



Cisco[®] Catalyst 3750 and 2970 Switches Using Switches with a PS Series Group

Abstract

This Technical Report describes how to use Cisco Catalyst 3750 and 2970 switches with a PS Series group to create a high performance and highly available iSCSI SAN.

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Table of Contents

Technical Report Revision Information	1
Cisco Revision Information	1
Introduction	1
Basic Steps	2
Understanding Switch and Server Recommendations	3
Spanning-Tree	3
Flow Control	4
Unicast Storm Control	5
Jumbo Frames	5
VLANs	6
Catalyst 3750 and 2970 Switch Configuration	6
Cisco Switch Interfaces	7
Enabling the PortFast Option to Configure STP Edge Ports	7
Configuring Flow Control	8
Disabling Unicast Storm Control	9
Configuring Jumbo Frames	9
Documentation and Customer Support	11

Technical Report Revision Information

The following table describes the release history of this Technical Report.

Technical Report Revision	Date	Change
1.0	4/19/2005	Initial release.

Cisco Revision Information

The following table shows the Cisco 3750 and 2970 Series switch software versions used for the preparation of this Technical Report.

Vendor	Model	Software Revision	Software Image
Cisco	WS-C3750G-24TS	12.2(20)SE4	C3750-I9-M
Cisco	WS-C2970G-24T-E	12.1(19)EA1d	C2970-I6L2-M

Introduction

This Technical Report describes how to use Cisco Catalyst 3750 and 2970 switches with a PS Series group to create a high-performance and highly-available iSCSI SAN.

The Cisco Catalyst 3750 switch is an innovative product that can be used in a SAN to provide highly scalable network connectivity. Featuring Cisco StackWise™ technology, the switch improves SAN efficiency by combining ease-of-use, scalability, and the highest resiliency available for stackable switches.

Cisco Catalyst 2970 switches are affordable Gigabit Ethernet switches that deliver wire-speed, intelligent services for small and medium businesses and enterprise branch offices. Featuring a complete set of services, the Catalyst 2970 switches can enhance network performance and increase productivity for today's knowledge workers by intelligently scaling beyond 100 Mbps over existing Category 5 copper cabling.

EqualLogic storage solutions offer a fundamental change in iSCSI SAN implementation. By configuring PS Series storage arrays into a PS Series group, both large and small businesses can incrementally deploy a modular and affordable iSCSI SAN solution that easily scales to hundreds of terabytes.

Built on ground-breaking, patented architecture, PS Series storage arrays deliver enterprise-quality performance and reliability for all major operating systems. Intelligent automation and seamless virtualization of a single pool of group storage greatly simplify storage management. PS Series storage arrays also provide a comprehensive set of high-level features, in addition to fully redundant, hot-swappable hardware.

Figure 1: PS Series Storage Array



Use the recommendations in this Technical Report for proper connectivity and configuration of Cisco Catalyst 3750 and 2970 switches and PS Series storage arrays to dramatically improve iSCSI SAN performance and data availability.

Basic Steps

Follow these recommended basic steps to use Cisco Catalyst 3750 and 2970 switches with PS Series storage arrays to create a high-performance and highly-available iSCSI SAN:

1. Set up a PS Series group and create volumes in the group. See the PS Series *QuickStart* or *Group Administration* manual for information. Also, see the *Network Connection and Performance Guidelines* Technical Report on the EqualLogic Customer Support website for detailed information about how to improve performance when using a PS Series group.
2. Set up the Cisco Catalyst 3750 and 2970 switches that will handle iSCSI traffic between servers and the PS Series group members (storage arrays). Be sure to follow these recommendations, listed in order of significance:

- It is recommended that you do not use Spanning-Tree (STP) on switch ports that connect end nodes (iSCSI initiators or storage array network interfaces). If you want to use STP or RSTP (preferable to STP), enable Cisco's PortFast option on each switch port that connects end nodes. PortFast will reduce network interruptions that occur when devices restart.

Note that the use of Spanning-Tree for a single-cable connection between switches is encouraged, as is the use of trunking for multiple-cable connections between switches.

- It is recommended that you configure Flow Control on each switch port that handles iSCSI traffic. PS Series storage arrays will correctly respond to Flow Control if enabled on a switch. If your server is using a software iSCSI initiator and NIC combination to handle iSCSI traffic, you must also enable Flow Control on the NICs to obtain the performance benefit.
- It is recommended that you disable unicast storm control on each switch that handles iSCSI traffic. However, the use of broadcast and multicast storm control is encouraged.
- Configure Jumbo Frames on each switch that handles iSCSI traffic. If your server is using a software iSCSI initiator and NIC combination to handle iSCSI traffic, you must also enable Jumbo Frames on the NICs to obtain the performance benefit (or reduce CPU overhead) and ensure consistent behavior.

Notes: Do not enable Jumbo Frames on switches unless Jumbo Frames is also configured on the NICs; otherwise, behavior may be inconsistent.

To simplify troubleshooting initial deployments, make sure that NICs, switches, and PS Series storage arrays are fully operational before enabling Jumbo Frames on the switches and NICs.

- Use VLANs to separate iSCSI SAN traffic from other network traffic. PS Series storage arrays do not support VLAN tagging.

Detailed information about the previous recommendations is provided later in this document.

3. Set up the servers that will access the PS Series group volumes. Servers require an installed iSCSI initiator to access group volumes, which are seen on the network as iSCSI targets. A server can use a software iSCSI initiator and network interface card (NIC) combination or an iSCSI HBA to access group volumes. See the PS Series *QuickStart* or *Group Administration* manual for information about connecting to volumes.

When configuring a software iSCSI initiator and NIC combination on a server, follow these recommendations:

- It is recommended that you enable Flow Control on each NIC that handles iSCSI traffic. Flow Control must also be enabled on the switches that handle iSCSI traffic to obtain the performance benefit.
- Enable Jumbo Frames on each NIC that handles iSCSI traffic. Jumbo Frames must also be enabled on the switches that handle iSCSI traffic to obtain the performance benefit (or reduce CPU overhead) and ensure consistent behavior.

Notes: Do not enable Jumbo Frames on NICs unless Jumbo Frames is also configured on the switches that handle iSCSI traffic; otherwise, behavior may be inconsistent.

To simplify troubleshooting initial deployments, make sure that NICs, switches, and PS Series storage arrays are fully operational before enabling Jumbo Frames on switches and NICs.

Detailed information about the previous recommendations is provided later in this document.

Understanding Switch and Server Recommendations

The following sections provide more information about the switch and server recommendations for creating a high-performance and highly-available iSCSI SAN using Cisco Catalyst 3750 and 2970 switches and PS Series storage arrays.

Spanning-Tree

For switch ports that connect end nodes (iSCSI initiators or storage array network interfaces), it is recommended that you do not use Spanning-Tree (STP). However, if you want to use STP or RSTP (preferable to STP) for switch ports that connect end nodes, it is recommended that you

enable Cisco's PortFast option on each switch port. PortFast will reduce network interruptions that occur when devices restart.

Note: The use of Spanning-Tree for a single-cable connection between switches or the use of trunking for multiple-cable connections between switches is encouraged.

Spanning-Tree Protocol (IEEE 802.1d) is a link management protocol that prevents loops in an Ethernet network by ensuring that only one active path exists between switches. Upon link up, a switch performs a 30 to 50 second STP calculation to transition ports into forwarding or blocking state. During this time, no user data passes through the ports. The result is that links will take longer to come online. This can cause long failover times when recovering from a network switch or PS Series storage array control module failover.

Rapid Spanning Tree Protocol (RSTP; IEEE 802.1w) allows a switch port to bypass the Spanning-Tree listening and learning states and quickly enter the STP forwarding state. In order to achieve fast convergence on a port, RSTP relies upon two variables: edge ports and link type. Switch ports connecting end nodes (iSCSI initiators and storage array network interfaces) should be configured as edge ports to take advantage of RSTP features. However, *do not* connect other hubs, switches, concentrators, or bridges to edge ports, because this may cause infinite packet loops.

Some switches have port settings that allow the immediate transition of the port into STP forwarding state upon link up. If you are using STP or RSTP, these settings should be enabled on ports that connect end nodes (iSCSI initiators and storage array network interfaces). For example, Cisco enhanced the original 802.1d STP specification with a proprietary feature called PortFast, which immediately transitions a port into STP forwarding state upon link up. If you are using STP or RSTP, switch ports that are connected to end nodes should be configured as edge ports using the PortFast command. However, *do not* connect other hubs, switches, concentrators, or bridges to these ports, because this may cause infinite packet loops.

See your switch documentation for information on Spanning-Tree, in addition to ***Error! Reference source not found.*** in this document.

Flow Control

EqualLogic recommends that you enable Flow Control on the switch ports that handle iSCSI traffic. In addition, if a server is using a software iSCSI initiator and NIC combination to handle iSCSI traffic, you must also enable Flow Control on the NICs to obtain the performance benefit.

On many networks, there can be an imbalance in the network traffic between the devices that send network traffic and the devices that receive the traffic. This is often the case in SAN configurations in which many servers (initiators) are communicating with storage devices. If senders transmit data simultaneously, they may exceed the throughput capacity of the receiver. When this occurs, the receiver may drop packets, forcing senders to retransmit the data after a delay. Although this will not result in any loss of data, latency will increase because of the retransmissions, and I/O performance will degrade.

Flow Control allows the receiver to instruct the sender to "throttle back" when the receiver senses that it is being overwhelmed by packets. The receiver does this by sending "pause frames" to the sender, which causes the sender to slow packet transmission for a short period of time. This allows the receiver to process its backlog so it can later resume accepting input. However, the amount of

delay introduced by this action is dramatically less than the overhead caused by TCP/IP packet retransmission.

See your switch and NIC documentation for information on enabling Flow Control, in addition to *Enabling the PortFast Option to Configure STP Edge Ports* in this document.

Unicast Storm Control

A traffic “storm” occurs when a large outpouring of packets creates excessive network traffic that degrades network performance. Many switches have traffic storm control features that prevent ports from being disrupted by broadcast, multicast, or unicast traffic storms on physical interfaces. These features typically work by discarding network packets when the traffic on an interface reaches a percentage of the overall load (usually 80 percent, by default).

Because iSCSI traffic is unicast traffic and can typically utilize the entire link, it is recommended that you disable unicast storm control on switches that handle iSCSI traffic. However, the use of broadcast and multicast storm control is encouraged.

See your switch documentation for information on disabling unicast storm control, in addition to *Disabling Unicast Storm Control* in this document.

Jumbo Frames

EqualLogic recommends that you enable Jumbo Frames on the switch ports that handle iSCSI traffic. In addition, if a server is using a software iSCSI initiator and NIC combination to handle iSCSI traffic, you must also enable Jumbo Frames on the NICs to obtain the performance benefit (or reduce CPU overhead) and ensure consistent behavior.

Ethernet traffic is transported in units called frames. A standard Ethernet frame allows up to 1500 bytes of data to be transferred in a single Ethernet transaction. Jumbo Frames extend Ethernet frames to 9000 bytes and allow more data to be transferred with each Ethernet transaction.

A PS Series storage array automatically supports standard Ethernet frames and Jumbo Frames up to 9000 bytes (9018 including the TCP header itself). (This is sometimes referred to as the “Alteon standard.”) PS Series storage arrays also support path MTU, which is the ability to automatically detect the maximum frame size between TCP/IP end points.

Note: To take advantage of Jumbo Frames, *all* devices in the network path between servers and the PS Series group—including the switches and the NICs used to access volumes—must have Jumbo Frames enabled.

Switches configured for Jumbo Frames will support both standard Ethernet frames and Jumbo Frames. However, if a NIC is configured for Jumbo Frames, but the switch is not, you may experience inconsistent behavior. The switch will function properly if the frames are small, but once the NIC attempts to send frames larger than 1500 bytes, the switch will not be able to handle the frames and will drop them. Also, if some switches are configured for Jumbo Frames, but others are not, you may experience inconsistent behavior if routing changes occur after the connection has been established.

Many low and mid-range network switches do not support Jumbo Frames. On switches that do support them, the feature is usually disabled by default, so you need to manually enable it.

Usually, VLANs must be enabled in order to enable Jumbo Frames on switches. See the switch documentation for details, in addition to *Configuring Jumbo Frames* in this document.

VLANs

EqualLogic recommends that you use virtual LANs (VLANs) to enable network switches to separate iSCSI SAN traffic from other network traffic. VLANs provide benefits similar to those of separate network switches, but with fewer physical switches and less management overhead. Because VLANs use logical rather than physical connections, they are flexible to operate.

Note: PS Series storage arrays do not support VLAN tagging.

Typically, VLANs are separate subnets in TCP/IP networks, so connectivity between VLANs usually requires L3 routing, which is a capability of the Cisco Catalyst 3750 and 2970 switches. VLANs also support different network settings, including Jumbo Frames. See *Jumbo Frames* for more information.

Separating iSCSI SAN traffic from LAN traffic also allows you to enable switch-based security enhancements, including port blocking, address filtering, etc.

Catalyst 3750 and 2970 Switch Configuration

The following sections provide information about configuring Cisco Catalyst 3750 and 2970 switches. For additional information, see:

- Cisco Catalyst 3750 switch:

Website: <http://www.cisco.com/en/US/products/hw/switches/ps5023/index.html>

Documentation: <http://www.cisco.com/univercd/cc/td/doc/product/lan/cat3750/index.htm>

- Cisco Catalyst 2970 switch:

Website: <http://www.cisco.com/en/US/products/hw/switches/ps5206/index.html>

Documentation: <http://www.cisco.com/univercd/cc/td/doc/product/lan/cat2970/index.htm>

Also, see the following manuals:

- Cisco Catalyst 3750 Switch *Software Configuration Guide*:

http://www.cisco.com/application/pdf/en/us/guest/products/ps5023/c2001/ccmigration_09186a008017ed8d.pdf

- Cisco Catalyst 2970 Switch *Software Configuration Guide*:

<http://www.cisco.com/univercd/cc/td/doc/product/lan/cat2970/12119ea1/2970scg/2970scg.pdf>

Cisco Switch Interfaces

For Cisco Catalyst 3750 and 2970 switches, an interface name is composed of three parts that are formatted as follows:

slot_number/interface_module_number/port_number

The variables are as follows:

- *slot_number* - The switch slot in which the interface module is installed. Module slots are numbered 0 to 12, from top to bottom. In the case of the Cisco 3750 switch, the first switch in a stack is slot number 1; then, the slot numbers increase by one for each switch added to the stack. In the case of the Cisco 2970 switch, the slot number is always 1. If not specified in a command, the default value will be the slot or switch to which you are currently connected.
- *interface_module_number* - The number of the interface module for this port. When the module consists of a single card or, in the case of the Cisco 3750 and 2970, this number is always 0.
- *port_number* - The port number on the interface module or, in the case of the Cisco 3750 and 2970, the port number on the switch. Also, keep in mind that, for some commands, you can assign several ports at once by using wildcards, such as 1/0/1-12 for the first twelve ports on module 0, switch 1.

Enabling the PortFast Option to Configure STP Edge Ports

To configure STP edge ports on Cisco Catalyst 3750 and 2970 switches, you must enable the PortFast option. PortFast minimizes the time that ports must wait for Spanning-Tree to converge and should only be used on ports connected to end nodes (end stations), including iSCSI initiators and storage array network interfaces.

Caution: Connecting hubs, concentrators, switches, or bridges to a port that has PortFast enabled can cause temporary spanning-tree loops. You should not enable PortFast on these ports.

The following example shows how to enable PortFast on Gigabit Ethernet interface 0/1 on switch 1:

```
Switch> enable
Switch# config t
Switch(config)# int gigabit 1/0/1
Switch(config-if)# spanning-tree portfast
Switch(config-if)# exit
Switch(config)# exit
Switch# copy running-config startup-config
```

To view or confirm Port Fast status on a port, use the following command.

```
Switch# show spanning-tree interface gigabitethernet0/1
```

Note: You can use the `spanning-tree portfast default` global configuration command to globally enable the PortFast feature on all nontrunking ports.

This example shows how to globally enable PortFast by default on all access ports:

```
Switch# config t
Switch(config)# spanning-tree portfast default
Switch(config)# end
Switch# copy running-config startup-config
```

See the *Cisco Catalyst 3750 Switch Software Configuration Guide* or the *Cisco Catalyst 2970 Switch Software Configuration Guide* for information on configuring Spanning-Tree Protocol.

For additional information on understanding and configuring Spanning-Tree Protocol on Catalyst switches, see:

http://www.cisco.com/en/US/tech/tk389/tk621/technologies_configuration_example09186a008009467c.shtml

Configuring Flow Control

This section describes how to configure Flow Control on Cisco Catalyst 3750 and 2970 switches. You must enable Flow Control on each switch port that handles iSCSI traffic.

Note: Cisco Catalyst 3750 and 2970 switch ports are capable of receiving, but not sending, pause frames.

The following commands shows how to configure Gigabit Ethernet interface 0/1 on switch 1 to auto-negotiate the correct Flow Control setting with the device to which it is connected:

```
Switch> enable
Switch# configure terminal
Switch(config)# interface gigabitethernet1/0/1
Switch(config-if)# flowcontrol receive desired
Switch(config-if)# exit
Switch(config)# exit
Switch# copy running-config startup-config
```

To view or confirm Flow Control status on a port, use the following command:

```
Switch# show flowcontrol interface gigabitethernet1/0/1
```

See the *Cisco Catalyst 3750 Switch Software Configuration Guide* or the *Cisco Catalyst 2970 Switch Software Configuration Guide* for detailed information on configuring Flow Control.

Disabling Unicast Storm Control

This section describes how to disable unicast storm control on Cisco Catalyst 3750 and 2970 switches.

The following example shows how to disable unicast storm control on Gigabit Ethernet interface 0/15 on switch 1 and verify the configuration:

```
Switch> enable
Switch# configure terminal
Switch(config)# interface gigabitethernet1/0/15
Switch(config-if)# no storm-control unicast level
Switch(config-if)# exit
Switch(config)# exit
Switch# copy running-config startup-config
```

To view or confirm storm control status on a port, use the following command.

```
Switch# show storm-control gigabitethernet1/0/15 unicast
Interface  Filter State    Level    Current
-----
Gi2/0/15   inactive          100.00%  N/A
```

For more information on configuring port-based traffic control on Catalyst switches, see:

http://www.cisco.com/en/US/products/hw/switches/ps5023/products_configuration_guide_chapter09186a008021272b.html

Configuring Jumbo Frames

On Cisco Catalyst 3750 and 2970 switches, you cannot set the MTU size for an individual interface. Instead, you must set it for all Gigabit Ethernet interfaces on the switch, or for all interfaces in a VLAN. When you change the MTU size, you must reset the switch before the new configuration takes effect. If you enter a value that is outside the allowed range for the specific type of interface, the value is not accepted.

Use the following commands to configure Jumbo Frames, which sets the maximum packet size to 9000 bytes, on Cisco Catalyst 3750 and 2970 switches:

```
Switch> enable
Switch# config t
Switch(config)# system mtu jumbo 9000
Switch(config)# exit
Switch# copy running-config startup-config
Switch# reload
```

The following example shows the output when you try to set Gigabit Ethernet interfaces to an out-of-range number:

```
Switch(config)# system mtu jumbo 25000
                        ^
% Invalid input detected at '^' marker.
```

Once the switch reloads, you can verify your settings by entering the `show system mtu` privileged EXEC command. For example:

```
Switch> enable
Switch# configure t
Switch(config)# show system mtu
Switch(config)# exit
```

The commands shown next are used to enable an individual VLAN to use Jumbo Frames. Note that you cannot enable Jumbo Frames on VLAN 1 on the 3750 or 2970 switch, so you must start with VLAN 2.

```
Switch# vlan database
Switch(vlan)# vlan 2 mtu 9000
Switch(vlan)# exit
```

The following commands configure Gigabit Ethernet interface 0/7 on switch 1 into VLAN 2:

```
Switch# config t
Switch(config)# int gigabitethernet 1/0/7
Switch(config-if)# switchport access vlan 2
Switch(config-if)# exit
Switch(config)# exit
Switch# copy running-config startup-config
```

To view or confirm MTU size on a port, use the following command.

```
Switch# show interface gi 1/0/7
```

For more information on configuring Jumbo Frames or Giant Frames on Catalyst switches, see:

http://www.cisco.com/en/US/products/hw/switches/ps700/products_configuration_example09186a008010edab.shtml

Documentation and Customer Support

Visit the EqualLogic Customer Support website, where you can download the latest documentation and firmware. You can also view FAQs, the Knowledge Base, and Tech Reports and submit a service request.

EqualLogic PS Series storage array documentation includes the following:

- *Release Notes*. Provides the latest information about PS Series storage arrays and groups.
- *QuickStart*. Describes how to set up the hardware and start using a PS Series storage array.
- *Group Administration*. Describes how to use the Group Manager GUI to manage a PS Series group. This manual provides comprehensive information about product concepts and procedures.
- *CLI Reference*. Describes how to use the Group Manager command line interface to manage a group and individual arrays.
- *Hardware Maintenance*. Provides information on maintaining the PS Series storage array hardware.

To access the Customer Support website, from the EqualLogic website (www.equallogic.com), click **Support** and log in to a support account. If you do not have an account, create one by clicking the link under the login prompt.

To contact customer support, send e-mail to supportnp@equallogic.com. If the issue is urgent, call 1-877-887-7337 to speak with a member of the customer support team.