Dell™ EqualLogic™ Configuration Guide

A guide to building an iSCSI based SAN solution with Dell™ EqualLogic™ PS Series Arrays

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Release Notes

January 2009	➢ Initial release of *Dell EqualLogic Configuration Guide*
February 2009	➢ Added o M1000e Integration

1 Introduction

The *Dell™ EqualLogic™ Configuration Guide* is provided as an aid to help storage administrators determine how best to build an iSCSI infrastructure for use within an EqualLogic SAN solution. This document will focus on configuration best practices, connection rules, general switch configuration parameters, and other helpful information. This document should not be considered a statement of support for any specific configuration. Actual viability of any configuration will depend on the capabilities of the individual components (switches, initiators, etc.) that make up the SAN infrastructure. This document should be used strictly as a guide in planning an EqualLogic SAN solution.

2 EqualLogic Infrastructure Requirements

Dell will support any switch infrastructure component within an EqualLogic SAN solution assuming it meets minimum standards (Defined in Appendix A) required to support high-performance iSCSI traffic. Dell will provide full support to resolve customer issues within the SAN solution. If an infrastructure component is identified as causing an issue, the customer may be required to directly contact that component vendor for further support.

3 Network Configuration and Design Considerations

Each control module has three network interface ports, labeled eth0, eth1, and eth2. A dual control module array provides three pairs of network interfaces. For example, eth0 on Control Module 0 (CM0) and eth0 on Control Module 1(CM1) is a pair. Only one port in a pair is active for I/O at one time. All ports are considered active on a single controller at a time.

In addition to the requirements and recommendations described in the following tables, all the usual rules for proper network configuration apply to the group members. General network configuration is beyond the scope of this document.

Requirement	Description
At least one network connection	An array must have at least one functioning network interface connected to a network (through a network switch, if possible). When you run the setup utility, you will assign an IP address and subnet mask to this interface.
Connectivity to group IP address	Each array must have at least one functioning network interface that is on the same subnet as the group IP address.
Switch connectivity	In a single-subnet group in which the arrays are connected to multiple switches, there must be network connectivity between the switches.
Flow Control enabled on switches and NICs	Enable Flow Control on each switch port that handles iSCSI traffic. 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 any performance benefit. PS Series storage arrays will correctly respond to Flow Control.

Table 1: Network Requirements

Recommendation	Description

Recommendation	Description
Redundant network Paths	Using a multi-pathing solution helps to ensure that no single point of failure exists between hosts and arrays. MPIO implementations should be available for most modern operating system environments.
For replication, a reliable, adequately sized network link	For effective and predictable replication, be sure that the network link between the primary and secondary groups is reliable and provides sufficient bandwidth for copying data.
No STP functionality on switch ports that connect end nodes	Do not use Spanning-Tree (STP) on switch ports that connect end nodes (iSCSI initiators or storage array network interfaces). However, if you want to use STP or Rapid STP (preferable to STP), you should enable the port settings available on some switches that let the port immediately transition into STP forwarding state upon link up. This functionality can reduce network interruptions that occur when devices restart, and should only be enabled on switch ports that connect end nodes. **Note:** The use of Spanning-Tree when using multiple independent single-cable connection between switches is encouraged. **Note:** Using native Link Aggregation "trunking" functionality between non-stacking switches rather than multiple, independent, single-cable connections is highly encouraged.
Jumbo Frames enabled on switches and NICs	Enable Jumbo Frames on each switch that handles iSCSI traffic. If your server is using a software iSCSI initiator and NIC combination, you must also enable Jumbo Frames on the NICs that handle iSCSI traffic to obtain any performance benefit and ensure consistent behavior.
VLANs	Configure switches to use VLANs in order to separate iSCSI SAN traffic from other network traffic.
Switched Gigabit Ethernet network	Connect arrays and hosts to a switched network and ensure that all network connections between hosts and arrays are Gigabit Ethernet. An array can operate at 10 and 100 Mbps, but performance will be significantly degraded.
Access to the group IP address	In a multi-subnet group, each configured network interface should have access to the subnet on which the group IP address resides.
Multiple network Connections	Connect multiple network interfaces on an array (to different switches, if possible). You can configure the interfaces (assign an IP address and subnet mask) after adding the array to the group.
Unicast Storm Control	Disabled unicast storm control on on each switch that handles iSCSI traffic.

Table 2: Network Recommendations

4 General Infrastructure Configuration

Dell recommends that all EqualLogic SAN solutions be configured for full redundancy. The following table identifies all opportunities for redundancy:

Component	Redundant Configuration
Hosts	Two or more network interface ports attached to the SAN. Each port should be connected to a different switch within the SAN. MPIO software solution enabled for redundancy
SAN Switches	Two or more switches configured for inter-switch communications with standard ports for uplink or stacked using proprietary stacking technology.
EqualLogic Array	Each array should have at least one port from each controller connected to each switch.

Table 3: Redundancy Definitions

Based on these definitions, the following sections will further define the connection recommendations for the primary component connections within the SAN infrastructure. While full redundancy in all SAN components is recommended, non-redundant connections are provided for those situations where full redundancy is not viable.

4.1 Array to Switch Infrastructure

4.1.1 Single Switch/Single Array Controller

Single controller arrays can connect to one or more switches within the SAN infrastructure. For the single array controller/single switch solution, one, two or more array controller ports should be connected to the switch as illustrated in Figure 1. These connections must not be aggregated in any way.

Note: This configuration does not provide a fully redundant storage infrastructure from host to array. Additional components are required for full redundancy.

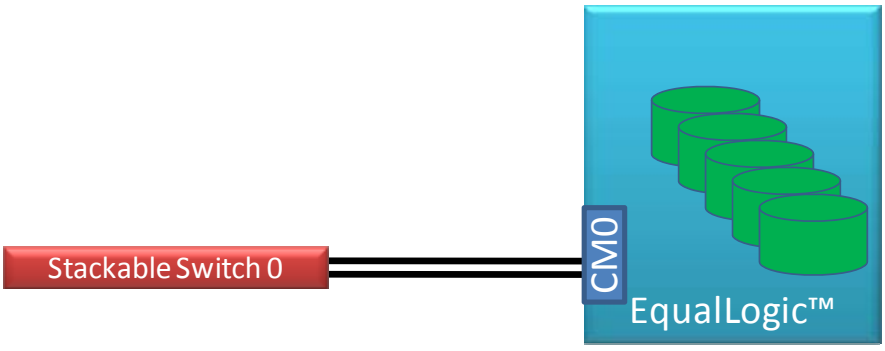

Figure 1: Single Controller Array to Single Switch Configuration

4.1.2 Single Switch/Dual Array Controller

For dual controller arrays connecting to a single Ethernet switch, one, two or more ports from controller CM0 should be connected to the switch. In addition, at least one port from array controller CM1 should also be connected to the switch. All three ports from CM1 can be connected to the switch to ensure that there is no performance decrease if

there is a failure in CM0. This will provide a redundant path to the array should an array controller fail as shown in Figure 2.

Note: This configuration does not provide a fully redundant storage infrastructure from host to array. Additional components are required for full redundancy.

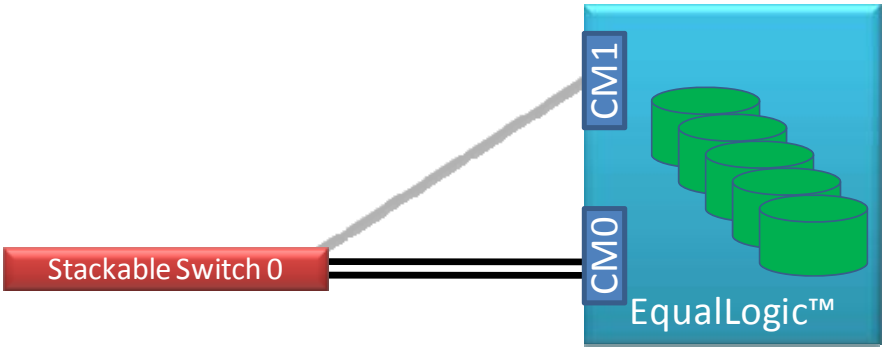

Figure 2: Dual Controller Array to Single Switch Configuration

4.1.3 Dual Switch/Single Array Controller

Single controller arrays can be connected to redundant switches as shown in Figure 3. Ensure that at least one port from CM0 is connected to the second switch. The two switches must be connected together via stacking connections or uplinking ports that are aggregated together to provide equivalent bandwidth based on the active CM0 ports connected to the SAN.

Note: This configuration does not provide a fully redundant storage infrastructure from host to array. Additional components are required for full redundancy.

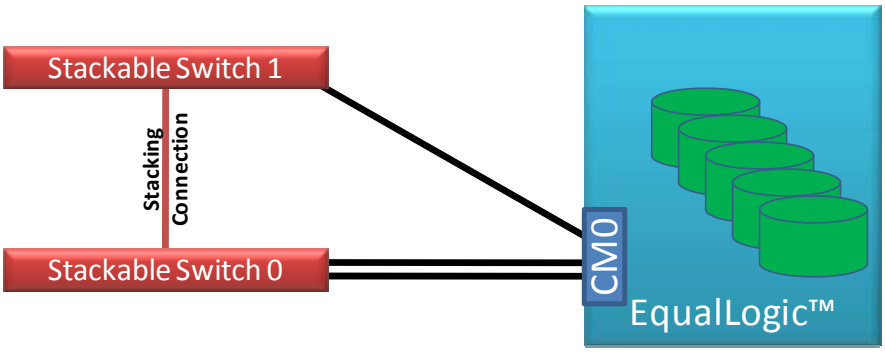

Figure 3: Dual Switch Array to Single Controller Configuration

4.1.4 Dual Switch/Dual Array Controller

Dual controller arrays should be configured such that two ports on Controller 0 attach to one switch and the third port connects to a second switch. Two ports on Controller 1 should connect to the second switch and the third port should connect to the first switch. The complete diagram in Figure 4 illustrates this connection requirement.

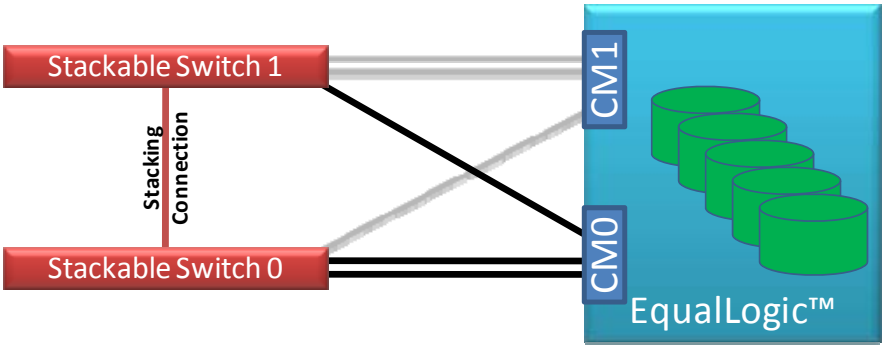

Figure 4: Dual Controller Array/ Dual Switch Configuration

NOTE: It is highly recommended that all components and connections within an EqualLogic SAN should be redundant in nature.

4.2 Host to Switch Infrastructure

Host computers should be configured with one or more network interface controllers (NICs) dedicated to iSCSI SAN communications or with one or more iSCSI host bus adapters (HBAs). If NICs are used for iSCSI communications, a supported software-based iSCSI initiator will be required. Most modern operating systems in use today provide software iSCSI initiators. If one is not available, then an iSCSI HBA will be required to connect the host to the iSCSI SAN.

NOTE: It is highly recommended that all components and connections within an EqualLogic SAN should be redundant in nature.

4.2.1 Single Initiator per Server

In a non-redundant host connection solution, a single NIC or HBA will be connected to one switch within the SAN infrastructure as illustrated in Figure 5.

Note: This configuration does not provide a fully redundant storage infrastructure from host to array. Additional components are required for full redundancy.

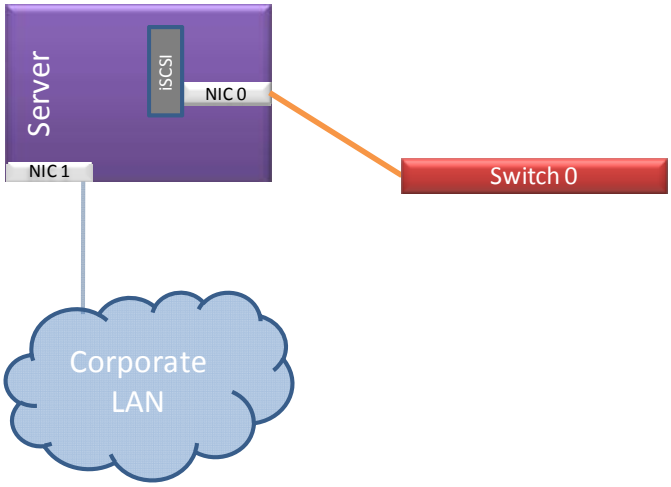

Figure 5: Host to Switch Configuration- Single Initiator/Single Switch

4.2.2 Multiple Initiators per Host/Single Switch

Redundant host solutions will incorporate two or more NICs or HBAs connected to one or more SAN switches. For hosts connecting to a single switch SAN, each NIC or HBA should be connected to the SAN switch as illustrated in Figure 6. Each NIC should have the iSCSI software initiator enabled and have either the Dell EqualLogic MPIO driver (located in the Host Integration Toolkit for Windows) or the native MPIO functionality for the host OS installed. HBA connections should leverage the standard MPIO functionality of the driver provided by the vendor to support failover and/or load-balancing features.

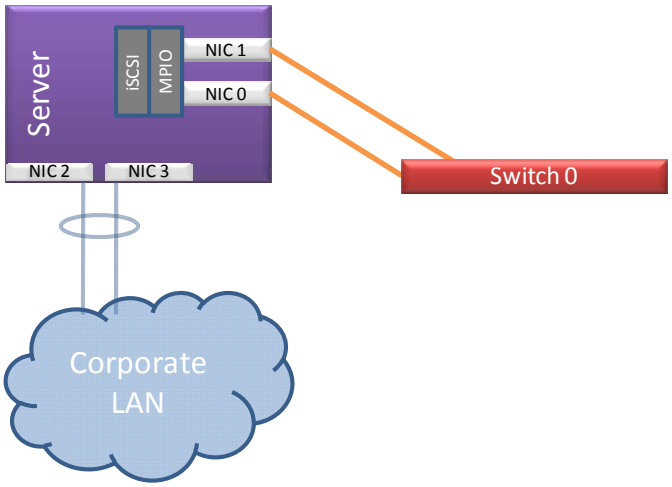

Figure 6: Host to Switch Configuration- Dual Initiator / Single Switch

Note: This configuration does not provide a fully redundant storage infrastructure from host to array. Additional components are required for full redundancy.

4.2.3 Multiple Initiators per Host/Dual Switch

For a redundant host connection to more than two switches, two or more NICs or HBAs will be configured such that one NIC/HBA is connected to one switch within the SAN infrastructure and the other NIC/HBA is connected to a second switch within the SAN infrastructure as show in Figure 7.

NOTE: See the Section discussing switch to switch connections elsewhere in this document for details on configuring a redundant SAN switch infrastructure.

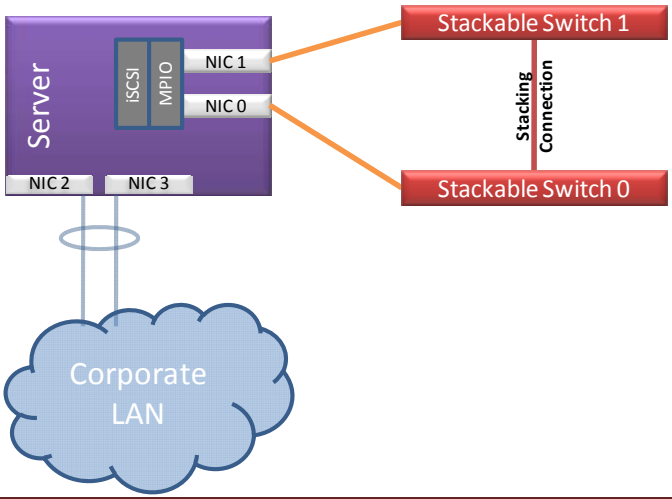

Figure 7: Multiple Initiator to Multiple Switch Configuration

When multiple NICs or HBAs are configured to support redundant host connections to the iSCSI SAN, the iSCSI initiators must be configured to support connection failover (and potentially load balancing) using industry standard Multi-Path Input/Output (MPIO) functionality. The steps to configure MPIO and the level of MPIO functionality are different for each operating system, so please consult your operating system documentation for further information.

4.3 Switch to Switch Connections

4.3.1 Stackable Switches

Stackable switches provide dedicated, high-bandwidth ports that connect switches together into either a bus, or more typically, loop architecture. High-bandwidth, inter-switch connectivity is an important factor in the overall performance of an EqualLogic SAN allowing the individual arrays to coordinate SAN activities and to allow data to be balanced between multiple arrays.

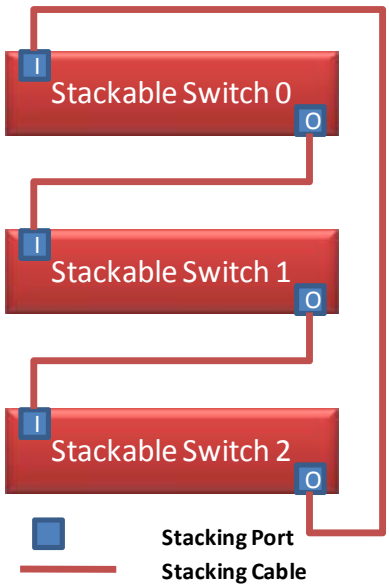

Figure 8: Example: 3 Switch Stack

In general, follow the instructions provided by the switch vendor for implementing a multiple-switch stack. If the switch vendor supports multiple stack topologies, implement the topology that provides the most redundancy and provides the ability to expand the stack without interruption of SAN traffic. Figure 8 illustrates an example using three stackable switches.

4.3.2 Non-Stackable Switches

Non-Stacking switches are a viable solution only for small EqualLogic SANs of 3 or fewer arrays. Non-stacking switches should be connected by using standard Ethernet ports configured into a Link Aggregation Group (LAG). Depending on the vendor, this will either be a LACP-compliant link group or an EtherChannel® link group. If the switches are of different vendors, LACP will be the standards-based protocol to be used. Please follow the directions provided by the switch vendor to implement the appropriate LAG type.

All LAGs should consist of an equivalent number of links to the total number of active ports on all arrays within the SAN. Each array can have up to 3x 1Gbps active ports, so LAG should be configured for 3x 1Gbps links per array. Figure 9 illustrates a non-stackable switch infrastructure with 4 ports on each switch configured into a LAG.

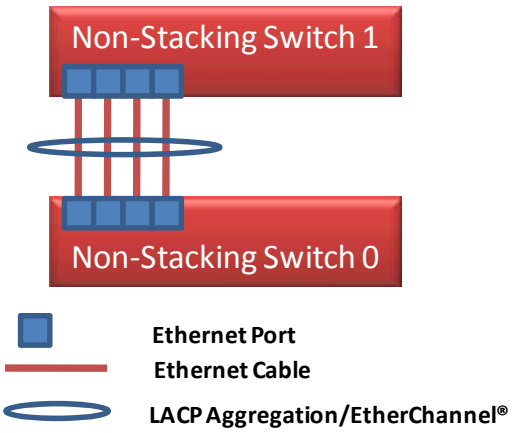

Figure 9: Example: 4-port Aggregated Uplink

4.4 Putting It All Together

Based on the previous discussions focusing on the three main infrastructure component connections - hosts, arrays, and switches, the following set of diagrams illustrate a set of redundant and non-redundant SAN configurations with all of the components combined into a complete set of solutions.

4.4.1 Fully Redundant SAN

The only design that addresses all of the possible failure modes for an iSCSI SAN that utilizes an EqualLogic array is illustrated in Figure 10. In this SAN design, each component of the SAN infrastructure has a redundant connection or path.

NOTE: For any production environment, this is the ONLY configuration that will completely protect your access to data and is the ONLY configuration recommended by Dell.

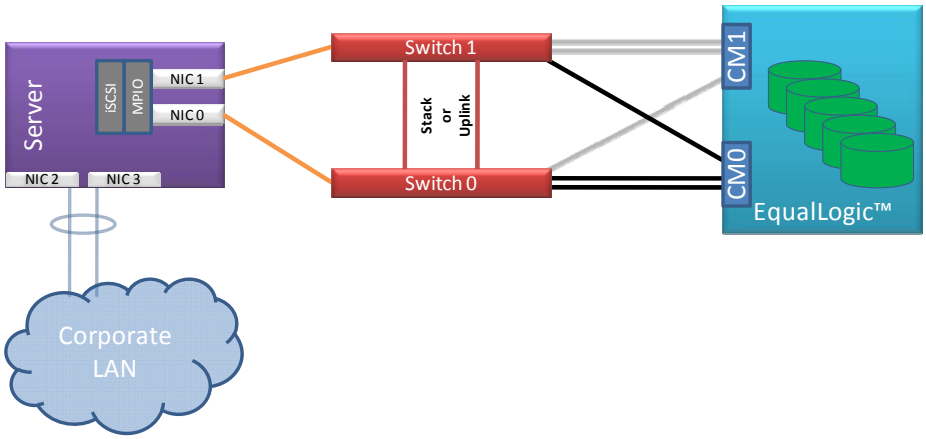

Figure 10: End-to-End Redundant SAN

4.4.2 Partially Redundant SAN Configurations

Though each of the SAN designs below will allow each host to access its data within the SAN, these are not recommended for production deployment, and should not be interpreted as a recommendation, as they do not provide a fully redundant SAN solution.

4.4.2.1 Single Array Controllers Configurations

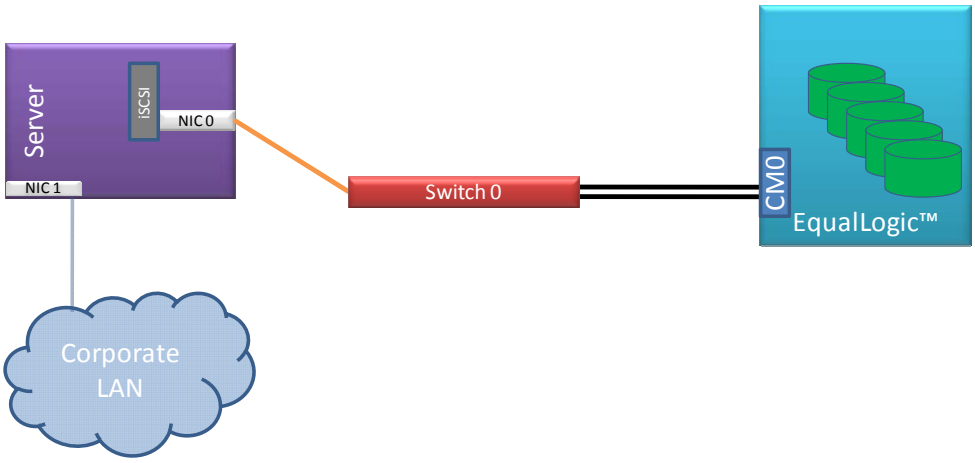

Figure 11: Single Controller/Single Switch/Single NIC

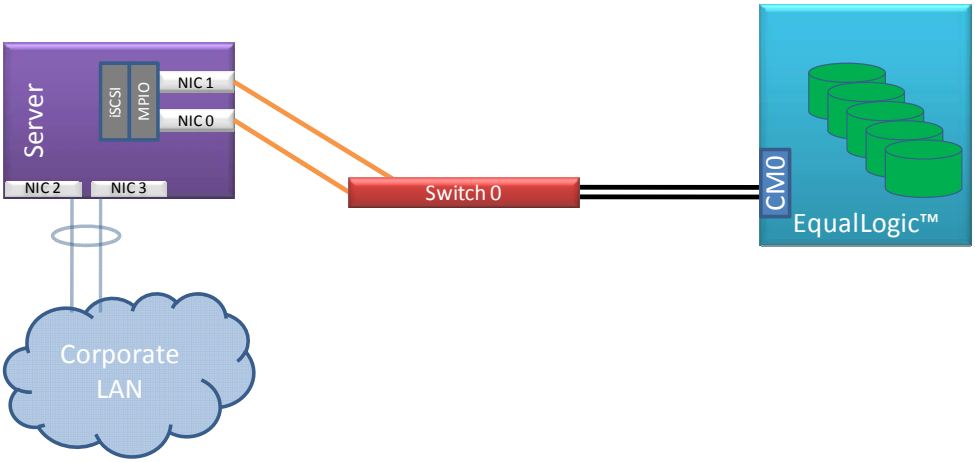

Figure 12: Single Controller/Single Switch/Dual NIC

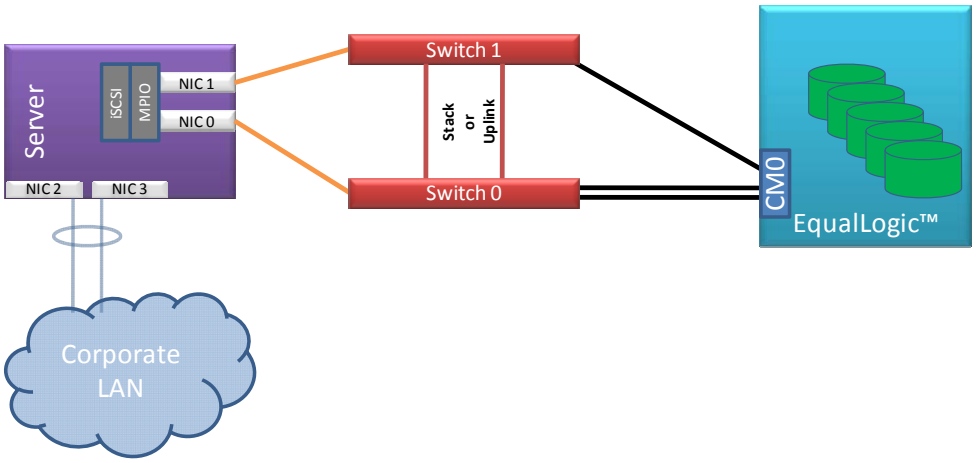

Figure 13: Single Controller/ Dual Switch/Dual NIC

4.4.2.2 Dual Array Controllers Configurations

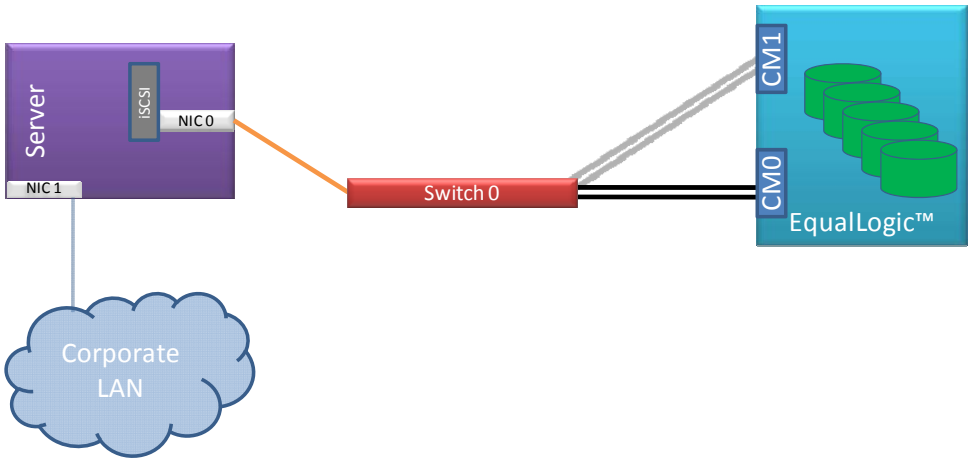

Figure 14: Dual Controller/Single Switch/Single NIC

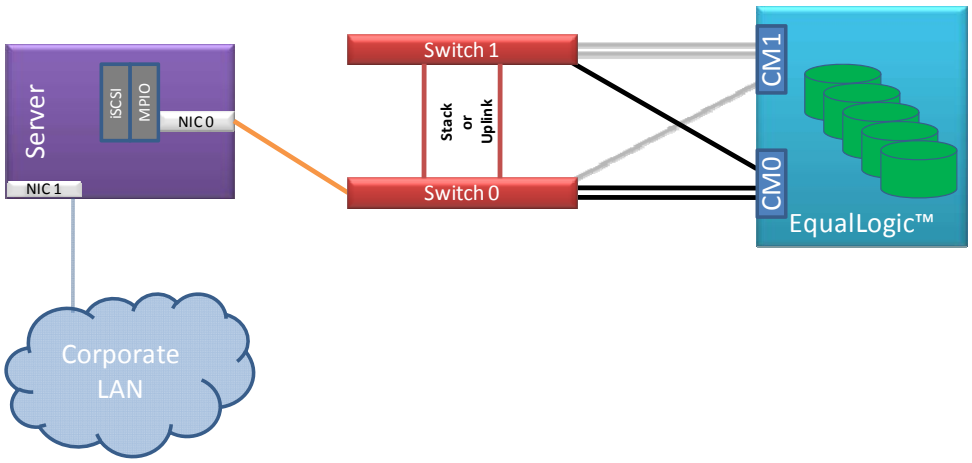

Figure 15: Dual Controller/Dual Switch/Single NIC

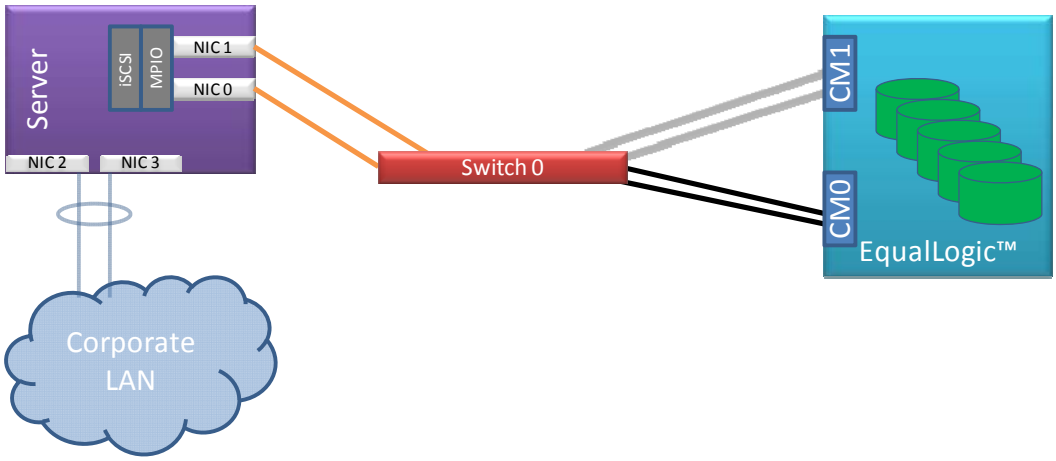

Figure 16: Dual Controller/Single Switch/Dual NIC

5 M1000e Blade Chassis Integration

M1000e and blade chassis' in general present some challenges with integration due to the limited options for I/O connectivity outside of the blade chassis. For more information pertaining to integrating blade solutions into the EqualLogic SAN infrastructure, please download the *Integrating Blade Solutions with the Dell EqualLogic PS Series* whitepaper from equallogic.com. In general, most blade integration solutions will require an external set of switches that will host the PS Series arrays that are then uplinked to the M1000e blade enclosure I/O modules. It is recommended that stackable blade I/O modules and external switches be utilized for all blade solutions when possible.

5.1 General Guidelines for Stackable Switches

Use the following guidelines for blade integration with EqualLogic SANs:

- Blade I/O modules and external switches should preferably be from the same vendor if possible.
- Stack blade I/O modules into one of two stacking architectures as described in Section 5.2
- Stack any external switches into a single stack as described in Section 4.3.1
- Interconnect blade I/O stack(s) with external switch stack via aggregated links
- Use 10GbE port options where available (See Figure 20)
    - Aggregate at least two 10GbE ports from each blade I/O module stack for redundancy
    - Distribute 10GbE links amongst multiple switches within each I/O module stack
    - Distribute 10GbE links evenly between all switches within the external switch stack
    - Use Switch vendor preferred method for link aggregation (if all switches from same vendor)
    - Use LACP as method for link aggregation when I/O modules and external switches are from different vendors
- Use 1GbE port options only if 10GbE is not available for up-linking
    - Aggregate at least two 1GbE ports each blade I/O module stack for redundancy
    - Aggregate at least one 1GbE port from each I/O module for every two blades in chassis
    - Distribute links amongst multiple switches within each I/O module stack
    - Distribute links evenly between all switches within the external switch stack
    - Use Switch vendor preferred method for link aggregation (if all switches from same vendor)
    - Use LACP as method for link aggregation when I/O modules and external switches are from different vendors

All configurations documented here assume that Fabric A is dedicated to client LAN traffic and Fabric B or C will be used for SAN infrastructure connectivity

5.2 M1000e Switch I/O Module Configuration

5.2.1 Single M1000e Enclosure Integration

For single M1000e enclosure, the two redundant switches in the fabric slots (B1 & B2 or C1 & C2) should be stacked together as shown in Figure 17 below.

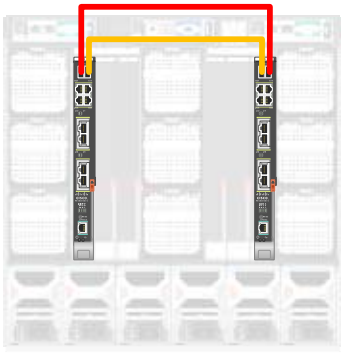

Figure 17: Single Enclosure Switch Stacking

5.2.2 Multiple M1000e Enclosure Solutions

Two options are available when configuring the blade I/O modules into stacks:

5.2.2.1 Dual I/O Module Stacks

The I/O modules in one half of the redundant fabric (B1 or C1) of each M1000e enclosure should be stacked together and the I/O modules in the other half of the redundant fabric (B2 or C2) should be stacked together as shown in Figure 18 below. This configuration scales the number of M1000e blade enclosures in parallel with the maximum stacking count for each I/O module vendor. In the case of the M1000e, the maximum number of I/O modules per stack is 9 modules for Cisco® Catalyst® 3130 family of switches and 10 modules for the PowerConnect M6220.

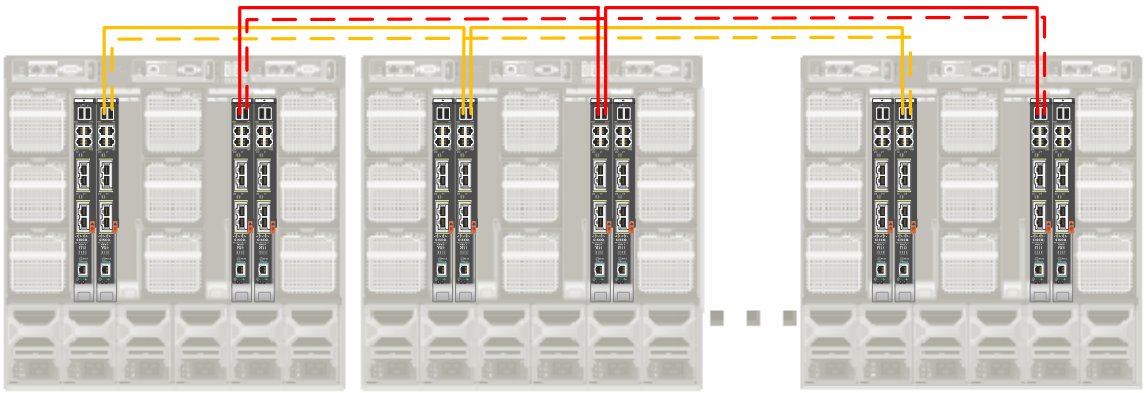

Figure 18:Dual I/O Module Stacks (Fabric B shown)

5.2.2.2 Single I/O Module Stack

All of the I/O modules in each of the enclosures can be stacked together as shown in Figure 19. This provides a single management structure for the blade I/O modules. This configuration scales the number of M1000e blade enclosures to ½ of the number allowed in the Dual Stack configuration. For Cisco Catalyst 3130 family of I/O modules, the enclosure limit would be 4 M1000e's, and for the PowerConnect M6220 I/O modules, the enclosure limit would be 5 M1000e's

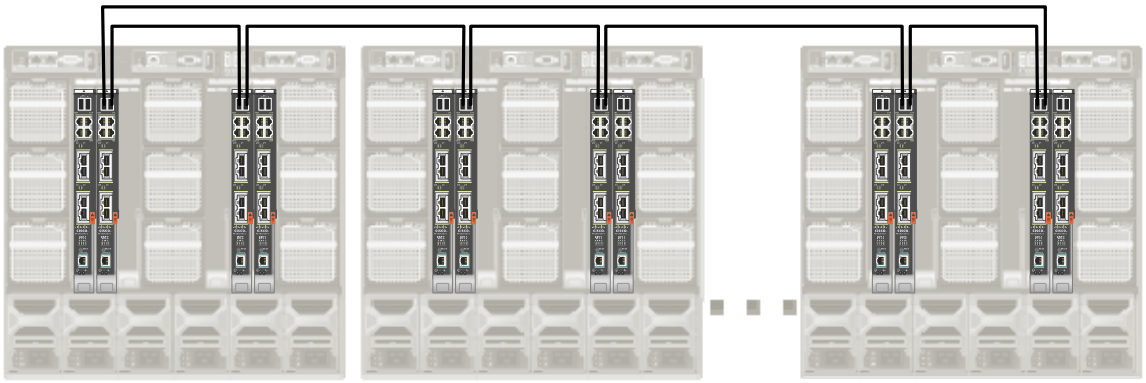

Figure 19: Single I/O Module Stack (Fabric B shown)

5.3 M1000e Ethernet Pass-Through I/O Module

Pass-Through modules are supported for use with EqualLogic SAN solutions. The Pass-Through module provides a simple, direct path from each blade server's optional Ethernet mezzanine card to an externally accessible port. These ports can then be connected to one or more external switches that are configured for EqualLogic SAN support as described in Section 4.3.

5.4 External Tier Stacking

The second tier for the SAN infrastructure should consist of two or more stackable switches – preferably from the same vendor as the M1000e switches (Cisco in this case). These switches should be configured as described for a non-Blade solution described in Sections 4.1 and 4.3 of this document. The number of external switches required will depend on the number of arrays being deployed as well as the type of uplink technology being used to connect the M1000e I/O stacks to the external tier stack.

5.5 Stack to Stack Interconnect

Connecting each blade enclosure I/O module stack to the external storage tier stack using either the 1Gb/s external Ethernet ports or by using optional 10Gb/s external uplink modules.

5.5.1 10GbE Uplinks Recommendations

The following recommendations should be used when connecting

- Aggregate at least two 10GbE ports from each blade I/O module stack for redundancy.

  If possible, any Link Aggregation Group used for connecting the I/O modules to the external switch stack should contain at least 2 links for redundancy. The actual number will depend on both the number of 10GbE ports available on each stack (spread across multiple modules within the stack) and the number of 10GbE ports available on the external switch stack.

  For example, each Cisco 3130X blade I/O module can have up to two 10GbE X2 ports and the Cisco 3750-E can have at most two 10GbE X2 ports. In most configurations, your external stack will be comprised of two switches – and a maximum of four 10GbE ports. Regardless of the number of M1000e enclosures, there are only four available ports to use for uplinking; therefore, only four 10GbE ports total can be used for uplinking – two ports per redundant stack in the dual stack blade configuration or four ports for the single stack blade configuration. This is illustrated in Figure 20.

- Distribute 10GbE links amongst multiple switches within each I/O module stack if supported

When the blade solution consists of more than one M1000e enclosure, the 10GbE ports used for up-linking should be distributed between multiple enclosures to protect against a complete enclosure failure.

- Distribute 10GbE links evenly between all switches within the external switch stack if supported

  When the external switch stack consists of more than one switch, the 10GbE ports used for up-linking should be distributed between all switches in the stack to protect against a switch failure.

- Use Switch vendor preferred method for link aggregation (if all switches from same vendor)

  Some switch vendors have proprietary or enhanced link aggregation protocols. For example, Cisco supports Port Aggregation Protocol (PAgP) that contains advanced management features.

- Use LACP as method for link aggregation when I/O modules and external switches are from different vendors

  The industry standard link aggregation protocol is IEEE 802.3ad, also known as the Link Aggregation Control Protocol (LACP). LACP is typically the only method for creating link aggregation groups that can link switches from multiple vendors.

Figure 20 illustrates an example of how to link the M1000e enclosures using Cisco Blade Switch 3130X I/O modules with an external switch stack consisting of Cisco 3750-E switches using 10GbE links.

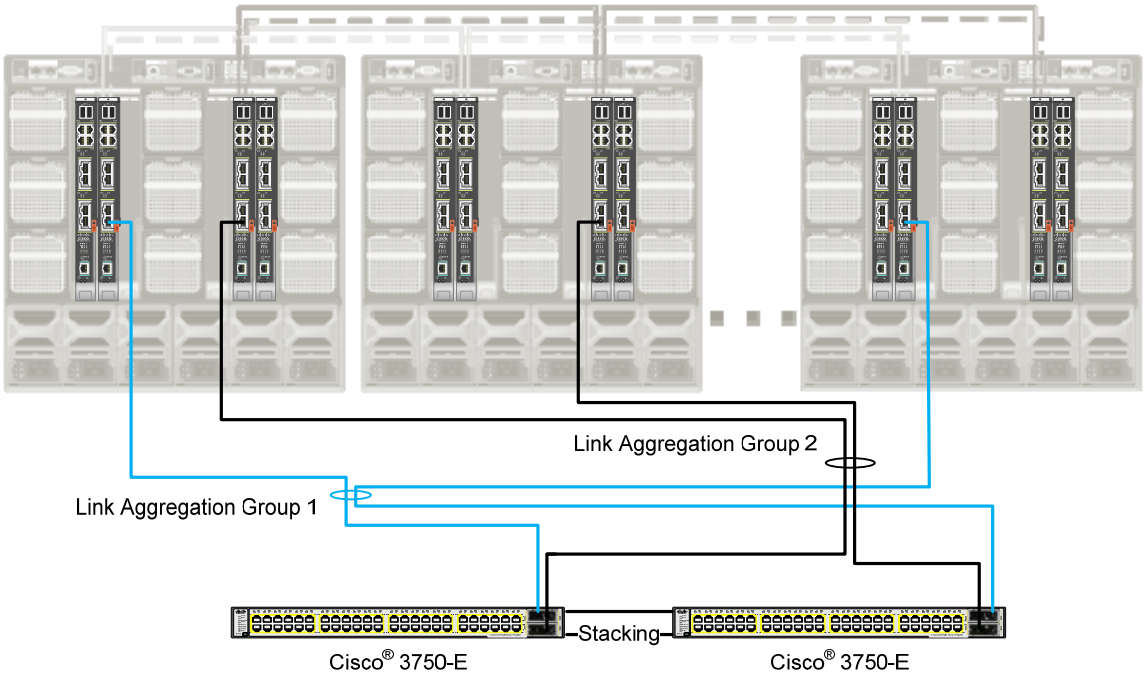

Figure 20: Stack to Stack Uplinks Using 10GbE Links

5.5.2 1GbE Uplinks Recommendations

If 10GbE links are not available, 1GbE links can be used to link the blade enclosure I/O modules to the external switch stack. Configurations using 1GbE uplinks should be limited to smaller installations limited to one or two M1000e blade enclosures due to increased cabling complexity.

The following recommendations should be used when connecting

- Aggregate at least two 1GbE ports from each blade I/O module stack for redundancy

- Configurations will be limited to one active link aggregation group per I/O module stack due to rapid spanning tree protocol restrictions.
- Link aggregation groups will typically contain a maximum size permitted by switch and/or I/O module vendor (typically eight 1GbE links).

➢ Distribute links amongst multiple switches within each I/O module stack if supported

When the blade solution consists of more than one M1000e enclosure, the 1GbE ports used for up-linking should be distributed between multiple enclosures to protect against a complete enclosure failure.

➢ Distribute links evenly between all switches within the external switch stack if supported

When the external switch stack consists of more than one switch, the 1GbE ports used for up-linking should be distributed between all switches in the external switch stack to protect against a switch failure.

➢ Use Switch vendor preferred method for link aggregation (if all switches from same vendor)

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The industry standard link aggregation protocol is IEEE 802.3ad, also known as the Link Aggregation Control Protocol (LACP). LACP is typically the only method for creating link aggregation groups that can link switches from multiple vendors.

illustrates an example of how to link the M1000e enclosures using Cisco Blade Switch 3130X I/O modules with an external switch stack consisting of Cisco 3750-E switches using 10GbE links.

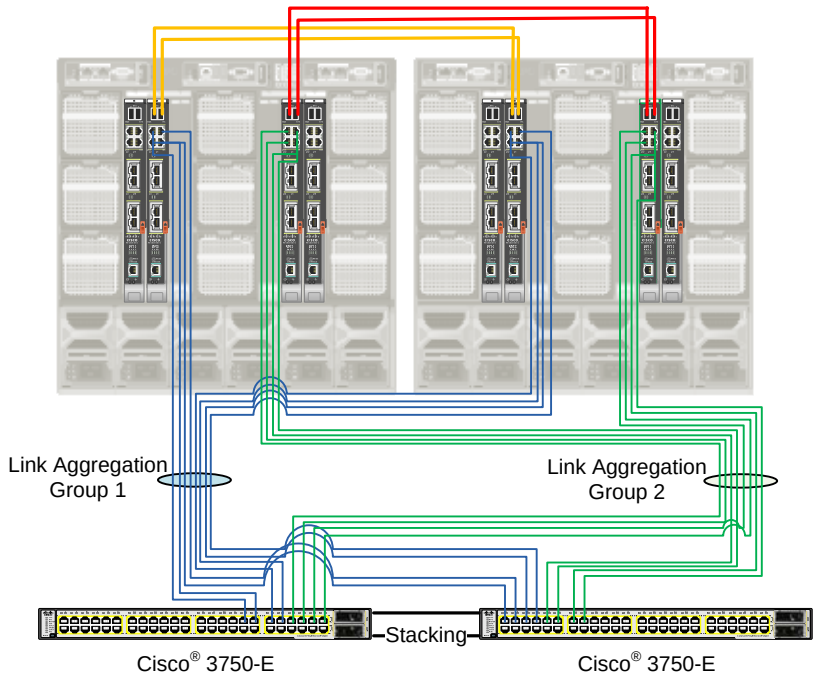

Figure 21: Stack to Stack Uplinks Using 1GbE Links

5.6 Additional Resources

- Cisco Stack Management Guidelines: http://www.cisco.com/en/US/docs/switches/lan/catalyst3750e_3560e/software/release/12.2_35_se2/configuration/guide/swstack.html
- Integrating Blade Solutions with the Dell EqualLogic PS Series http://www.equallogic.com/resourcecenter/assetview.aspx?id=7173

Appendix A: General Requirements for Switches When Used with EqualLogic PS Series Arrays

For a switch to provide reliable operation within a Dell EqualLogic SAN infrastructure, the following features must be available:

- ***Non-Blocking backplane design***

  A switch should be able to provide the same amount of backplane bandwidth to support full duplex communication on ALL ports simultaneously.

- ***Support for Inter-Switch Linking (ISL) or Dedicated Stacking Architecture***

  ISL support is required to link all switches in SAN infrastructure together. For non-stacking switches, the switch should support designating one or more (through Link Aggregation Groups) ports for inter-switch links.

  For stacking switches, the use of stacking ports for ISL is assumed. Switch should provide at least 20 Gbps full-duplex bandwidth.

- ***Support for creating Link Aggregation Groups (LAG)***

  For non-stacking switches, the ability to bind multiple physical ports into a single logical link for use as an ISL is required. Switch should support creating LAGs of at least 8x 1Gbps ports or at least 1x 10Gbps port.

  Note: Non-stacking switches with more than three EqualLogic Arrays could exhibit some performance reduction.

- ***Support for active or passive Flow Control (802.3x) on ALL ports.***

  Switches must be able to actively manage “pause” frames received from hosts, or they must passively pass all “pause” frames through to the target arrays.

- ***Support for Rapid Spanning Tree Protocol (R-STP)***

  For SAN infrastructures consisting of more than 2 non-stacking switches, R-STP must be enabled on all ports used for ISLs. All non-ISL ports should be marked as “edge” ports or set to “portfast”.

- ***Support for Jumbo Frames***

Not a requirement, but desirable. Many storage implementations can take advantage of Jumbo Frames. Jumbo frames may not provide any performance increases depending on the application and data characteristics.

- ***Ability to disable Unicast Storm Control***

iSCSI in general, and Dell EqualLogic SANs in particular can send packets in a very "bursty" profile that many switches mis-diagnose as a viral induced packet storm. Since the SAN should be isolated from general Ethernet traffic, the viral possibilities are non-existent. Switches need to always pass Ethernet packets regardless of bandwidth utilization.

- ***Adequate Buffer Space per switch port***

The Dell EqualLogic SAN solution makes use of the SAN infrastructure to support inter-array communication and data load balancing on top of supporting data transfers between the hosts and the SAN. For this reason, the more buffer space per port that a switch can provide the better.

Due to the multitude of buffer implementations used by switch vendors, Dell cannot provide definitive guidelines as to how much is enough, but should be enough such that data is not lost during when traffic reaches extreme levels.

Appendix B: PowerConnect 54xx Configuration

The PowerConnect 54xx Family of switches must be placed in "privileged" mode to perform configuration steps in this Appendix. Use the following command to enter "privileged" mode:

```
console> enable

console#
```

Note: You may be prompted for a password after submitting the `enable` command

The PowerConnect 54xx Family of switches must be place into configuration mode before any configuration steps can be performed. To enter configuration mode, the following command must be entered:

```
console# configure

console(config)#
```

PowerConnect 54xx Family of switches are non-stacking switches and must be configured independently using either the web-based Switch manager or the Command Line Interface (CLI). The instructions in this Appendix provide CLI commands for configuration. Please go to Dell's support website for the latest documentation if the web-interface is preferred.

Port references for the PowerConnect 54xx switch must use the `interface` command and the port references are in the form of "g"+<port#>.

For example, Port 10 on the Powerconnect 5424 would be referenced as

```
console(config)# interface ethernet g10
```

To reference a range of ports, the `interface range` command must be used with the port reference in the form of "g(" + <begport#> + "-" + <endport#> + ")".

For example, to reference all ports between port g1 and port g15 would be referenced as

```
console(config)# interface range ethernet g(1-15)
```

Disabling iSCSI Optimization Setting

The PowerConnect 54xx family of switches has a global feature called "iSCSI Optimization" that is designed to configure the Quality of Service settings to allow iSCSI frames to have priority over other frame types within the switch. The settings used when this command is enabled are designed to optimize an iSCSI storage solution consisting of a single iSCSI storage device and is not optimal for a SAN consisting of multiple EqualLogic PS Series arrays in a peer storage configuration and must be disabled for switches used within a PS Series SAN.

To disable the iSCSI Optimization settings for the PowerConnect 54xx family of switches, perform the following steps:

```
console# configure
console(config)# no iscsi enable
console(config)# exit
console# copy running-config startup-config
console# exit
```

Enabling the PortFast Option to Configure STP Edge Ports

To enable PortFast on a single port, the spanning-tree portfast command must be used. PortFast should be enabled only on those ports being used to for inter-switch connections.

The following steps are an example of using this command to enable portfast on port 10 of the PowerConnect 5448

```
console# configure
console(config)# spanning-tree mode rstp
console(config)# interface ethernet g10
console(config-if)# spanning-tree portfast
console(config-if)# exit
console(config)# exit
console# copy running-config startup-config
console# exit
```

Configuring Flow Control

Flow control on the PowerConnect 54xx Family of switches is off by default. To enable flow control on all ports in the switch, use the `system flowcontrol` command. Flow control only works when the port is in full duplex mode, so be sure to enable full duplex on the port before enabling flow control

To enable flow control on all ports of a PowerConnect 5448, enter the following commands:

```
console# configure
```

```
console(config)# interface range ethernet g(1-48)
console(config-if)# speed 1000
console(config-if)# duplex full
console(config-if)# flowcontrol on
console(config-if)# exit
console(config)# exit
console# copy running-config startup-config
console# exit
```

Configuring Storm Control

To disable port storm control on the PowerConnect 54xx switch, use the `no port storm-control broadcast enable` command. The following steps are an example of using this command to disable storm control on a single port of a PowerConnect 5448 switch:

```
console# configure
console(config)#  interface Ethernet g1
console(config-if)# no port storm-control broadcast enable
console(config-if)# exit
console(config)#  exit
console# copy running-config startup-config
console# exit
```

The following steps are an example of how to disable storm control on all ports of a PowerConnect 5448 switch:

```
console# configure
console(config)# interface range ethernet all
console(config-if)# no port storm-control broadcast enable
console(config-if)# exit
```

```
console(config)# exit
console# copy running-config startup-config
console# exit
```

Configuring Jumbo Frames

Jumbo frames are not enabled by default. To enable jumbo frames on the PowerConnect 54xx switch, use the `port jumbo-frame` global configuration command. Jumbo frames are enabled on all ports on a switch when enabled.

```
console# configure
console(config)# port jumbo-frame
console(config)# exit
console# copy running-config startup-config
console# exit
```

Appendix C: PowerConnecct 62xx Configuration

The PowerConnect 62xx Family of switches must be placed in "privileged" mode to perform configuration steps in this Appendix. Use the following command to enter "privileged" mode:

```
console> enable

console#
```

Note: You may be prompted for a password after submitting the `enable` command

The PowerConnect 62xx Family of switches must be place into configuration mode before any configuration steps can be performed. To enter configuration mode, the following command must be entered:

```
console# configure

console(config)#
```

PowerConnect 62xx Family of switches are stacking switches and must be configured as a stack using either the web-based Switch manager or the Command Line Interface (CLI). The instructions in this Appendix provide CLI commands for configuration. Please go to Dell's support website for the latest documentation if the web-interface is preferred.

Interface Naming Convention

The conventions for naming interfaces on Dell PowerConnect 62xx family of switches are as follows:

- Unit#/Interface ID — each interface is identified by the Unit# followed by a / symbol and then the Interface ID (see below). For example, 2/g10 identifies gigabit port 10 within the second unit of a stack.
- Unit# — the unit number is used only in a stacking solution where a number of switches are stacked to form a virtual device. In this case, the unit number identifies the physical device identifier within the stack.
- Interface ID — is formed by the interface type followed by the interface number. There is currently a predefined list of interface types (see below). If additional interface types are to be defined, they must be registered with Dell. For example, 2/g10 identifies the gigabit port 10 on the second unit.
- Interface Types — the following interface types are defined in the 6200 series switches:
    - g — gigabit Ethernet port (for example, 1/g2 is the gigabit Ethernet port 2).
    - xg — 10 Gigabit Ethernet port (for example, 1/xg2 is the 10 gigabit Ethernet port 2).

Enabling the PortFast Option to Configure STP Edge Ports

To enable PortFast on a single port, the spanning-tree portfast command must be used. The following steps are an example of using this command to enable portfast on port 10 of the first PowerConnect 6248 in a stack

```
console# configure
console(config)# spanning-tree mode rstp
console(config)# interface ethernet 1/g10
console(config-if)# spanning-tree portfast
console(config-if)# exit
console(config)# exit
console# copy running-config startup-config
console# exit
```

Configuring Flow Control

Flow control on the PowerConnect 62xx Family of switches is off by default. To enable flow control on all ports in the switch, use the `flowcontrol` command.

To enable flow control on all ports of a PowerConnect 6248, enter the following commands:

```
console# configure
console(config)# flowcontrol
console(config)# exit
console# copy running-config startup-config
console# exit
```

Configuring Storm Control

To disable port storm control on the PowerConnect 62xx switch, use the `no storm-control unicast` command. The following steps are an example of using this command to disable the unicast storm control on a single port – Port 10 of Switch 3 in a stack:

```
console# configure
console(config)# interface ethernet 3/g10
```

```
console(config-if)# no storm-control unicast
console(config-if)# exit
console(config)# exit
console# copy running-config startup-config
console# exit
```

The following steps are an example of how to disable unicast storm control on all ports in a PowerConnect 62xx switch stack:

```
console# configure
console(config)# interface range ethernet all
console(config-if)# no storm-control unicast
console(config-if)# exit
console(config)# exit
console# copy running-config startup-config
console# exit
```

Configuring Jumbo Frames

Jumbo frames are not enabled by default. To enable jumbo frames on the Powerconnect 62xx switch, use the `mtu` interface configuration command with a parameter of `9216`. Because the `mtu` command is an interface configuration command, each port must be individually configured with the `mtu` command. All ports on a switch can be configured using the `port range` command.

```
console# configure
console(config)# interface range ethernet all
console(config-if)# mtu 9216
console(config-if)# exit
console(config)# exit
console# copy running-config startup-config
```

```
console# exit
```

Appendix D: Cisco IOS Based Switch Configuration

Cisco IOS based switches must be placed in "privileged" mode to perform configuration steps in this Appendix. Use the following command to enter "privileged" mode:

```
Switch> enable

Switch#
```

Cisco IOS based switches must be place into configuration mode before any configuration steps can be performed. To enter configuration mode, the following command must be entered:

```
Switch# configure terminal
```

To configure a port on non-chassis based Cisco IOS switch, the interface type, stack member number, module number, and switch port number must be provided, and enter interface configuration mode.

- *Interface Type*—Gigabit Ethernet and small form-factor pluggable (SFP) modules(`gigabitethernet` or `gi`), 10-Gigabit Ethernet (`tengigabitethernet` or `te`).
- *Stack member number*—Identifies the switch within the stack. The switch number range is 1 to 9 and is assigned the first time the switch initializes. All standalone switches have stack member number equal to 1. When a switch is added to an existing stack it will receive a new stack member number and it keeps that number until another is assigned to it. Non-Stackable switches have a stack member number of 1.

  The switch port LEDs can be configured in Stack mode to identify the stack member number of a switch.
- *Module number*—The module or slot number on the switch is always 0.
- *Port number*—Reflects the actual port number on the switch. Port numbers always begin at 1, starting with the far left port when facing the front of the switch.

  For switches that have Cisco TwinGig Converter Modules in 10-Gigabit Ethernet module slots, the interface type is `tengigabitethernet`, and the port numbers restart at 1. For example, the first port on the first TwinGig Converter Module is referenced as `tengigabitethernet1/0/1` and the first port on the second TwinGig Converter Module would be referenced as `tengigabitethernet1/0/3`.

  For switches that are using Cisco dual SFP X2 converter modules in the 10-Gigabit Ethernet module slots, the SFP module ports are numbered consecutively following the fixed port interfaces. For example, if the switch has 24 fixed ports, the SFP module ports are `gigabitethernet1/0/25` through `gigabitethernet1/0/28`.

A Catalsyt® 3750-E example:

Port 4 is idenetified by entering the following command:

```
Switch(config)# interface gigabitethernet1/0/4
```

Enabling the PortFast Option to Configure STP Edge Ports

To configure STP edge ports on Cisco IOS-based switches, the Portfast option must be set on the desired port(s).

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

```
Switch> enable
Switch# configigure terminal
Switch(config)# interface gi1/0/1
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: Use the spanning-tree portfast default global configuration command to globally enable the PortFast feature on all non-trunking ports.

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

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

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 2970switches. You must enable Flow Control on each switch port that handles iSCSI traffic.

Note: Cisco Catalyst 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
```

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 switches, MTU size cannot be set for an individual interface. Instead, it must be configured for all Gigabit Ethernet ports on the switch, or for all ports in a VLAN. When the MTU size is changed, the switch must reset before the new configuration takes effect. If a value is entered 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:

```
Switch> enable

Switch# config terminal

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 outof-range number:

```
Switch(config)# system mtu jumbo 25000
                                    ^

% Invalid input detected at '^' marker.
```

Once the switch reloads, the configuration can be verified by entering the following commands:

```
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 VLAN1 cannot have Jumbo Frames enabled. VLAN 2 must be used if Jumbo Frames are required.

```
Switch# vlan database

Switch(vlan)# vlan 2 mtu 9000

Switch(vlan)# exit
```

To view or confirm MTU size on port 7 of the switch, use the following command.

```
Switch# show interface gigabitethernet1/0/7
```

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