk0_ec    devices=cge0 cge1
trk0_la    devices=cge2 cge3 cge4 :protocol=lacp
fsn    failsafe nic devices : fsn0
trk    trunking devices : trk0_la trk0_ec
```

Note

This example lists the virtual devices for server_2. On this Data Mover, there are three virtual devices: a FSN named fsn0, an Ethernet channel named trk0_ec, and a link aggregation named trk0_la.

View information about a specific virtual device

Action

To obtain detailed information about a specific virtual device, use this command syntax:
`$ server_sysconfig <movername> -virtual -info <device>`
where:
`<movername>` = name of the Data Mover
`<device>` = name of the device
Example:
To obtain detailed information about server_2, type:
`$ server_sysconfig server_2 -virtual -info trk0_la`

Output

```
server_2 :
*** Trunk trk0_la: Link is Up ***
*** Trunk trk0_la: Timeout is Short ***
*** Trunk trk0_la: Statistical Load Balancing is TCP ***
Device     Local Grp   Remote Grp Link LACP Duplex  Speed
-----------------------------------------------------------------
cge2       10000       45110      Up   Up   Full    1000 Mbs
cge3       10000       45110      Up   Up   Full    1000 Mbs
cge4       10000       45110      Up   Up   Full    1000 Mbs
```

Remove a FSN device

To remove a FSN device, first delete any interfaces configured on the device by using the server_ifconfig command. Then delete the FSN device by using the server_sysconfig command.

CAUTION EMC does not recommend using the -force option to the server_sysconfig command because this option deletes all interfaces that use the virtual device.

1. If an interface is configured on the FSN device, remove the interface by using this command syntax:

   ```
   $ server_ifconfig <movername> -delete <fsn_interface_name>
   ```

   where:

   <movername> = name of the Data Mover on which the FSN device exists

   <fsn_interface_name> = name of the interface on the FSN device

   Example:

   ```
   $ server_ifconfig server_2 -delete fsn0
   ```

   Output:

   ```
   server_2 : done
   ```

2. Remove the FSN device by using this command syntax:

   ```
   $ server_sysconfig <movername> -virtual -delete <device>
   ```

   where:

   <movername> = name of the Data Mover on which the device exists

   <device> = name of the FSN device to delete

   Example:

   ```
   $ server_sysconfig server_2 -virtual -delete fsn0
   ```

   Output:

   ```
   server_2 : done
   ```

3. Verify that you removed the FSN device for server_2 by typing:

   ```
   $ server_sysconfig server_2 -virtual
   ```

   Output:

   ```
   server_2 :
   Virtual devices:

   trk0_ec    devices=cge0 cge1
   trk0_la    devices=cge2 cge3 cge4 :protocol=lacp
   fsn    failsafe nic devices :
   trk    trunking devices : trk0_la trk0_ec
   ```

Remove an Ethernet channel

To remove an Ethernet channel device, first delete any interfaces configured on the device by using the server_ifconfig command. Then delete the Ethernet channel device by using the server_sysconfig command.

CAUTION EMC does not recommend using the -force option to the server_sysconfig command because this option deletes all interfaces that use the virtual device.

1. If an interface is configured on the Ethernet channel device, remove the interface by using this command syntax:

   $ **server_ifconfig** *<movername>* **-delete** *<interface_name>*

   where:

   <movername> = name of the Data Mover on which the FSN device exists

   <interface_name> = name of the interface on the Ethernet channel device

   Example:

   $ **server_ifconfig server_2 -delete trk0_ec**

   Output:

   ```
   server_2 : done
   ```

2. Remove the Ethernet channel device by using this command syntax:

   $ **server_sysconfig** *<movername>* **-virtual -delete** *<device>*

   where:

   <movername> = name of the Data Mover on which the device exists

   <device> = name of the Ethernet channel device to delete

   Example:

   $ **server_sysconfig server_2 -virtual -delete trk0_ec**

   Output:

   ```
   server_2 : done
   ```

3. Verify that you removed the Ethernet channel for server_2 by typing:

   $ **server_sysconfig server_2 -virtual**

   Output:

   ```
   server_2 :
   Virtual devices:

   trk0_la    devices=cge2 cge3 cge4 :protocol=lacp
   fsn    failsafe nic devices :
   trk    trunking devices : trk0_la
   ```

Remove a link aggregation

To remove a link aggregation device, first delete any interfaces configured on the device by using the server_ifconfig command. Then delete the link aggregation device by using the server_sysconfig command.

CAUTION EMC does not recommend using the -force option to the server_sysconfig command because this option deletes all interfaces that use the virtual device.

1. If an interface is configured on the link aggregation, remove the interface by using this command syntax:

   $ **server_ifconfig** *<movername>* **-delete** *<interface_name>*

   where:

   <movername> = name of the Data Mover on which the FSN device exists

   <interface_name> = name of the interface on the link aggregation

   Example:

   $ **server_ifconfig server_2 -delete trk0_la**

   Output:

   ```
   server_2 : done
   ```

2. Remove the link aggregation device by using this command syntax:

   $ **server_sysconfig** *<movername>* **-virtual -delete** *<device>*

   where:

   <movername> = name of the Data Mover on which the device exists

   <device> = name of the link aggregation device to delete

   Example:

   $ **server_sysconfig server_2 -virtual -delete trk0_la**

   Output:

   ```
   server_2 : done
   ```

3. Verify that you removed the link aggregation for server_2 by typing:

   $ **server_sysconfig server_2 -virtual**

   Output:

   ```
   server_2 :
   Virtual devices:

   fsn     failsafe nic devices :
   trk     trunking devices :
   ```

Configure statistical load balancing on a Data Mover

To configure all Ethernet channels or link aggregations on a Data Mover to use the same method of statistical load balancing, use the trunk LoadBalance parameter.

You can configure statistical load balancing by IP addresses, TCP ports and IP addresses, or MAC addresses. The default method is by IP addresses.

If you use the server_sysconfig command to specify a load balancing value for a specific Ethernet channel or link aggregation differing from the per-Data Mover setting, that value overrides the one set with the LoadBalance parameter. Configure an Ethernet channel on page 20 and Configure link aggregation on page 25 provide information about using the load balancing with the server_sysconfig command.

Note: Restart the Data Mover to have these settings take effect.

Action
To enable statistical load balancing based on TCP ports and IP addressing, use this command syntax: $ **server_param** *<movername>* **-facility** *<facility_name>* **-modify** *<param_name>* **-value** *<new_value>* where: *<movername>* = name of the specified Data Mover *<facility_name>* = name of the facility to which the parameter belongs; facility names are case-sensitive *<param_name>* = name of the parameter; parameter names are case-sensitive *<new_value>* = value to set for the specified parameter (ip (default), tcp, or mac) Example: To set the LoadBalance parameter to tcp, type: $ **server_param server_2 -facility trunk -modify LoadBalance -value tcp**
Output
server_2 : done

5 Troubleshooting

As part of an effort to continuously improve and enhance the performance and capabilities of its product lines, EMC periodically releases new versions of its hardware and software. Therefore, some functions described in this document may not be supported by all versions of the software or hardware currently in use. For the most up-to-date information on product features, refer to your product release notes.

If a product does not function properly or does not function as described in this document, contact your EMC Customer Support Representative.

Problem Resolution Roadmap for VNX contains additional information about using EMC Online Support and resolving problems.

Topics included in this chapter are:

- EMC E-Lab Interoperability Navigator on page 44
- Tips for Ethernet channels and link aggregations on page 44
- Tips for FSNs on page 45
- Error messages on page 45
- EMC Training and Professional Services on page 46

EMC E-Lab Interoperability Navigator

The EMC E-Lab™ Interoperability Navigator is a searchable, web-based application that provides access to EMC interoperability support matrices. It is available on EMC Online Support at http://Support.EMC.com. After logging in, in the right pane under **Product and Support Tools**, click **E-Lab Navigator**.

Tips for Ethernet channels and link aggregations

When diagnosing problems with Ethernet channels and link aggregations, remember traffic might not travel over the same link in both directions. Traffic might come in over one link and leave over another. However, if a Data Mover uses a TOE network interface card, inbound and outbound traffic travels through the same port. Using the same port is critical because TOE devices store part of the TCP state. For every inbound connection to a TOE device, the system transfers the outbound connection to the port used by the switch for the inbound connection.

You can determine if the system is using a TOE device by using the server_sysconfig -pci command. If a TOE device is present, the output is: Alacritech Gigabit TOE.

To change the traffic flow for a TOE device, change the port that your switch uses. The Data Mover accommodates that change. The documentation for your switch provides information about changing the port your switch uses.

One of the best tools for diagnosing problems with virtual devices is the server_sysconfig -virtual -info command.

If communication with some network nodes seems to function properly while communication with other nodes functions poorly or not at all, there is a probability that one or more of the switch ports to which the physical ports of the virtual device are connected is not configured consistently with the other ports. To diagnose this problem:

1. Disconnect the network cables attached to ports that are part of the virtual device in question, one by one at the Data Mover.
2. Each time you disconnect a cable, use the switch commands to verify that one of the virtual device's physical links becomes disabled due to the loss of the link:
   - For any cable disconnection that does not cause the physical link to become disabled, that port on the Data Mover is not connected to a physical port of the switch, which is part of the same virtual device.
   - This indicates a misconfiguration of the switch or cabling not matching the switch configuration.

To verify that the Data Mover and switch configurations match:

1. In turn, physically connect each port of the virtual device, as defined on the switch, as the only connected port of the virtual device.

2. While that port is the only connected port, generate traffic from the Data Mover (for instance, by using the server_ping command) and ensure:
   - The Data Mover is communicating successfully through that port of the virtual device. If communication fails, the virtual device configuration on the Data Mover does not match that of the switch for this port.
   - The MAC address reported in every case is the same address that the switch learned on the logical port of the virtual device.
3. Generate traffic on any other ports configured on the Data Mover that is not a part of the virtual device in question:
   - The switch should learn the same MAC address on the switch port of the virtual device.
   - If more than one MAC address is reported on the switch port of the virtual device, a port on the Data Mover that is not part of the virtual device is connected to a switch port that is part of the virtual device.

Tips for FSNs

If the devices of a FSN are connected to different switches, it is critical that all switch ports of the FSN be configured to immediately switch from blocking mode to forwarding mode and not pass through spanning tree states of listening and learning when an interface comes up. On Cisco switches, this means the portfast capability must be enabled for each of the ports connected between the switch and the constituent devices of the FSN.

This is necessary to guarantee that the switch forwards the Ethernet frame that the Data Mover generates when a physical link is enabled. This is done on a port-to-port basis. The portfast variable, when enabled, causes the port to immediately switch from blocking to forwarding mode. Do not use portfast on switch-to-switch connections.

If you notice a FSN device toggling between components, it might be because a primary device is configured and the primary device is having intermittent failures.

Error messages

All event, alert, and status messages provide detailed information and recommended actions to help you troubleshoot the situation.

To view message details, use any of these methods:

- Unisphere software:
  - Right-click an event, alert, or status message and select to view Event Details, Alert Details, or Status Details.
- CLI:

- Type nas_message -info <MessageID>, where <MessageID> is the message identification number.

- *Celerra Error Messages Guide*:
  - Use this guide to locate information about messages that are in the earlier-release message format.

- EMC Online Support:
  - Use the text from the error message's brief description or the message's ID to search the Knowledgebase on EMC Online Support. After logging in to EMC Online Support, locate the applicable **Support by Product** page, and search for the error message.

EMC Training and Professional Services

EMC Customer Education courses help you learn how EMC storage products work together within your environment to maximize your entire infrastructure investment. EMC Customer Education features online and hands-on training in state-of-the-art labs conveniently located throughout the world. EMC customer training courses are developed and delivered by EMC experts. Go to EMC Online Support at http://Support.EMC.com for course and registration information.

EMC Professional Services can help you implement your system efficiently. Consultants evaluate your business, IT processes, and technology, and recommend ways that you can leverage your information for the most benefit. From business plan to implementation, you get the experience and expertise that you need without straining your IT staff or hiring and training new personnel. Contact your EMC Customer Support Representative for more information.

Glossary

D

device
Two types of devices are physical (port) and virtual.

See also *virtual device*.

E

Ethernet channel
High-availability feature that enables multiple active Ethernet connections to the same switch to appear as a single link with a single MAC address and potentially multiple IP addresses.

F

Fail-Safe Network (FSN)
High-availability feature that extends link failover out into the network by providing switch-level redundancy. A FSN appears as a single link with a single MAC address and potentially multiple IP addresses.

failover
Process of immediately routing data to an alternate data path or device to avoid interrupting services in the event of a failure. The impact to service is dependent on the application's ability to handle the change gracefully.

Fast Ethernet
Any Ethernet specification with a speed of 100 Mb/s. Based on the IEEE 802.3u specification.

G

Gigabit Ethernet
Any Ethernet specification with a speed of 1000 Mb/s. IEEE 802.3z defines Gigabit Ethernet over fiber and cable, which has a physical media standard of 1000Base-X (1000Base-SX short wave, 1000Base-LX long wave) and 1000Base-CX shielded copper cable. IEEE 802.3ab defines Gigabit Ethernet over an unshielded twisted pair (1000Base-T).

I

Internet Protocol (IP)
Network layer protocol that is part of the Open Systems Interconnection (OSI) reference model. IP provides logical addressing and service for end-to-end delivery.

IP interface
Named logical entity representing a physical device (a port) or a virtual device (a combination of physical devices) and used to assign an IP address to the device. There may be multiple IP interfaces associated with a single device.

L

link
Working data connection between systems on a network. Also, a connection between two or more ports.

link aggregation
High-availability feature based on the IEEE 802.3ad Link Aggregation Control Protocol (LACP) standard which allows Ethernet ports with characteristics similar to the same switch to combine into a single virtual device, or link with a single MAC address and potentially multiple IP addresses.

P

port
Physical connection point to a network or a number used at the transport layer to track host-to-host virtual circuits.

S

standby device
Device held in reserve against a failure of its active partner. When the active device fails, the standby device takes over.

T

TCP Offload Engine (TOE)
TOE network interface card offloads TCP protocol stack processing from the host and helps improve network performance and reduce CPU utilization.

Transmission Control Protocol (TCP)
Connection-oriented transport protocol that provides reliable data delivery.

trunk
Set of physical network devices bundled together for high availability. Ethernet channels and link aggregations are trunks.

V

virtual device
Combination of multiple physical devices defined by a single MAC address.

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