



Best Practices for Mixed Speed Devices within a 10 Gb EqualLogic SAN Using Force10 S4820T Switches

A Dell EqualLogic Best Practices Technical White Paper

Dell Storage Engineering
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Feedback

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Executive Summary

To incrementally upgrade a SAN from a 1 Gb environment to a 10 Gb environment, you can use the auto-negotiable 1 GbE/10 GbE ports on a 10 Gb Ethernet switch in the transition from 1 Gb to 10 Gb. A 1 Gb environment with the Dell™ Force10™ S4820T shows no performance degradation when compared to a pure 1 Gb environment using a standard 1 Gb Ethernet switch such as the PowerConnect 7048. In addition, when running a mixed speed environment using both 1 Gb and 10 Gb devices, switch performance is within the expected range.



1 Introduction

With the growth of 10 Gb Ethernet, many Dell EqualLogic™ customers are transitioning from pure 1 GbE to pure 10 GbE environments. To complete this transition, new switches, storage arrays, and host Network Interface Cards (NICs) are required. In some deployments it is not feasible to convert all components from 1 Gb to 10 Gb at the same time.

This white paper discusses how the added complexity of a mixed speed design affects the performance characteristics of the Storage Area Network (SAN) solution, based on testing and evaluating workload data run in a pure 1 GbE environment, in a mixed environment, and in a pure 10 GbE environment. Also provided are a recommendation for using 1 Gb and 10 Gb devices in a single 10 Gb SAN fabric and instructions for how to use Force10 S4820T switches in a mixed-speed EqualLogic SAN.

1.1 Audience

This technical white paper is intended for storage administrators, SAN system designers, storage consultants, or anyone who is tasked with integrating a 1 GbE and 10 GbE solution with EqualLogic PS Series storage for use in a production SAN. It is assumed that readers have experience in designing and/or administering a shared storage solution.

1.2 Terminology

This section defines terms that are commonly used in this paper and the context in which they are used.

CAT6 – Category 6 is a cabling standard for Ethernet networks. CAT6 is suitable for use with 1 Gb or 10 Gb Ethernet network devices and is recommended for use with EqualLogic SANs.

Host/port ratio – The ratio of the total number of host network interfaces connected to the SAN divided by the total number of active PS Series array member network interfaces connected to the SAN. A ratio of 1:1 is ideal for optimal SAN performance, but higher port ratios are acceptable in specific cases. An unbalanced host to port ratio can negatively affect performance in a SAN when oversubscription occurs.

LAG – A link aggregation group (LAG) is multiple switch ports configured to act as a single high-bandwidth connection to another switch. Unlike a stack, each individual switch must still be administered separately and also functions separately.

Stack – An administrative grouping of switches that enables the management and function of multiple switches to act as if they were one single switch. The switch stack connections also serve as high-bandwidth interconnects.

TOR switch – A top of rack (ToR) switch.



2 Product overview

The Force10 S-Series S4820T was the 10 GbE switch used in the tests for this paper. The Force10 S4820T is an low-latency 10/40 GbE ToR switch purpose-built for applications in high-performance data center and computing environments. The non-blocking, cut-through switching architecture of the S4820T delivers line-rate L2 and L3 forwarding capacity with ultra-low latency to maximize network performance.

This switch includes the following features:

- 1-RU high-density 10/40 GbE ToR switch with 48 dual-speed 1/10 GbE (SFP+) ports and four 40 GbE
- QSFP+ uplinks (with ability to provide 64 additional 10 GbE ports with breakout cables)
- 1.28 Tbps (full-duplex) non-blocking, cut-through switching fabric that delivers line-rate performance under full load with sub 700 ns latency
- Scalable L2 and L3 Ethernet switching with QoS and a full complement of standards-based IPv4 and IPv6 features for unicast and multicast applications.



3 Test methodology

The test cases used in this paper were designed to test the ability and performance of the SAN during a transition from a purely 1 GbE environment to a purely 10 GbE environment. The same workloads were run in all four test configurations to ensure that the data could be compared directly without introducing additional variables beyond the transition from a 1 Gb infrastructure to a 10 Gb infrastructure.

In order to determine the relative performance of each SAN design the performance tool vdbench was used to capture throughput values for four distinct I/O workloads. vdbench is “a disk and tape I/O workload generator for verifying data integrity and measuring performance of direct attached and network connected storage.” You can find more information about vdbench at

<http://sourceforge.net/projects/vdbench/>.

Note: All EqualLogic SAN best practices such as enabling flow control and Jumbo frames, were implemented.

For more information on EqualLogic Best Practices, refer to the *EqualLogic Configuration Guide* at <http://en.community.dell.com/dell-groups/dtcmmedia/m/mediagallery/19852516/download.aspx>.

See [Appendix A](#) for details about the hardware and software infrastructure.

See [Appendix B](#) for a list of vdbench parameters.

The following four vdbench workloads were defined:

- Test configuration A
 - All hosts - 8K random 67% read (monitor IOPS, throughput, response time)
- Test configuration B
 - All hosts - 256K sequential read (monitor IOPS, throughput, response time)
- Test configuration C
 - All hosts - 256K sequential write (monitor IOPS, throughput, response time)
- Test configuration D (mixed workload)
 - 50% hosts - 8K random 67% read (monitor IOPS, throughput, response time)
 - 25% hosts - 256K sequential read (monitor IOPS, throughput, response time)
 - 25% hosts - 256K sequential write (monitor IOPS, throughput, response time)

Each vdbench workload was run for three hours and the I/O rate was not capped (the vdbench “iorate” parameter was set to “max”). The throughput values used in the relative performance graphs are the combined sums of the values reported by all of the hosts.



4 Test setup and configuration

Four configurations were used to test the transition from a pure 1 Gb environment to a pure 10 Gb environment.

Note: In all tests and configurations, Data Center Bridging (DCB) was disabled because it is not within the scope of this paper.

Test configuration A: 1 Gb environment (baseline)

Test configuration A was a pure 1 Gb environment. Hosts, arrays, and switches were all 1 Gb. The arrays were configured into a single pool of four arrays. This test was the baseline for the 1 Gb performance which was used to compare with test configurations B through D.

Test configuration B: 1 Gb components with a 10 Gb switch infrastructure

Test configuration B was the same environment as test configuration A except using a 10 Gb switch. The first step of an infrastructure upgrade is to upgrade the switch. The 1 Gb switch was replaced with a Force10 S4820T 10 Gb (10GBASE-T) switch with dual speed and auto-negotiable 1 GbE/10 GbE ports which allowed continued 1 Gb connections on the SAN with a switch capable of running 10 Gb. The arrays were configured into a single pool of four arrays. The results of this test configuration were compared to those in test configuration A (refer to [Section 5](#)) to ensure that the 1 Gb performance was not degraded when using the dual speed, auto-negotiable 1 GbE/10 GbE ports on the 10 Gb switch.

Test configuration C: 1 Gb and 10 Gb components with a 10 Gb switch infrastructure

In test configuration C, 1 Gb and 10 Gb devices were mixed in the same fabric, but the 1Gb initiators were only used to access the 1Gb arrays and the 10Gb initiators were used only to access the 10 Gb arrays. This is the next logical step to upgrade the infrastructure when adding 10 Gb devices (hosts and arrays) to an existing 1 Gb infrastructure. Testing in this configuration determined if running 1 Gb and 10 Gb speeds on the same switch would have any effect. Within the same EqualLogic group, the 1 Gb and 10 Gb arrays were put into separate pools of four arrays each. Identical workloads were run on both the 1 Gb and 10 Gb devices at the same time. The 1 Gb performance data was compared to the 1 Gb baseline data in test configuration A, and the 10 Gb performance data was compared to the 10 Gb baseline data in test configuration D. By comparing the data from test configuration C to the baseline data in tests A and D, we see that running 1 Gb and 10 Gb devices together does not have an effect on the performance.

Test configuration D: 10 Gb environment (baseline)

Test configuration D, and the final step of the infrastructure upgrade, involved removing the 1 Gb devices and testing an environment running only 10 Gb devices. The arrays were configured into a single pool of four arrays. This configuration was the 10 Gb performance baseline which was used to compare to the test results in test configuration C.



4.1 1 Gb environment (baseline)

This section describes the configuration used for test configuration A, the pure 1 GbE environment, illustrated in Figure 1.

- Eight PowerEdge R610 servers
 - Windows Server 2008 R2 SP1
 - One 1 GbE Broadcom NIC per host (two active 1 GbE ports on the SAN)
- Four EqualLogic PS6100XV arrays
 - Four active 1 GbE storage controller ports (four active 1 GbE ports on the SAN)
- Two PowerConnect 7048R switches
 - Stack mode (the 2 7048 switches are stacked together)
- One pool of four arrays
- Four iSCSI volumes dedicated to each host

Note: A host to storage port ratio of 1:1 was maintained (16 host ports: 16 array ports).

The two PowerConnect 7048 switches were stacked and the entire configuration was cabled using EqualLogic best practices. Refer to [Appendix A](#), titled “Solution infrastructure details” for the hardware specifications of the servers and arrays.

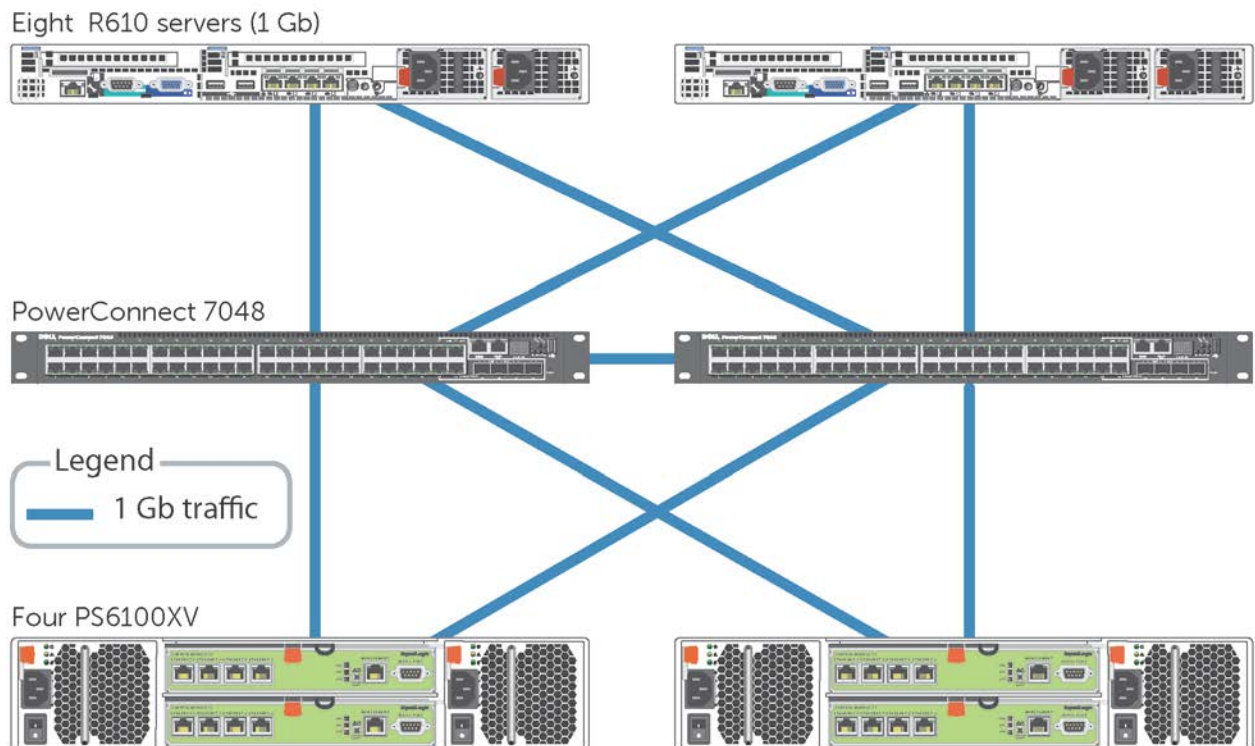


Figure 1 Test configuration A

4.2 1 Gb components with a 10 Gb switch infrastructure

This section describes test configuration B consisting of 1 GbE hosts, 1 GbE arrays, and using a 10 GbE switch as shown in Figure 2.

- Eight PowerEdge R610 servers
 - Windows Server 2008 R2 SP1
 - One 1 GbE Broadcom NIC per host (2 active 1GbE ports on the SAN)
- Four EqualLogic PS6100XV arrays
 - Four active 1 GbE storage controller ports (four active 1 GbE ports on the SAN)
- Two Force10 S4820T switches
 - LACP between the 2 S4820T switches
- One pool of four arrays
- Four iSCSI volumes dedicated to each host

Note: A host to storage port ratio of 1:1 is maintained (16 host ports: 16 array ports).

The two S4820T switches were configured in a LAG and the entire configuration was cabled using EqualLogic best practices. Hardware specifications of the servers and arrays can be found in [Appendix A](#), titled "Solution infrastructure details".

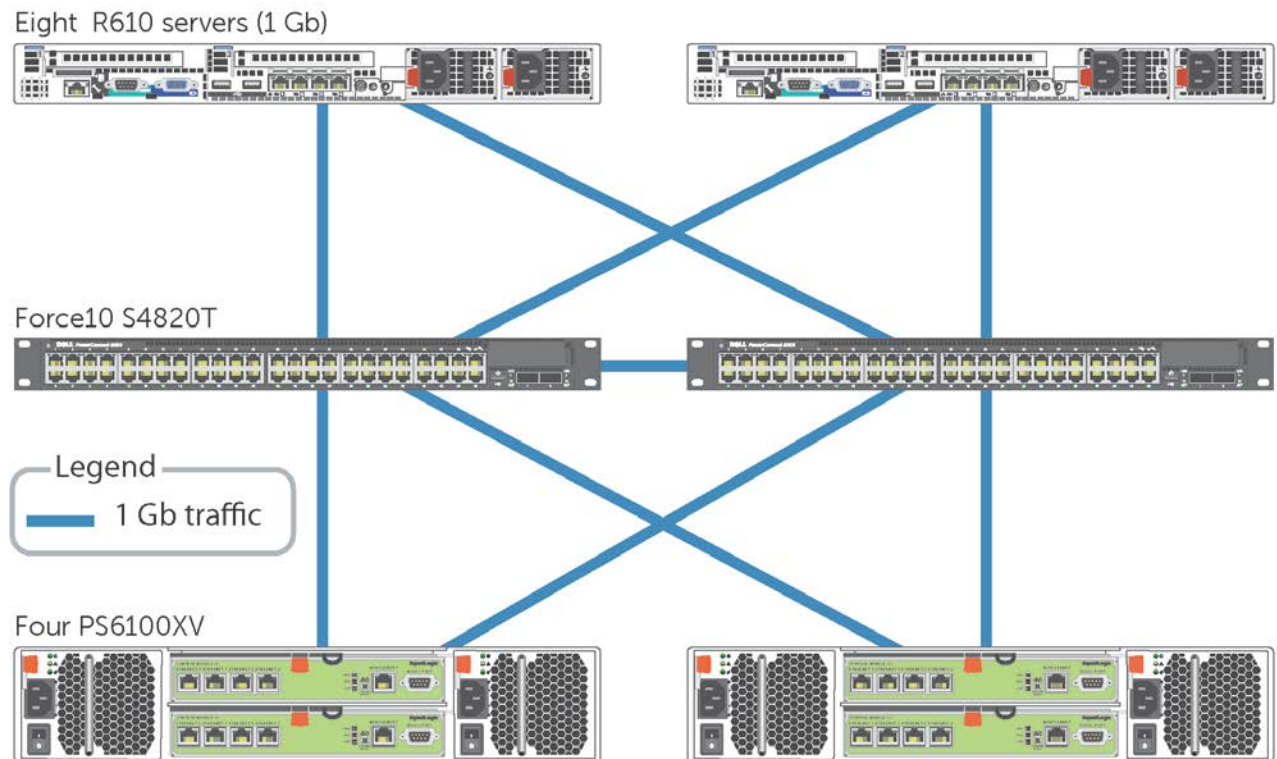


Figure 2 Test configuration B

4.3 1 Gb and 10 Gb components with a 10 Gb switch infrastructure

This section describes Test configuration C which includes 1 GbE and 10 GbE hosts and arrays using a 10 GbE switch as illustrated in Figure 3.

- Ten PowerEdge R610 servers (eight for 1 Gb, two for 10 Gb)
 - Windows Server 2008 R2 SP1
 - One 1 GbE Broadcom NIC per 1 Gb host (two active 1 GbE ports on the SAN)
 - One 10 GbE Intel X540 NIC per 10 Gb host (two active 1 GbE ports on the SAN)
- Four EqualLogic PS6100XV (1 Gb) arrays
 - Four active 1 GbE storage controller ports (four active 1 GbE ports on the SAN)
- Four EqualLogic PS6110XV (10 Gb) arrays
 - One active 10GBASE-T storage controller port (one active 10 GbE port on the SAN)
- Two Force10 S4820T switches
 - LACP LACP between the 2 S4820T switches
- One pool of four arrays for 1 GbE
- One pool of four arrays for 10 GbE
- Four iSCSI volumes dedicated to each host (1 GbE)
- 16 iSCSI volumes dedicated to each host (10 GbE)

Note: A host to storage port ratio of 1:1 was maintained (16 host ports: 16 array ports for 1 Gb and four host ports: four array ports for 10 Gb).

The two S4820T switches were configured in a LAG and the entire configuration was cabled using EqualLogic best practices. Hardware specifications of the servers and arrays are in [Appendix A](#), titled "Solution infrastructure details".

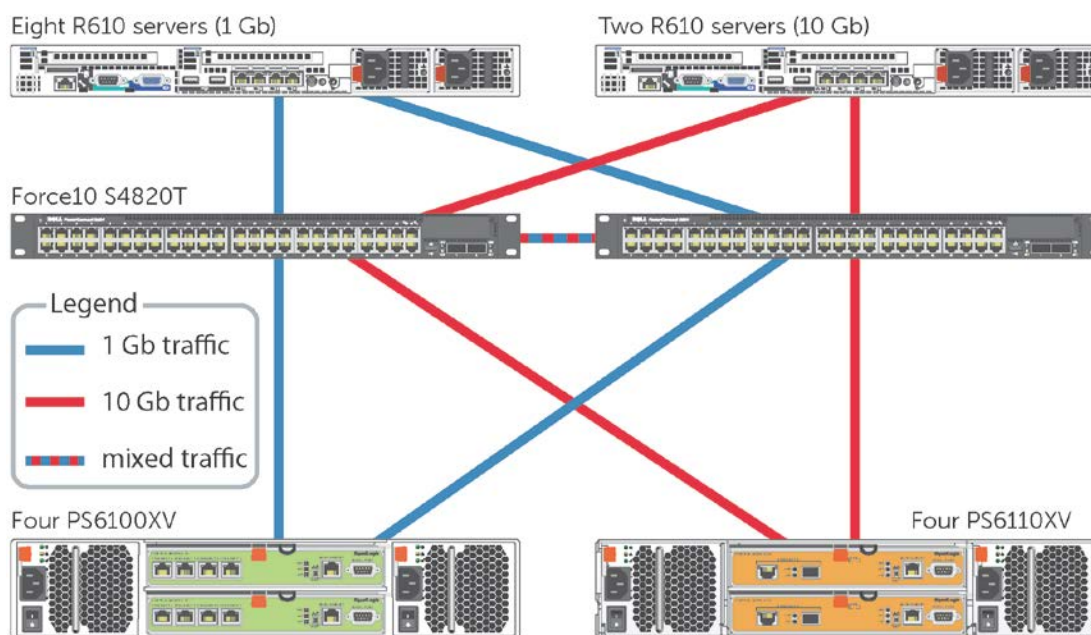


Figure 3 Test configuration C

4.4 10 Gb environment (baseline)

This section describes test configuration D which used a pure 10 GbE environment as illustrated in Figure 4.

- Two PowerEdge R610 servers
 - Windows Server 2008 R2 SP1
 - One 10 GbE Intel X540 NIC per 10 Gb host (two active 10 GbE ports on the SAN)
- Four EqualLogic PS6110XV (10 Gb) arrays
 - One active 10GBASE-T storage controller port (one active 10 GbE port on the SAN)
- Two Force10 S4820T switches
 - LACP LACP between the 2 S4820T switches
- One pool of four arrays
- Four iSCSI volumes dedicated to each host (1 GbE)

Note: A host to storage port ratio of 1:1 was maintained (4 host ports: 4 array ports).

The two Force10 S4820T switches were configured in a LAG and the entire configuration was cabled using EqualLogic best practices. Hardware specifications of the servers and arrays is available in [Appendix A](#), titled, "Solution infrastructure details".

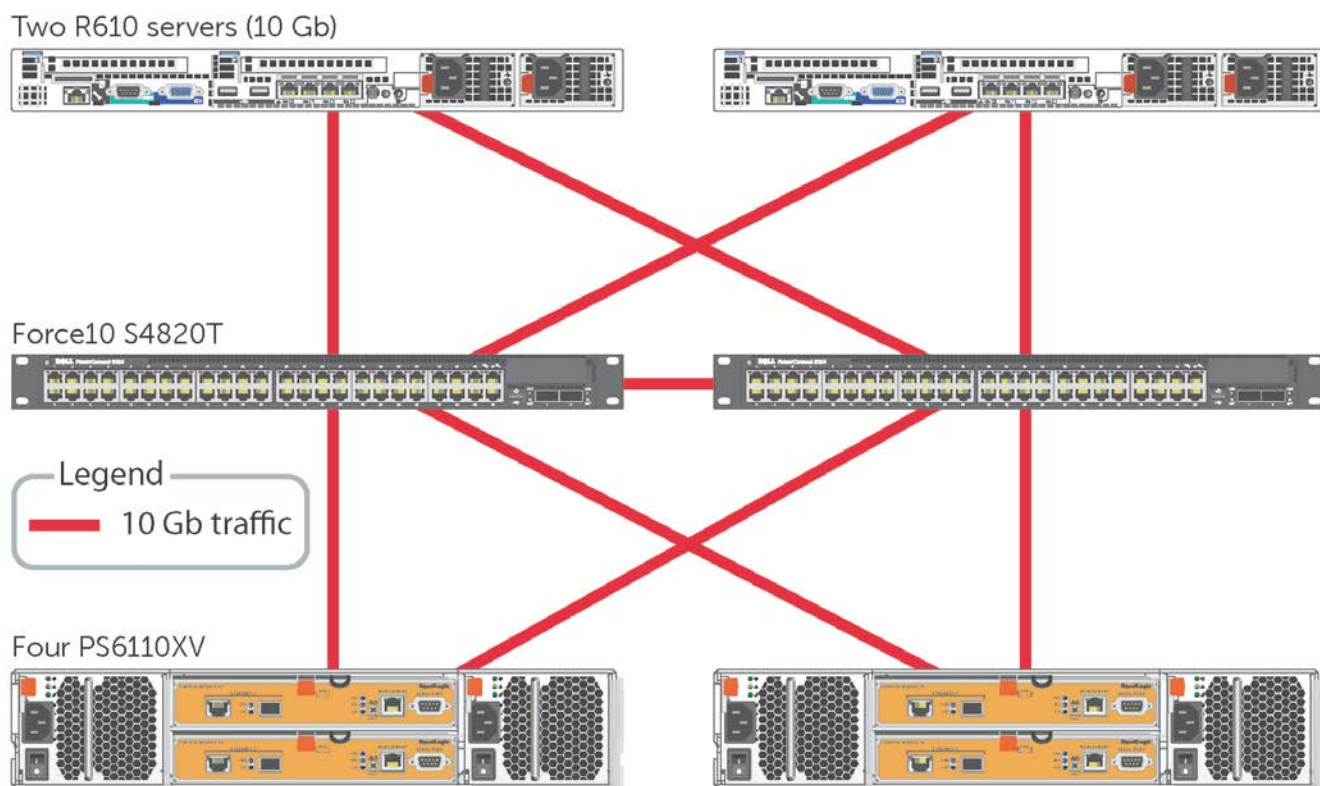


Figure 4 Test configuration D

5 Results and analysis

Note: The results provided in this paper are intended for the purpose of comparing the specific configurations used in our lab environment. The results do not portray the maximum capabilities of any system, software, or storage.

The graph in Figure 5 shows a performance comparison of a pure 1 Gb environment (test configuration A - baseline) and a 1 Gb environment using the Force10 S4820T 10 Gb switch auto-negotiated down to 1 Gb speeds (test configuration B). All of the workloads previously defined are shown. This graph illustrates that running a 1 Gb environment using a 10 Gb switch auto-negotiated to 1 Gb has a minimal effect on the performance of the SAN with the exception of the sequential workloads which have slightly better performance with the 10Gb switch versus the 1 Gb switch.

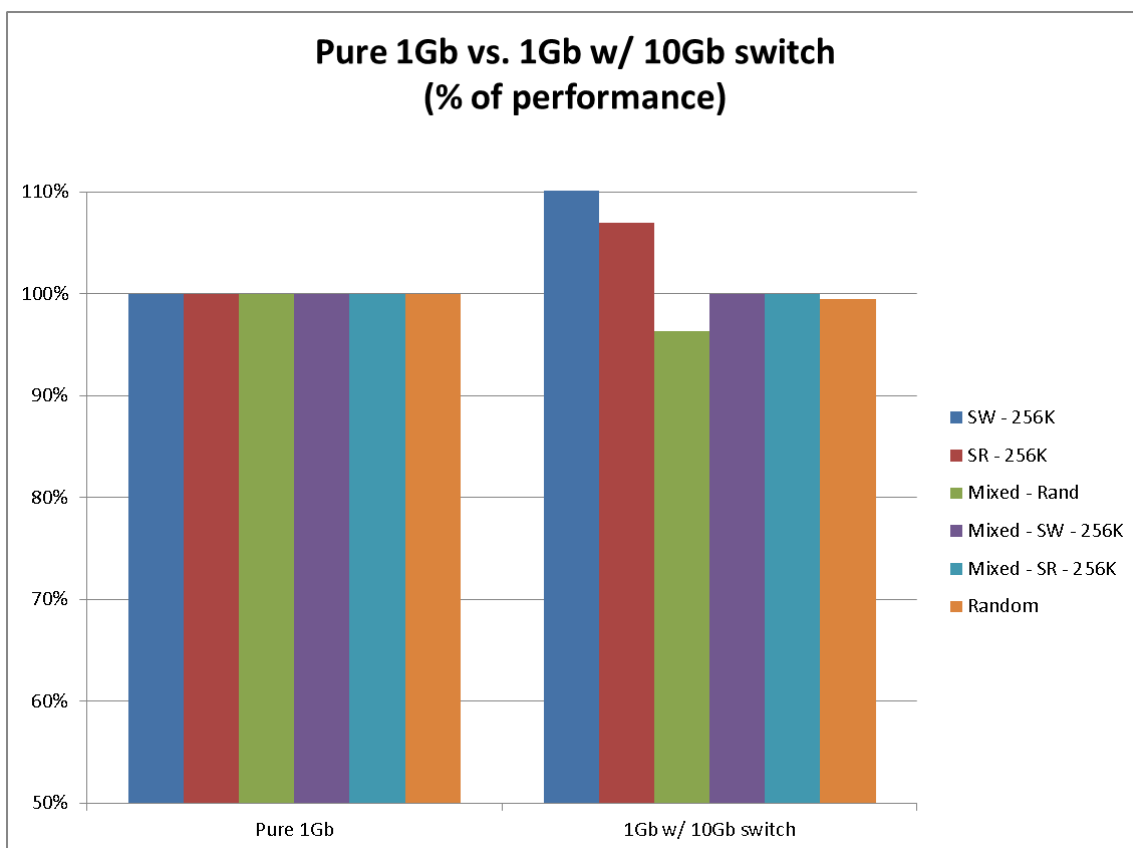


Figure 5 Pure 1 Gb versus 1 Gb with 10 Gb switch

The graph in Figure 6 shows the performance comparison of a pure 1 Gb environment (test configuration A - baseline) and a 1 Gb performance in a mixed speed environment with both 1 Gb and 10Gb devices connected to the same switch (test configuration C). All the workloads previously defined are shown. Figure 6 illustrates that running in a mixed speed environment with both 1 Gb and 10Gb devices connected to the same switch has very little effect on the 1 Gb performance of the SAN.

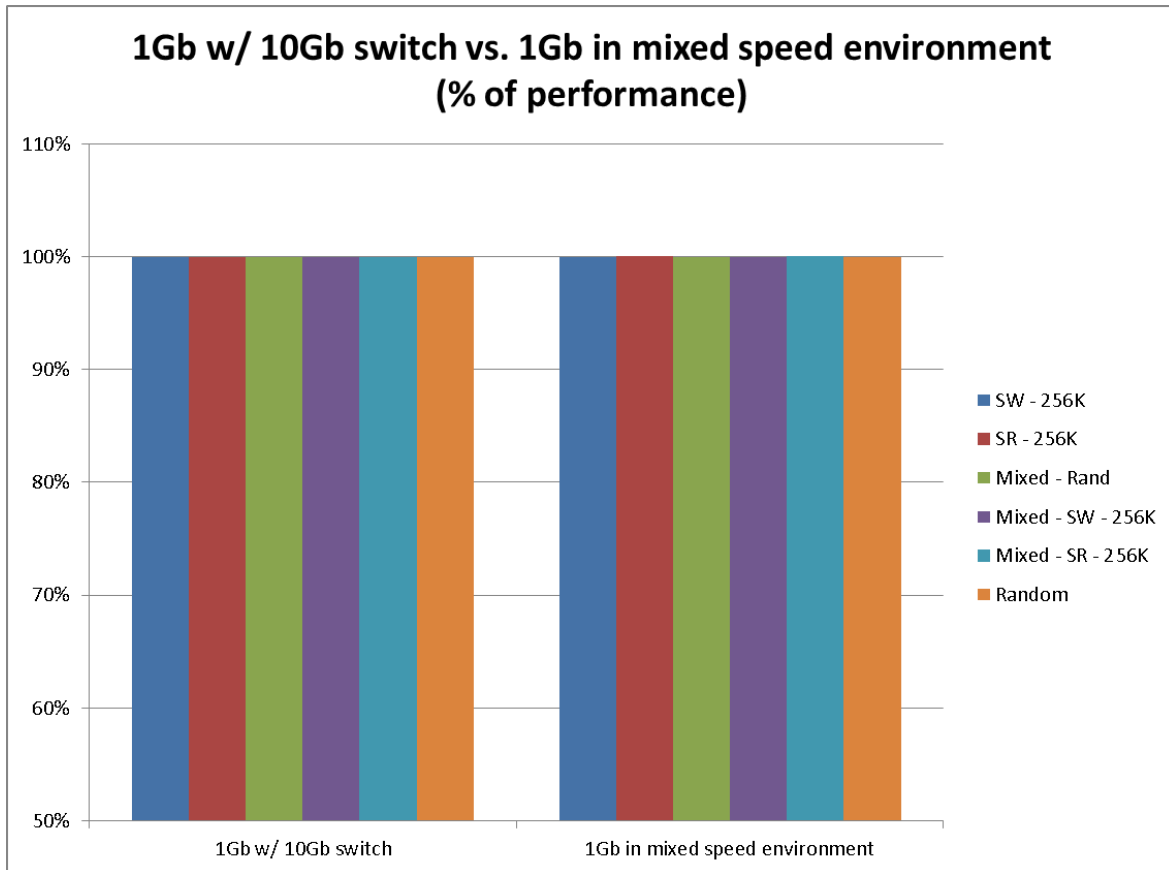


Figure 6 1 Gb with 10 Gb switch versus 1 Gb in a mixed speed environment

Figure 7 illustrates the performance comparison of a pure 10 Gb environment (test configuration D – baseline) and a 10 Gb in a mixed speed environment with both 1 Gb devices and 10 Gb devices connected to the same switch (test configuration C). All the workloads previously defined are shown. This graph shows that running in a mixed speed environment with both 1 Gb and 10 Gb devices connected to the same switch has a very minor effect (< 3%) on the 10 Gb performance of the SAN.

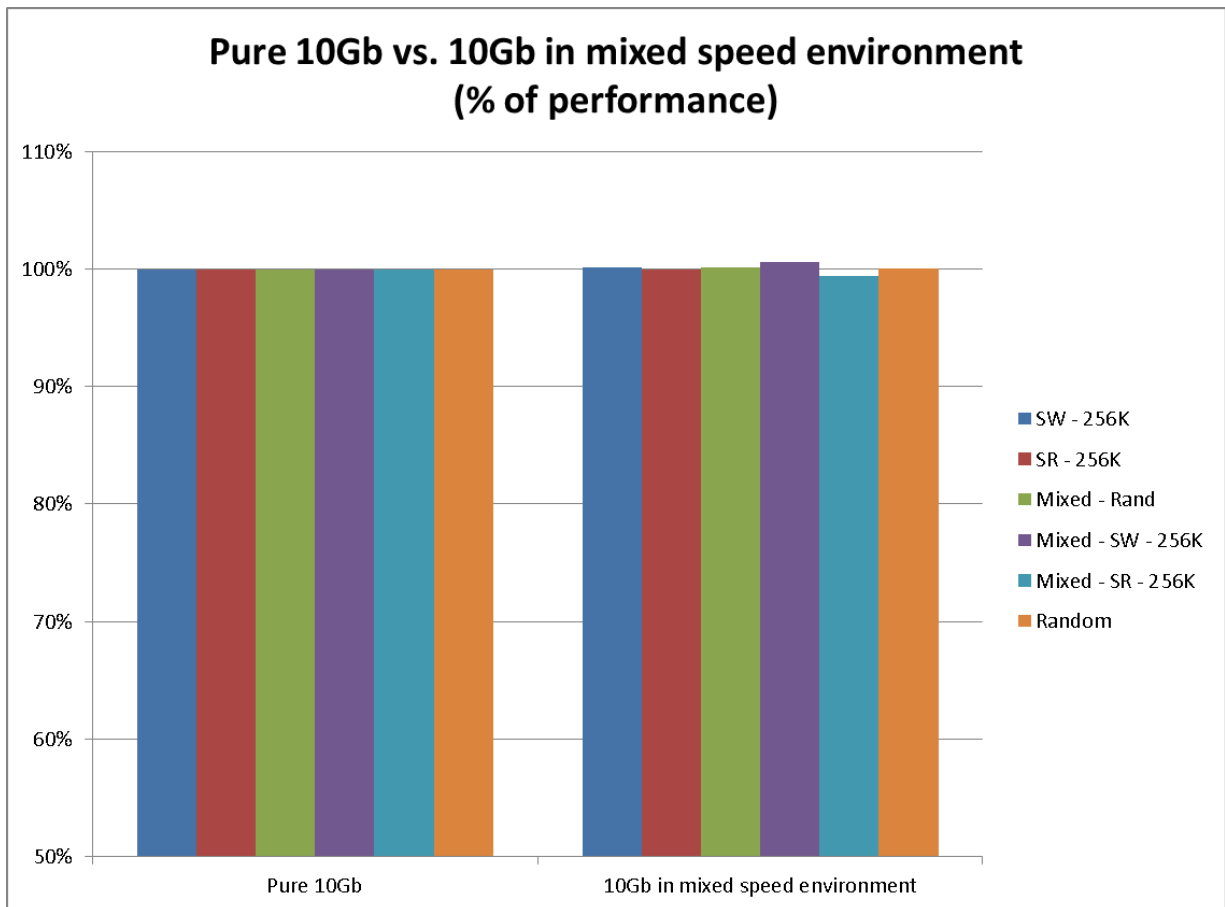


Figure 7 Pure 10 Gb versus 10 Gb in a mixed speed environment



6 Best practice recommendations

While transitioning from a pure 1 Gb infrastructure to a pure 10 Gb infrastructure, it may be necessary to have both 1 Gb and 10 Gb arrays in the same SAN infrastructure. When using mixed speed devices, use the following best practices:

- When using a switch in a mixed speed environment, the 1 Gb arrays and the 10 Gb arrays must be kept in separate pools.
- 1 Gb hosts should only be connected to 1 Gb arrays.
- 10 Gb hosts should only be connected to 10 Gb arrays.
Connecting a 1 Gb host to a 10 Gb array or a 10 Gb host to a 1 Gb array can result in a host or array port overloading. This is because the 10 Gb ports have bandwidth capabilities that are ten times the 1 Gb port. If a host port attempts to send ten times more data than the array port is able to process, then it can result in dropped packets and will degrade the performance of the SAN.
- When migrating the switch from a 1 Gb to a 10 Gb environment, downtime of the network must be considered. Physically replacing a 1 Gb switch with a 10 Gb switch requires downtime and, after replacement, the 1 Gb switch has to be initially configured. Once configured, the Force10 S4820T does not have to be re-configured for 1 Gb or 10 Gb operation. At this point, the user can connect the 10 Gb hosts and 10 Gb arrays to the switch to run in a mixed-speed environment.
- Several methods are available to transition the hosts and arrays from a mixed speed environment to a pure 10 Gb environment. One method is to remove the 1 Gb hosts and arrays from the infrastructure and replace them with new 10 Gb hosts and arrays. This method requires data migration from the 1 Gb arrays to the new 10 Gb arrays. EqualLogic includes a feature with the ability to move volumes from one storage pool (set of arrays) to another storage pool. Once the volumes have been successfully moved from the 1 Gb arrays to the new 10 Gb arrays using the "move volume" operation, the 1 Gb arrays can be deleted and removed from the SAN group for repurposing. This feature, along with the ability to have 1 Gb arrays in the same SAN with 10 Gb arrays, provides a simple process for migrating from a pure 1 Gb solution to a pure 10 Gb solution.
- Another method to transition hosts and arrays is to convert the existing 1 Gb hosts and arrays to 10 Gb. On the host side, this requires downtime in order to replace the 1 Gb NIC in the host with a 10 Gb NIC, to download and install new drivers, and to download and install other necessary software and firmware. After the correct 10 Gb network infrastructure and connections are in place, the arrays can be converted.
 - There are two available strategies when converting arrays depending on whether or not temporary data unavailability can be tolerated. Note that testing these strategies was not within the scope of this paper.
 - > Downtime strategy
If a short period (less than an hour) of data unavailability can be tolerated, the downtime strategy should be used. The array to be converted is shut down, converted, and then



brought back up to rejoin the group. This is the simpler of the two strategies because it takes the least amount of time and requires no data movement. However, any volumes that are wholly or partially contained on the array that is being converted will be unavailable while it is shut down.

> No downtime strategy

The no downtime strategy is used when data must be available at all times. The array to be converted is first removed from the group using the delete member operation, converted while out of the group, and then rejoined to the group. Since the delete member function moves all data off the array before removing it from the group and maintains all volumes online and accessible while doing so, there is no downtime. However, this method takes significantly longer than the downtime method because the data must be migrated off and then back onto the array that is being converted. This method also requires enough free space on the group to temporarily hold the data being moved from the array. If the extra space is not available, another member can be temporarily added to the group.



Conclusion

This paper demonstrates that 1 Gb arrays and 10 Gb arrays can be connected to the same switch and mixed speed traffic can be run without any performance degradation. It also shows that a 1 Gb SAN using a 10 Gb switch with auto-negotiable 1 GbE/10 GbE ports will not experience any performance degradation compared to a 1 GbE SAN using a 1Gb switch.



A Solution infrastructure details

Switch Configuration Guides are also published to provide step-by-step instructions for configuring Ethernet switches for use with EqualLogic PS Series storage using Dell best practices. These SCGs are located on Dell TechCenter at <http://en.community.dell.com/techcenter/storage/w/wiki/4250.switch-configuration-guides-by-sis.aspx>.

Switches	
Switch Model	PowerConnect 7048R
7048R Firmware	Firmware version: 4.2.1.3
Switch Model	Force10 S4820T
8164 Firmware	Firmware version: 8.3.19.0

Server	
Server Model	PowerEdge R610
BIOS	Dell Inc. 6.2.3, 4/26/12
Processor	Intel(R) Xeon(R) CPU E5520 @ 2.27GHz, 2261 Mhz, 4 Core(s), 8 Logical Processor(s)
OS Name	Microsoft Windows Server 2008 R2 Enterprise
OS Version	6.1.7601 SP1 Build 7601

Network Adapter (1G)	
Model	Broadcom BCM5709C NetXtreme II GigE (NDIS VBD Client)
Driver Version	7.2.8.0
Profile	Storage Server
Jumbo Packet	9000 Bytes
Flow Control	RX/TX enabled



iSCSI initiator version	6.1.7601.17514
RX buffers	3000
TX Buffers	5000

Network Adapter (10G)	
Model	Intel(R) Ethernet 10G 2P X540-t
Driver Version	2.11.114.0
Use Data Center Bridging	Disabled
Profile	Storage Server
Jumbo Packet	9014 Bytes
Flow Control	RX/TX enabled
iSCSI initiator version	6.1.7601.17514
RX buffers	4096
TX Buffers	16384

MPIO Configuration	
HITKit version	4.0.0.6163
MPIO Device Specific Module	Maximum sessions per slice:2
	Maximum sessions per volume:6
Default Load Balancing Policy	Least Queue Depth

Array (1G)	
Model	PS6100XV
Firmware	6.0.1 (R264419)
Enable performance load balancing in pools	disabled



Array (1G)	
Raid Type	RAID 10
Control module	Model70-0400(TYPE 11)
Boot ROM	3.6.4
Cables to Switch	CAT6 copper

Array (10G)	
Model	PS6110XV
Firmware	6.0.1 (R264419)
Enable performance load balancing in pools	disabled
Raid Type	RAID 10
Control module	model70-0477 (TYPE 14)
Boot ROM	3.9.1
Cables to Switch	CAT6 copper



B Vdbench parameters

```
sd=A-a,lun=\\.\PhysicalDrive1
sd=A-b,lun=\\.\PhysicalDrive2
sd=A-c,lun=\\.\PhysicalDrive3
sd=A-d,lun=\\.\PhysicalDrive4
sd=A-e,lun=\\.\PhysicalDrive5
sd=A-f,lun=\\.\PhysicalDrive6
sd=A-g,lun=\\.\PhysicalDrive7
sd=A-h,lun=\\.\PhysicalDrive8
sd=A-i,lun=\\.\PhysicalDrive9
sd=A-j,lun=\\.\PhysicalDrive10
sd=A-k,lun=\\.\PhysicalDrive11
sd=A-l,lun=\\.\PhysicalDrive12
sd=A-m,lun=\\.\PhysicalDrive13
sd=A-n,lun=\\.\PhysicalDrive14
sd=A-o,lun=\\.\PhysicalDrive15
sd=A-p,lun=\\.\PhysicalDrive16
```

```
sd=B-a,lun=\\.\PhysicalDrive1,range=(0m,10m),hitarea=1m
sd=B-b,lun=\\.\PhysicalDrive2,range=(0m,10m),hitarea=1m
sd=B-c,lun=\\.\PhysicalDrive3,range=(0m,10m),hitarea=1m
sd=B-d,lun=\\.\PhysicalDrive4,range=(0m,10m),hitarea=1m
sd=B-e,lun=\\.\PhysicalDrive5,range=(0m,10m),hitarea=1m
sd=B-f,lun=\\.\PhysicalDrive6,range=(0m,10m),hitarea=1m
sd=B-g,lun=\\.\PhysicalDrive7,range=(0m,10m),hitarea=1m
sd=B-h,lun=\\.\PhysicalDrive8,range=(0m,10m),hitarea=1m
sd=B-i,lun=\\.\PhysicalDrive9,range=(0m,10m),hitarea=1m
sd=B-j,lun=\\.\PhysicalDrive10,range=(0m,10m),hitarea=1m
sd=B-k,lun=\\.\PhysicalDrive11,range=(0m,10m),hitarea=1m
sd=B-l,lun=\\.\PhysicalDrive12,range=(0m,10m),hitarea=1m
sd=B-m,lun=\\.\PhysicalDrive13,range=(0m,10m),hitarea=1m
sd=B-n,lun=\\.\PhysicalDrive14,range=(0m,10m),hitarea=1m
sd=B-o,lun=\\.\PhysicalDrive15,range=(0m,10m),hitarea=1m
sd=B-p,lun=\\.\PhysicalDrive16,range=(0m,10m),hitarea=1m
```

```
sd=C-a,lun=\\.\PhysicalDrive1
sd=C-b,lun=\\.\PhysicalDrive2
sd=C-c,lun=\\.\PhysicalDrive3
sd=C-d,lun=\\.\PhysicalDrive4
sd=C-e,lun=\\.\PhysicalDrive5
sd=C-f,lun=\\.\PhysicalDrive6
sd=C-g,lun=\\.\PhysicalDrive7
sd=C-h,lun=\\.\PhysicalDrive8
sd=D-a,lun=\\.\PhysicalDrive9,range=(0m,10m),hitarea=1m
sd=D-b,lun=\\.\PhysicalDrive10,range=(0m,10m),hitarea=1m
```



```

sd=D-c,lun=\\.\PhysicalDrive11,range=(0m,10m),hitarea=1m
sd=D-d,lun=\\.\PhysicalDrive12,range=(0m,10m),hitarea=1m
sd=E-e,lun=\\.\PhysicalDrive13,range=(0m,10m),hitarea=1m
sd=E-f,lun=\\.\PhysicalDrive14,range=(0m,10m),hitarea=1m
sd=E-g,lun=\\.\PhysicalDrive15,range=(0m,10m),hitarea=1m
sd=E-h,lun=\\.\PhysicalDrive16,range=(0m,10m),hitarea=1m

wd=wd1,sd=A-*,seekpct=100,rdpct=67,xfersize=8k,iorate=9999999,priority=1
wd=wd2,sd=B-
*,seekpct=0,rdpct=100,rhpct=100,whpct=100,xfersize=256k,iorate=9999999,priority=
1
wd=wr1,sd=B-
*,seekpct=0,rdpct=0,xfersize=256k,rhpct=100,whpct=100,iorate=9999999,priority=1

* Rand 8K I/O on 50% volumes
wd=wm1,sd=C-*,seekpct=100,rdpct=67,xfersize=8k

* Seq Read 256K on 25% volumes
wd=wm2,sd=D-*,seekpct=0,rdpct=100,rhpct=100,whpct=100,xfersize=256k

* Seq Write 256K on 25% volumes
wd=wm3,sd=E-*,seekpct=0,rdpct=0,xfersize=256k,rhpct=100,whpct=100

rd=rd1,wd=wr1,elapsed=10800,interval=30,forthreads=5
rd=rd2,wd=wd2,elapsed=10800,interval=30,forthreads=5
rd=rd3,wd=wd1,elapsed=10800,interval=30,forthreads=5
rd=rd1,wd=wm*,elapsed=10800,interval=30,forthreads=5,iorate=9999999

```



C Switch Configs

This appendix contains the running configs for both S4820T switches used in this paper. The configurations were the same for all test cases in which the S4820T was used.

```
-----
----- Switch 1 RUNNING CONFIG -----
-----
show run
Current Configuration ...
! Version 8.3.19.0
! Last configuration change at Thu Apr 25 06:06:43 2013 by admin
! Startup-config last updated at Thu Apr 25 06:07:07 2013 by admin
!
boot system stack-unit 0 primary system: A:
boot system stack-unit 0 secondary system: B:
boot system stack-unit 0 default system: A:
!
redundancy auto-synchronize full
!
hardware watchdog
!
hostname sw1
!
enable password level 15 7 b125455cf679b208e757efcd29be021d58a2feb76a450d1c
!
username admin password 7 d56e97de90fffd4b privilege 15
!
stack-unit 0 provision S4820
!
interface TenGigabitEthernet 0/0
  no ip address
  mtu 12000
  switchport
  flowcontrol rx on tx off
  spanning-tree rstp edge-port
  no shutdown
!
interface TenGigabitEthernet 0/1
  no ip address
  mtu 12000
  switchport
  flowcontrol rx on tx off
  spanning-tree rstp edge-port
  no shutdown
```




```

!
interface TenGigabitEthernet 0/2
  no ip address
  mtu 12000
  switchport
  flowcontrol rx on tx off
  spanning-tree rstp edge-port
  no shutdown
!
interface TenGigabitEthernet 0/3
  no ip address
  mtu 12000
  switchport
  flowcontrol rx on tx off
  spanning-tree rstp edge-port
  no shutdown
!
interface TenGigabitEthernet 0/4
  no ip address
  mtu 12000
  switchport
  flowcontrol rx on tx off
  spanning-tree rstp edge-port
  no shutdown
!
interface TenGigabitEthernet 0/5
  no ip address
  mtu 12000
  switchport
  flowcontrol rx on tx off
  spanning-tree rstp edge-port
  no shutdown
!
interface TenGigabitEthernet 0/6
  no ip address
  mtu 12000
  switchport
  flowcontrol rx on tx off
  spanning-tree rstp edge-port
  no shutdown
!
interface TenGigabitEthernet 0/7
  no ip address
  mtu 12000
  switchport
  flowcontrol rx on tx off
  spanning-tree rstp edge-port

```



```

no shutdown
!
interface TenGigabitEthernet 0/8
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree rstp edge-port
no shutdown
!
interface TenGigabitEthernet 0/9
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree rstp edge-port
no shutdown
!
interface TenGigabitEthernet 0/10
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree rstp edge-port
no shutdown
!
interface TenGigabitEthernet 0/11
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree rstp edge-port
no shutdown
!
interface TenGigabitEthernet 0/12
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree rstp edge-port
no shutdown
!
interface TenGigabitEthernet 0/13
no ip address
mtu 12000
switchport
flowcontrol rx on tx off

```



```

    spanning-tree rstp edge-port
    no shutdown
!
interface TenGigabitEthernet 0/14
    no ip address
    mtu 12000
    switchport
    flowcontrol rx on tx off
    spanning-tree rstp edge-port
    no shutdown
!
interface TenGigabitEthernet 0/15
    no ip address
    mtu 12000
    switchport
    flowcontrol rx on tx off
    spanning-tree rstp edge-port
    no shutdown
!
interface TenGigabitEthernet 0/16
    no ip address
    mtu 12000
    switchport
    flowcontrol rx on tx off
    spanning-tree rstp edge-port
    no shutdown
!
interface TenGigabitEthernet 0/17
    no ip address
    mtu 12000
    switchport
    flowcontrol rx on tx off
    spanning-tree rstp edge-port
    no shutdown
!
interface TenGigabitEthernet 0/18
    no ip address
    mtu 12000
    switchport
    flowcontrol rx on tx off
    spanning-tree rstp edge-port
    no shutdown
!
interface TenGigabitEthernet 0/19
    no ip address
    mtu 12000
    switchport

```



```

flowcontrol rx on tx off
spanning-tree rstp edge-port
no shutdown
!
interface TenGigabitEthernet 0/20
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree rstp edge-port
no shutdown
!
interface TenGigabitEthernet 0/21
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree rstp edge-port
no shutdown
!
interface TenGigabitEthernet 0/22
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree rstp edge-port
no shutdown
!
interface TenGigabitEthernet 0/23
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree rstp edge-port
no shutdown
!
interface TenGigabitEthernet 0/24
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree mstp edge-port
spanning-tree rstp edge-port
spanning-tree 0 portfast
spanning-tree pvst edge-port
no shutdown
!

```



```

interface TenGigabitEthernet 0/25
  no ip address
  mtu 12000
  switchport
  flowcontrol rx on tx off
  spanning-tree mstp edge-port
  spanning-tree rstp edge-port
  spanning-tree 0 portfast
  spanning-tree pvst edge-port
  no shutdown
!
interface TenGigabitEthernet 0/26
  no ip address
  mtu 12000
  switchport
  flowcontrol rx on tx off
  spanning-tree mstp edge-port
  spanning-tree rstp edge-port
  spanning-tree 0 portfast
  spanning-tree pvst edge-port
  no shutdown
!
interface TenGigabitEthernet 0/27
  no ip address
  mtu 12000
  switchport
  flowcontrol rx on tx off
  spanning-tree mstp edge-port
  spanning-tree rstp edge-port
  spanning-tree 0 portfast
  spanning-tree pvst edge-port
  no shutdown
!
interface TenGigabitEthernet 0/28
  no ip address
  mtu 12000
  switchport
  flowcontrol rx on tx off
  spanning-tree mstp edge-port
  spanning-tree rstp edge-port
  spanning-tree 0 portfast
  spanning-tree pvst edge-port
  no shutdown
!
interface TenGigabitEthernet 0/29
  no ip address
  mtu 12000

```



```

switchport
flowcontrol rx on tx off
spanning-tree mstp edge-port
spanning-tree rstp edge-port
spanning-tree 0 portfast
spanning-tree pvst edge-port
no shutdown
!
interface TenGigabitEthernet 0/30
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree mstp edge-port
spanning-tree rstp edge-port
spanning-tree 0 portfast
spanning-tree pvst edge-port
no shutdown
!
interface TenGigabitEthernet 0/31
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree mstp edge-port
spanning-tree rstp edge-port
spanning-tree 0 portfast
spanning-tree pvst edge-port
no shutdown
!
interface TenGigabitEthernet 0/32
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree mstp edge-port
spanning-tree rstp edge-port
spanning-tree 0 portfast
spanning-tree pvst edge-port
no shutdown
!
interface TenGigabitEthernet 0/33
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree mstp edge-port

```



```

spanning-tree rstp edge-port
spanning-tree 0 portfast
spanning-tree pvst edge-port
no shutdown
!
interface TenGigabitEthernet 0/34
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree mstp edge-port
spanning-tree rstp edge-port
spanning-tree 0 portfast
spanning-tree pvst edge-port
no shutdown
!
interface TenGigabitEthernet 0/35
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree mstp edge-port
spanning-tree rstp edge-port
spanning-tree 0 portfast
spanning-tree pvst edge-port
no shutdown
!
interface TenGigabitEthernet 0/36
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree mstp edge-port
spanning-tree rstp edge-port
spanning-tree 0 portfast
spanning-tree pvst edge-port
no shutdown
!
interface TenGigabitEthernet 0/37
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree mstp edge-port
spanning-tree rstp edge-port
spanning-tree 0 portfast
spanning-tree pvst edge-port

```



```

no shutdown
!
interface TenGigabitEthernet 0/38
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree mstp edge-port
spanning-tree rstp edge-port
spanning-tree 0 portfast
spanning-tree pvst edge-port
no shutdown
!
interface TenGigabitEthernet 0/39
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree mstp edge-port
spanning-tree rstp edge-port
spanning-tree 0 portfast
spanning-tree pvst edge-port
no shutdown
!
interface TenGigabitEthernet 0/40
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree mstp edge-port
spanning-tree rstp edge-port
spanning-tree 0 portfast
spanning-tree pvst edge-port
no shutdown
!
interface TenGigabitEthernet 0/41
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree mstp edge-port
spanning-tree rstp edge-port
spanning-tree 0 portfast
spanning-tree pvst edge-port
no shutdown
!
interface TenGigabitEthernet 0/42

```




```

no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree mstp edge-port
spanning-tree rstp edge-port
spanning-tree 0 portfast
spanning-tree pvst edge-port
no shutdown
!
interface TenGigabitEthernet 0/43
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree mstp edge-port
spanning-tree rstp edge-port
spanning-tree 0 portfast
spanning-tree pvst edge-port
no shutdown
!
interface TenGigabitEthernet 0/44
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree mstp edge-port
spanning-tree rstp edge-port
spanning-tree 0 portfast
spanning-tree pvst edge-port
no shutdown
!
interface TenGigabitEthernet 0/45
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree mstp edge-port
spanning-tree rstp edge-port
spanning-tree 0 portfast
spanning-tree pvst edge-port
no shutdown
!
interface TenGigabitEthernet 0/46
no ip address
mtu 12000
switchport

```



```

flowcontrol rx on tx off
spanning-tree mstp edge-port
spanning-tree rstp edge-port
spanning-tree 0 portfast
spanning-tree pvst edge-port
no shutdown
!
interface TenGigabitEthernet 0/47
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree mstp edge-port
spanning-tree rstp edge-port
spanning-tree 0 portfast
spanning-tree pvst edge-port
no shutdown
!
interface fortyGigE 0/48
no ip address
mtu 12000
flowcontrol rx on tx off
!
port-channel-protocol LACP
port-channel 1 mode active
no shutdown
!
interface fortyGigE 0/52
no ip address
mtu 12000
flowcontrol rx on tx off
!
port-channel-protocol LACP
port-channel 1 mode active
no shutdown
!
interface fortyGigE 0/56
no ip address
mtu 12000
flowcontrol rx on tx off
no shutdown
!
interface fortyGigE 0/60
no ip address
mtu 12000
flowcontrol rx on tx off
no shutdown

```



```

!
interface ManagementEthernet 0/0
  ip address 192.168.54.242/24
  no shutdown
!
interface ManagementEthernet 1/0
  no shutdown
!
interface ManagementEthernet 2/0
  no shutdown
!
interface ManagementEthernet 3/0
  no shutdown
!
interface ManagementEthernet 4/0
  no shutdown
!
interface ManagementEthernet 5/0
  no shutdown
!
interface ManagementEthernet 6/0
  no shutdown
!
interface ManagementEthernet 7/0
  no shutdown
!
interface ManagementEthernet 8/0
  no shutdown
!
interface ManagementEthernet 9/0
  no shutdown
!
interface ManagementEthernet 10/0
  no shutdown
!
interface ManagementEthernet 11/0
  no shutdown
!
interface Port-channel 1
  no ip address
  mtu 12000
  switchport
  no shutdown
!
interface Vlan 1
!untagged TenGigabitEthernet 0/0-47
!untagged Port-channel 1

```



```

!
management route 192.168.0.0/16 192.168.54.1
!
ip ssh server enable
!
protocol lldp
!
line console 0
  exec-timeout 0 0
line vty 0
  exec-timeout 0 0
line vty 1
line vty 2
line vty 3
line vty 4
line vty 5
line vty 6
line vty 7
line vty 8
line vty 9
!
end
swl#

```

```

-----
-----          VERSION          -----
-----

```

```

show version
Dell Force10 Real Time Operating System Software
Dell Force10 Operating System Version: 2.0
Dell Force10 Application Software Version: 8.3.19.0
Copyright (c) 1999-2012 by Dell Inc. All Rights Reserved.
Build Time: Fri Dec 21 20:21:22 2012
Build Path: /sites/sjc/work/build/buildSpaces/build08/E8-3-
19/SW/SRC/Cp_src/Radius
swl uptime is 4 week(s), 0 day(s), 0 hour(s), 19 minute(s)

```

System image file is "system://A"

```

System Type: S4820
Control Processor: Freescale QorIQ P2020 with 2147483648 bytes of memory.

```



128M bytes of boot flash memory.

1 52-port GE/TE/FG (SE)
48 Ten GigabitEthernet/IEEE 802.3 interface(s)
4 Forty GigabitEthernet/IEEE 802.3 interface(s)
sw1#

----- Interface Status -----

show interface status

Port	Description	Status	Speed	Duplex	Vlan
Te 0/0		Up	1000 Mbit	Full	1
Te 0/1		Up	1000 Mbit	Full	1
Te 0/2		Up	1000 Mbit	Full	1
Te 0/3		Up	1000 Mbit	Full	1
Te 0/4		Up	1000 Mbit	Full	1
Te 0/5		Up	1000 Mbit	Full	1
Te 0/6		Up	1000 Mbit	Full	1
Te 0/7		Up	1000 Mbit	Full	1
Te 0/8		Up	10000 Mbit	Full	1
Te 0/9		Up	10000 Mbit	Full	1
Te 0/10		Down	Auto	Auto	1
Te 0/11		Down	Auto	Auto	1
Te 0/12		Down	Auto	Auto	1
Te 0/13		Down	Auto	Auto	1
Te 0/14		Down	Auto	Auto	1
Te 0/15		Down	Auto	Auto	1
Te 0/16		Down	Auto	Auto	1
Te 0/17		Down	Auto	Auto	1
Te 0/18		Down	Auto	Auto	1
Te 0/19		Down	Auto	Auto	1
Te 0/20		Down	Auto	Auto	1
Te 0/21		Down	Auto	Auto	1
Te 0/22		Down	Auto	Auto	1
Te 0/23		Down	Auto	Auto	1
Te 0/24		Up	1000 Mbit	Full	1
Te 0/25		Up	1000 Mbit	Full	1
Te 0/26		Up	1000 Mbit	Full	1
Te 0/27		Up	1000 Mbit	Full	1
Te 0/28		Up	1000 Mbit	Full	1
Te 0/29		Up	1000 Mbit	Full	1
Te 0/30		Up	1000 Mbit	Full	1
Te 0/31		Up	1000 Mbit	Full	1
Te 0/32		Up	1000 Mbit	Full	1
Te 0/33		Up	1000 Mbit	Full	1



Te 0/34	Up	1000 Mbit Full	1
Te 0/35	Up	1000 Mbit Full	1
Te 0/36	Up	1000 Mbit Full	1
Te 0/37	Up	1000 Mbit Full	1
Te 0/38	Up	1000 Mbit Full	1
Te 0/39	Up	1000 Mbit Full	1
Te 0/40	Up	10000 Mbit Full	1
Te 0/41	Up	10000 Mbit Full	1
Te 0/42	Down	Auto Auto	1
Te 0/43	Up	10000 Mbit Full	1
Te 0/44	Up	10000 Mbit Full	1
Te 0/45	Up	10000 Mbit Full	1
Te 0/46	Up	10000 Mbit Full	1
Te 0/47	Up	10000 Mbit Full	1
Fo 0/48	Up	40000 Mbit Full	--
Fo 0/52	Up	40000 Mbit Full	--
Fo 0/56	Down	40000 Mbit Auto	--
Fo 0/60	Down	40000 Mbit Auto	--

swl#



```

-----
----- Switch 2  RUNNING CONFIG -----
-----
show run
Current Configuration ...
! Version 8.3.19.0
! Last configuration change at Thu Apr 25 06:05:47 2013 by admin
! Startup-config last updated at Thu Apr 25 06:05:53 2013 by admin
!
boot system stack-unit 0 primary system: A:
boot system stack-unit 0 secondary system: B:
boot system stack-unit 0 default system: A:
!
redundancy auto-synchronize full
!
hardware watchdog
!
hostname sw2
!
enable password level 15 7 b125455cf679b208e757efcd29be021d58a2feb76a450d1c
!
username admin password 7 d56e97de90fffd4b privilege 15
!
stack-unit 0 provision S4820
!
interface TenGigabitEthernet 0/0
  no ip address
  mtu 12000
  switchport
  flowcontrol rx on tx off
  spanning-tree rstp edge-port
  no shutdown
!
interface TenGigabitEthernet 0/1
  no ip address
  mtu 12000
  switchport
  flowcontrol rx on tx off
  spanning-tree rstp edge-port
  no shutdown
!
interface TenGigabitEthernet 0/2
  no ip address
  mtu 12000
  switchport
  flowcontrol rx on tx off
  spanning-tree rstp edge-port

```



```

no shutdown
!
interface TenGigabitEthernet 0/3
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree rstp edge-port
no shutdown
!
interface TenGigabitEthernet 0/4
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree rstp edge-port
no shutdown
!
interface TenGigabitEthernet 0/5
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree rstp edge-port
no shutdown
!
interface TenGigabitEthernet 0/6
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree rstp edge-port
no shutdown
!
interface TenGigabitEthernet 0/7
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree rstp edge-port
no shutdown
!
interface TenGigabitEthernet 0/8
no ip address
mtu 12000
switchport
flowcontrol rx on tx off

```




```

spanning-tree rstp edge-port
no shutdown
!
interface TenGigabitEthernet 0/9
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree rstp edge-port
no shutdown
!
interface TenGigabitEthernet 0/10
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree rstp edge-port
no shutdown
!
interface TenGigabitEthernet 0/11
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree rstp edge-port
no shutdown
!
interface TenGigabitEthernet 0/12
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree rstp edge-port
no shutdown
!
interface TenGigabitEthernet 0/13
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree rstp edge-port
no shutdown
!
interface TenGigabitEthernet 0/14
no ip address
mtu 12000
switchport

```



```

    flowcontrol rx on tx off
    spanning-tree rstp edge-port
    no shutdown
!
interface TenGigabitEthernet 0/15
    no ip address
    mtu 12000
    switchport
    flowcontrol rx on tx off
    spanning-tree rstp edge-port
    no shutdown
!
interface TenGigabitEthernet 0/16
    no ip address
    mtu 12000
    switchport
    flowcontrol rx on tx off
    spanning-tree rstp edge-port
    no shutdown
!
interface TenGigabitEthernet 0/17
    no ip address
    mtu 12000
    switchport
    flowcontrol rx on tx off
    spanning-tree rstp edge-port
    no shutdown
!
interface TenGigabitEthernet 0/18
    no ip address
    mtu 12000
    switchport
    flowcontrol rx on tx off
    spanning-tree rstp edge-port
    no shutdown
!
interface TenGigabitEthernet 0/19
    no ip address
    mtu 12000
    switchport
    flowcontrol rx on tx off
    spanning-tree rstp edge-port
    no shutdown
!
interface TenGigabitEthernet 0/20
    no ip address
    mtu 12000

```



```

switchport
flowcontrol rx on tx off
spanning-tree rstp edge-port
no shutdown
!
interface TenGigabitEthernet 0/21
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree rstp edge-port
no shutdown
!
interface TenGigabitEthernet 0/22
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree rstp edge-port
no shutdown
!
interface TenGigabitEthernet 0/23
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree rstp edge-port
no shutdown
!
interface TenGigabitEthernet 0/24
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree mstp edge-port
spanning-tree rstp edge-port
spanning-tree 0 portfast
spanning-tree pvst edge-port
no shutdown
!
interface TenGigabitEthernet 0/25
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree mstp edge-port
spanning-tree rstp edge-port

```



```

spanning-tree 0 portfast
spanning-tree pvst edge-port
no shutdown
!
interface TenGigabitEthernet 0/26
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree mstp edge-port
spanning-tree rstp edge-port
spanning-tree 0 portfast
spanning-tree pvst edge-port
no shutdown
!
interface TenGigabitEthernet 0/27
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree mstp edge-port
spanning-tree rstp edge-port
spanning-tree 0 portfast
spanning-tree pvst edge-port
no shutdown
!
interface TenGigabitEthernet 0/28
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree mstp edge-port
spanning-tree rstp edge-port
spanning-tree 0 portfast
spanning-tree pvst edge-port
no shutdown
!
interface TenGigabitEthernet 0/29
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree mstp edge-port
spanning-tree rstp edge-port
spanning-tree 0 portfast
spanning-tree pvst edge-port
no shutdown

```



```

!
interface TenGigabitEthernet 0/30
  no ip address
  mtu 12000
  switchport
  flowcontrol rx on tx off
  spanning-tree mstp edge-port
  spanning-tree rstp edge-port
  spanning-tree 0 portfast
  spanning-tree pvst edge-port
  no shutdown
!
interface TenGigabitEthernet 0/31
  no ip address
  mtu 12000
  switchport
  flowcontrol rx on tx off
  spanning-tree mstp edge-port
  spanning-tree rstp edge-port
  spanning-tree 0 portfast
  spanning-tree pvst edge-port
  no shutdown
!
interface TenGigabitEthernet 0/32
  no ip address
  mtu 12000
  switchport
  flowcontrol rx on tx off
  spanning-tree mstp edge-port
  spanning-tree rstp edge-port
  spanning-tree 0 portfast
  spanning-tree pvst edge-port
  no shutdown
!
interface TenGigabitEthernet 0/33
  no ip address
  mtu 12000
  switchport
  flowcontrol rx on tx off
  spanning-tree mstp edge-port
  spanning-tree rstp edge-port
  spanning-tree 0 portfast
  spanning-tree pvst edge-port
  no shutdown
!
interface TenGigabitEthernet 0/34
  no ip address

```



```

mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree mstp edge-port
spanning-tree rstp edge-port
spanning-tree 0 portfast
spanning-tree pvst edge-port
no shutdown
!
interface TenGigabitEthernet 0/35
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree mstp edge-port
spanning-tree rstp edge-port
spanning-tree 0 portfast
spanning-tree pvst edge-port
no shutdown
!
interface TenGigabitEthernet 0/36
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree mstp edge-port
spanning-tree rstp edge-port
spanning-tree 0 portfast
spanning-tree pvst edge-port
no shutdown
!
interface TenGigabitEthernet 0/37
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree mstp edge-port
spanning-tree rstp edge-port
spanning-tree 0 portfast
spanning-tree pvst edge-port
no shutdown
!
interface TenGigabitEthernet 0/38
no ip address
mtu 12000
switchport
flowcontrol rx on tx off

```



```

spanning-tree mstp edge-port
spanning-tree rstp edge-port
spanning-tree 0 portfast
spanning-tree pvst edge-port
no shutdown
!
interface TenGigabitEthernet 0/39
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree mstp edge-port
spanning-tree rstp edge-port
spanning-tree 0 portfast
spanning-tree pvst edge-port
no shutdown
!
interface TenGigabitEthernet 0/40
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree rstp edge-port
no shutdown
!
interface TenGigabitEthernet 0/41
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree rstp edge-port
no shutdown
!
interface TenGigabitEthernet 0/42
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree mstp edge-port
spanning-tree rstp edge-port
spanning-tree 0 portfast
spanning-tree pvst edge-port
no shutdown
!
interface TenGigabitEthernet 0/43
no ip address
mtu 12000

```



```

switchport
flowcontrol rx on tx off
spanning-tree rstp edge-port
no shutdown
!
interface TenGigabitEthernet 0/44
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree rstp edge-port
no shutdown
!
interface TenGigabitEthernet 0/45
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree rstp edge-port
no shutdown
!
interface TenGigabitEthernet 0/46
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree rstp edge-port
no shutdown
!
interface TenGigabitEthernet 0/47
no ip address
mtu 12000
switchport
flowcontrol rx on tx off
spanning-tree rstp edge-port
no shutdown
!
interface fortyGigE 0/48
no ip address
mtu 12000
flowcontrol rx on tx off
!
port-channel-protocol LACP
port-channel 1 mode active
no shutdown
!
interface fortyGigE 0/52

```




```

no ip address
mtu 12000
flowcontrol rx on tx off
!
port-channel-protocol LACP
port-channel 1 mode active
no shutdown
!
interface fortyGigE 0/56
no ip address
mtu 12000
flowcontrol rx on tx off
no shutdown
!
interface fortyGigE 0/60
no ip address
mtu 12000
flowcontrol rx on tx off
no shutdown
!
interface ManagementEthernet 0/0
ip address 192.168.54.243/24
no shutdown
!
interface ManagementEthernet 1/0
no shutdown
!
interface ManagementEthernet 2/0
no shutdown
!
interface ManagementEthernet 3/0
no shutdown
!
interface ManagementEthernet 4/0
no shutdown
!
interface ManagementEthernet 5/0
no shutdown
!
interface ManagementEthernet 6/0
no shutdown
!
interface ManagementEthernet 7/0
no shutdown
!
interface ManagementEthernet 8/0
no shutdown

```



```

!
interface ManagementEthernet 9/0
  no shutdown
!
interface ManagementEthernet 10/0
  no shutdown
!
interface ManagementEthernet 11/0
  no shutdown
!
interface Port-channel 1
  no ip address
  mtu 12000
  switchport
  no shutdown
!
interface Vlan 1
!untagged TenGigabitEthernet 0/0-47
!untagged Port-channel 1
!
management route 192.168.0.0/16 192.168.54.1
!
ip ssh server enable
!
protocol lldp
!
line console 0
  exec-timeout 0 0
line vty 0
  exec-timeout 0 0
line vty 1
line vty 2
line vty 3
line vty 4
line vty 5
line vty 6
line vty 7
line vty 8
line vty 9
!
end
sw2#

```

```

-----
-----
-----
--          VERSION          -----

```



```

-----
show version
Dell Force10 Real Time Operating System Software
Dell Force10 Operating System Version: 2.0
Dell Force10 Application Software Version: 8.3.19.0
Copyright (c) 1999-2012 by Dell Inc. All Rights Reserved.
Build Time: Fri Dec 21 20:21:22 2012
Build Path: /sites/sjc/work/build/buildSpaces/build08/E8-3-
19/SW/SRC/Cp_src/Radius
sw2 uptime is 4 week(s), 0 day(s), 0 hour(s), 18 minute(s)

System image file is "system://A"

System Type: S4820
Control Processor: Freescale QorIQ P2020 with 2147483648 bytes of memory.

128M bytes of boot flash memory.

 1 52-port GE/TE/FG (SE)
48 Ten GigabitEthernet/IEEE 802.3 interface(s)
 4 Forty GigabitEthernet/IEEE 802.3 interface(s)
sw2#
-----

```

```

----- Interface Status -----
show interface status

```

Port	Description	Status	Speed	Duplex	Vlan
Te 0/0		Up	1000 Mbit	Full	1
Te 0/1		Up	1000 Mbit	Full	1
Te 0/2		Up	1000 Mbit	Full	1
Te 0/3		Up	1000 Mbit	Full	1
Te 0/4		Up	1000 Mbit	Full	1
Te 0/5		Up	1000 Mbit	Full	1
Te 0/6		Up	1000 Mbit	Full	1
Te 0/7		Up	1000 Mbit	Full	1
Te 0/8		Up	10000 Mbit	Full	1
Te 0/9		Up	10000 Mbit	Full	1
Te 0/10		Down	Auto	Auto	1
Te 0/11		Down	Auto	Auto	1
Te 0/12		Down	Auto	Auto	1
Te 0/13		Down	Auto	Auto	1
Te 0/14		Down	Auto	Auto	1
Te 0/15		Down	Auto	Auto	1
Te 0/16		Down	Auto	Auto	1
Te 0/17		Down	Auto	Auto	1



Te 0/18	Down	Auto	Auto	1
Te 0/19	Down	Auto	Auto	1
Te 0/20	Down	Auto	Auto	1
Te 0/21	Down	Auto	Auto	1
Te 0/22	Down	Auto	Auto	1
Te 0/23	Down	Auto	Auto	1
Te 0/24	Up	1000 Mbit	Full	1
Te 0/25	Up	1000 Mbit	Full	1
Te 0/26	Up	1000 Mbit	Full	1
Te 0/27	Up	1000 Mbit	Full	1
Te 0/28	Up	1000 Mbit	Full	1
Te 0/29	Up	1000 Mbit	Full	1
Te 0/30	Up	1000 Mbit	Full	1
Te 0/31	Up	1000 Mbit	Full	1
Te 0/32	Up	1000 Mbit	Full	1
Te 0/33	Up	1000 Mbit	Full	1
Te 0/34	Up	1000 Mbit	Full	1
Te 0/35	Up	1000 Mbit	Full	1
Te 0/36	Up	1000 Mbit	Full	1
Te 0/37	Up	1000 Mbit	Full	1
Te 0/38	Up	1000 Mbit	Full	1
Te 0/39	Up	1000 Mbit	Full	1
Te 0/40	Down	Auto	Auto	1
Te 0/41	Down	Auto	Auto	1
Te 0/42	Up	10000 Mbit	Full	1
Te 0/43	Down	Auto	Auto	1
Te 0/44	Down	Auto	Auto	1
Te 0/45	Down	Auto	Auto	1
Te 0/46	Down	Auto	Auto	1
Te 0/47	Down	Auto	Auto	1
Fo 0/48	Up	40000 Mbit	Full	--
Fo 0/52	Up	40000 Mbit	Full	--
Fo 0/56	Down	40000 Mbit	Auto	--
Fo 0/60	Down	40000 Mbit	Auto	--

sw2#



Additional resources

Support.dell.com is focused on meeting your needs with proven services and support.

DellTechCenter.com is an IT Community where you can connect with Dell Customers and Dell employees for the purpose of sharing knowledge, best practices, and information about Dell products and your installations.

Referenced or recommended Dell publications:

- Dell EqualLogic Configuration Guide:
<http://en.community.dell.com/techcenter/storage/w/wiki/2639.equallogic-configuration-guide.aspx>
- Deploying Mixed 1 Gb-10 Gb Ethernet SANs using Dell EqualLogic Storage Arrays
<http://en.community.dell.com/techcenter/storage/w/wiki/2640.deploying-mixed-1-gb-10-gb-ethernet-sans-using-dell-equallogic-storage-arrays-by-sis.aspx>

For EqualLogic best practices white papers, reference architectures, and sizing guidelines for enterprise applications and SANs, refer to Storage Infrastructure and Solutions Team Publications at:

- <http://dell.to/sM4hJT>





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