Dell EqualLogic Best Practices Series

Dell EqualLogic PS Series Reference Architecture for Dell Force10 S-Series S60

Four-Switch SAN Reference

Storage Infrastructure and Solutions Engineering
Dell Product Group
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1 Introduction

Dell™ Force10® S60 (S60) switch is a 1U form factor based, 48 GbE port, wire speed Layer 2 and 3 Ethernet switch. The S60 switch supports 48x 1 GbE ports with 44 (1-44) of these ports being 1000Base-T copper ports, and four (45-48) of these ports that can be configured for fiber or copper (SFP) interfaces. In addition, this switch has two plug-in modules that can support either 10 GbE or 24 GbE stacking modules.

2 Objectives

This document provides details for configuring the S60 for use with EqualLogic™ PS Series storage arrays. The goal of this exercise is not to provide a comprehensive set of possible configurations, but to illustrate one possible solution that provides excellent performance and scalability as validated by testing in our labs.

The test objectives used while testing the S60 configuration are defined below:

- Test the ability of the switch configuration to pass iSCSI traffic as defined by realistic application workloads and server/storage configurations while meeting stringent networking performance parameters.
- Determine the scalability behavior of the switch configuration for a standardized set of I/O workloads and provide sizing guidance in terms of the number of storage arrays and servers that can be supported by a SAN configured with S60 switches.

3 Conclusions

Dell Labs conducted testing that proves the value of the S60 when used to build a SAN with the Dell EqualLogic™ series of virtual storage arrays. Based on this testing, we determined that the S60 is an excellent switch for use when building SANs that consist of one or more 1 Gbps EqualLogic PS Series arrays.

Our lab tests of this SAN solution yielded the following results:

- With four Dell Force10 S60 switches, the SAN scaled easily to support 16 arrays and 32 hosts
- Sequential Write performance scaled linearly to 92% of the theoretical baseline in terms of throughput as measured at the host.
- Sequential Read Performance scaled linearly to 92% in terms of throughput as measured at the host.
- The Random Read/Write performance in terms of IOs per second scaled linearly to 97% of the theoretical baseline on a per-server performance basis.
- TCP retransmissions from arrays, as polled periodically from array counters and SAN Headquarters (SANHQ) were low (< 0.5%) across all test configurations. This is another indicator that there are no bottlenecks or design issues within the switch that limited the ability of the switch to support the reference architecture.

In conclusion, our test results indicate no performance based limitations in configurations up to 16 arrays and while utilizing the maximum available ports.

A reference architecture paper for a two-switch SAN solution is also available if your SAN requires a smaller number of arrays or hosts.

4 Reference architecture

4.1 Reference architecture overview

The reference architecture described in this paper consists of four Dell Force10 S60 switches. Connected to these switches are a total of 16 PS6000XV arrays and 32 Dell PowerEdge™ R710 servers, which make use of most of the fixed ports available on the S60 switches.

Figure 1 shows the four switch/16 array SAN test configuration.

Note: Only the active controller ports are shown.

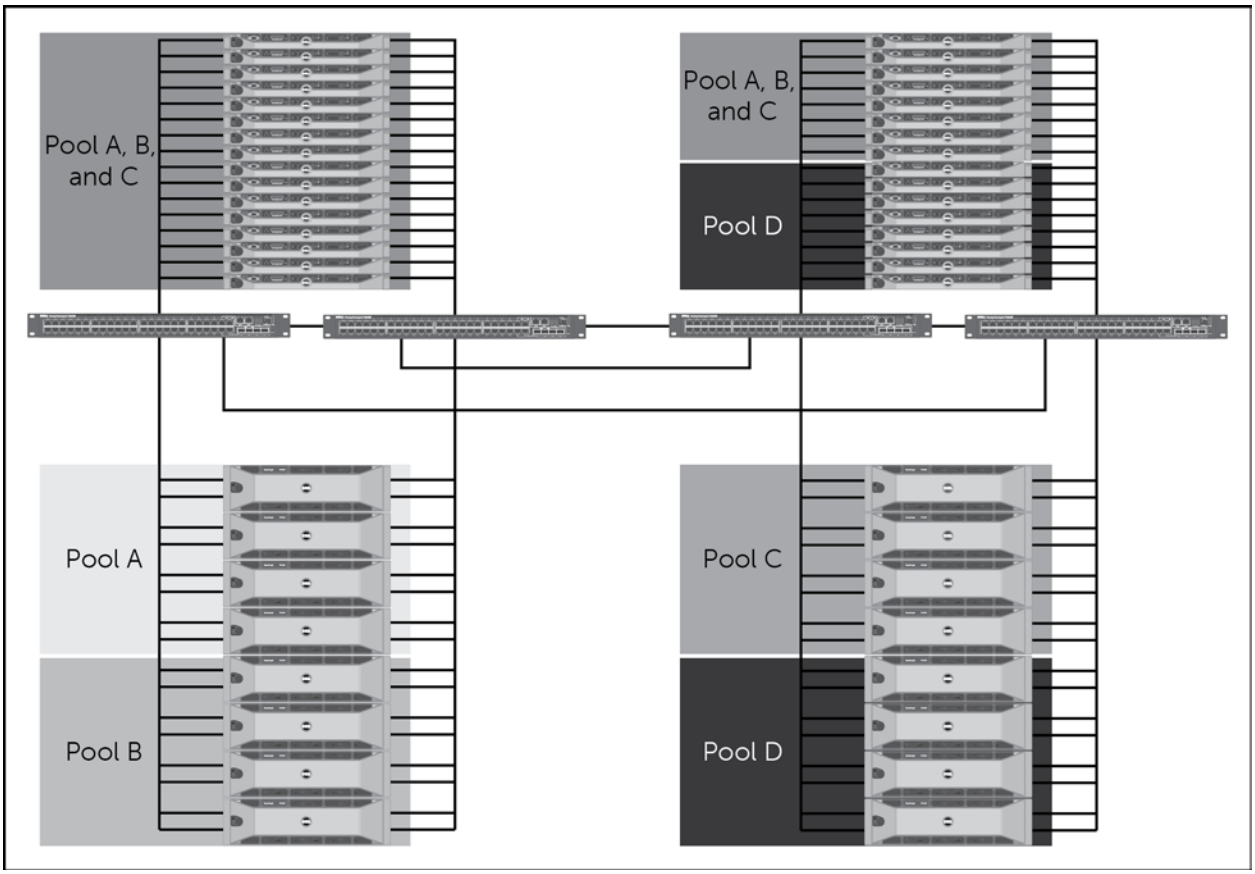

Figure 1 Four switch/16 array reference configuration

Because our goal is to help you deploy a switch-based SAN easily and quickly, we use a standard host configuration and a standard EqualLogic Group configuration, accept default switch settings wherever possible, and employ all accepted best practice recommendations for EqualLogic SANs.

When developing this reference architecture, we used the following guidelines:

- All hosts had two iSCSI Ethernet ports attached to the SAN per EqualLogic documented best practices for a redundant storage network.
- All NICs were configured based on default settings ("out of the box") with the exception of Jumbo Frames and Flow Control for RX which were enabled for all testing.

- Microsoft® Windows Server® 2008 R2 was the operating system for all hosts.
- EqualLogic Host Integration Toolkit was used for all hosts and all iSCSI sessions were MPIO based.
- Number of host connections to the SAN was equal to the number of active array ports connected to the SAN.
    - PS6000 series array has four active array ports, for each array in the test configuration, there were two hosts (with 2 NIC ports each) connected to the SAN.
    - The ratio of hosts to arrays is based solely on the 2:1 host to array ratio or the available number of ports remaining after the arrays are connected.
- All SAN infrastructures were configured to a single L2 (non-routed) subnet.
- All SAN infrastructures were based on standard IPv4 addressing.
- All testing did include three pre-defined standardized workloads that reflect various types of real-world SAN utilization.

Note: For more information on EqualLogic SAN design, consult the *EqualLogic Configuration Guide* that can be found at www.delltechcenter.com/page/equallogic+configuration+guide.

4.2 Server configuration

This reference architecture uses 32 Dell PowerEdge™ R710 rack servers. Table 1 provides the model specifications and configuration settings for each server.

Table 1 Server specifications and configuration settings

PowerEdge R710 specifications	
BIOS	2.1.15
Intel™ 5500-5520 chipset	A02
OS	Windows Server® 2008 R2 v6.1.7600
Service Packs and Hotfixes	KB979711, KB976443
Host Network Interface configuration (x2 per server)	
Model	Dell Broadcom™ BCM5709 – Onboard
iSCSI Offload Engine (iSOE)	Disabled
TCP Offload Engine (ToE)	Disabled
NDIS Mode	Enabled
OS Network stack TCP	Autotuninglevel = disabled (default setting 'normal') To disable autotuning run the following command from the CLI: `netsh int tcp set global autotuninglevel=disabled`
iSCSI Initiator	Microsoft® Windows Server® 2008 R2
BCM 5709 Software	Firmware: 5.2.7 NDIS driver: 5.2.14 VBD driver: 5.2.22
Large Segment Offload (LSO)	Disabled
Receive Buffers	2000
MPIO configuration	
Dell EqualLogic Host Integration Toolkit	Version 3.2
Dell EqualLogic MPIO Device Specific Module	These default settings used: Maximum Sessions per Slice: 2 Maximum Sessions per Volume: 6

4.3 Array configuration

Sixteen EqualLogic PS Series arrays were used in this test. Each server is described in Table 2 below.

Table 2 Array configuration information

EqualLogic storage	
Array model	EqualLogic PS6000XV
Firmware	5.0.2

4.4 Switch configuration

The following sections specify the hardware used and settings recommended to configure the switches in this reference architecture.

4.4.1 Switch configuration overview

Table 3 provides an overview of the switch configuration for this SAN.

Table 3 Switch configuration overview

Dell Force10 S60	
Switch firmware	8.3.3.4
Stacking modules	Dual port 24 Gb (12 Gb for each port)
Cable Types	
Host–switch cable type	CAT6
Array–switch cable type	CAT6
Switch–switch cable type	12 G stacking cable
Configuration Settings	
Switch inter-connection	Two dual port stacking modules, 12 Gbps full duplex speed for each port
Global switch settings	Flow control enabled **Note:** The S60 supports only the rx control option. The S60 does not transmit pause frames. Portfast enabled
Individual port settings	MTU=9216

4.4.2 Array and server port configuration

For this switch, MTU size is an interface specific setting and by default is set to 1554 bytes. For Dell EqualLogic iSCSI SAN solutions, Dell recommends Jumbo MTU size. Use the commands below to configure the following for all interfaces for each member:

- Jumbo MTU
- Flow control
- Switchport (to enable Layer 2 data transmission)
- No shutdown (to enable all selected interfaces/ports)
- Portfast (edge-port)

```
s60>enable

s60#configure
```

```
s60(conf)#interface range gigabitethernet 0/0 – 47 , gigabithethernet
1/0 – 47

s60(conf-if-range-gi-0/0-47,gi-1/0-47)#mtu 9216

s60(conf-if-range-gi-0/0-47,gi-1/0-47)#switchport

s60(conf-if-range-gi-0/0-47,gi-1/0-47)#flowcontrol rx on

s60(conf-if-range-gi-0/0-47,gi-1/0-47)#spanning-tree rstp edge-port

s60(conf-if-range-gi-0/0-47,gi-1/0-47)#no shutdown

s60(conf-if-range-gi-0/0-47,gi-1/0-47)#exit

s60(conf)#exit

s60#wr

s60#reload
```

4.4.3 Stack configuration

Stack configuration provides 12 Gbps bandwidth for each stacking port. In the validation tests for four switches we used two dual port stacking modules.

Stack connectivity with S60 requires stacking modules and cabling only. No special configuration commands are required to make the stacking configuration active.

Appendix A Switch port mappings

1	3	5	7	17	19	21	23	25	27	29	31	37	39	41	43
A13 P2	A14 P2	A15 P2	A16 P2	S25 P3	S27 P3	S29 P3	S31 P3	A9 P2	A10 P2	A11 P2	A10 P3	S17 P3	S19 P3	S21 P3	S23 P3
A13 P3	A14 P3	A15 P3	A16 P3	S26 P3	S28 P3	S30 P3	S32 P3	A9 P3	A10 P3	A11 P3	A12 P3	S18 P3	S20 P3	S22 P3	S24 P3
2	4	6	8	18	20	22	24	26	28	30	32	38	40	42	44

SW1

1	3	5	7	17	19	21	23	25	27	29	31	37	39	41	43
A13 P0	A14 P0	A15 P0	A16 P0	S25 P2	S27 P2	S29 P2	S31 P2	A9 P0	A10 P0	A11 P0	A12 P0	S17 P2	S19 P2	S21 P2	S23 P2
A13 P1	A14 P1	A15 P1	A16 P1	S26 P2	S28 P2	S30 P2	S32 P2	A9 P1	A10 P1	A11 P1	A12 P1	S18 P2	S20 P2	S22 P2	S24 P2
2	4	6	8	18	20	22	24	26	28	30	32	38	40	42	44

SW2

1	3	5	7	17	19	21	23	25	27	29	31	37	39	41	43
A5 P2	A6 P2	A7 P2	A8 P2	S9 P3	S11 P3	S13 P3	S15 P3	A1 P2	A2 P2	A3 P2	A4 P2	S1 P3	S3 P3	S5 P3	S7 P3
A5 P3	A6 P3	A7 P3	A8 P3	S10 P3	S12 P3	S14 P3	S16 P3	A1 P3	A2 P3	A3 P3	A4 P3	S2 P3	S4 P3	S6 P3	S8 P3
2	4	6	8	18	20	22	24	26	28	30	32	38	40	42	44

SW3

1	3	5	7	17	19	21	23	25	27	29	31	37	39	41	43
A5 P0	A6 P0	A7 P0	A8 P0	S9 P2	S11 P2	S13 P2	S15 P2	A1 P0	A2 P0	A3 P0	A4 P0	S1 P2	S3 P2	S5 P2	S7 P2
A5 P1	A6 P1	A7 P1	A8 P1	S10 P2	S12 P2	S14 P2	S16 P2	A1 P1	A2 P1	A3 P1	A4 P1	S2 P2	S4 P2	S6 P2	S8 P2
2	4	6	8	18	20	22	24	26	28	30	32	38	40	42	44

SW4

Array Connections:

Ax Px = Storage Array ID and NIC port

Host Connections

Sx Px = Server ID and NIC Port

Figure 2 Switch port mappings for the four switch configuration

Appendix B TCP/IP configuration

B.1 Arrays

Array Group IP Address: 192.168.201.50

Array	Port 0 IP Address	Port 1 IP Address	Port 2 IP Address	Port 3 IP Address
EQL01	192.168.201.51	192.168.201.61	192.168.201.71	192.168.201.81
EQL02	192.168.201.52	192.168.201.62	192.168.201.72	192.168.201.82
EQL03	192.168.201.53	192.168.201.63	192.168.201.73	192.168.201.83
EQL04	192.168.201.54	192.168.201.64	192.168.201.74	192.168.201.84
EQL05	192.168.201.55	192.168.201.65	192.168.201.75	192.168.201.85
EQL06	192.168.201.56	192.168.201.66	192.168.201.76	192.168.201.86
EQL07	192.168.201.57	192.168.201.67	192.168.201.77	192.168.201.87
EQL08	192.168.201.58	192.168.201.68	192.168.201.78	192.168.201.88
EQL09	192.168.201.59	192.168.201.69	192.168.201.79	192.168.201.89
EQL10	192.168.201.60	192.168.201.70	192.168.201.80	192.168.201.90
EQL11	192.168.201.11	192.168.201.21	192.168.201.31	192.168.201.41
EQL12	192.168.201.12	192.168.201.22	192.168.201.32	192.168.201.42
EQL13	192.168.201.13	192.168.201.23	192.168.201.33	192.168.201.43
EQL14	192.168.201.14	192.168.201.24	192.168.201.34	192.168.201.44
EQL15	192.168.201.15	192.168.201.25	192.168.201.35	192.168.201.45
EQL16	192.168.201.16	192.168.201.26	192.168.201.36	192.168.201.46

B.2 Hosts

Server	NIC 2 IP Address	NIC 3 IP Address
SVR01	192.168.201.101	192.168.201.201
SVR02	192.168.201.102	192.168.201.202
SVR03	192.168.201.103	192.168.201.203
SVR04	192.168.201.104	192.168.201.204
SVR05	192.168.201.105	192.168.201.205

SVR06	192.168.201.106	192.168.201.206
SVR07	192.168.201.107	192.168.201.207
SVR08	192.168.201.108	192.168.201.208
SVR09	192.168.201.109	192.168.201.209
SVR10	192.168.201.110	192.168.201.210
SVR11	192.168.201.111	192.168.201.211
SVR12	192.168.201.112	192.168.201.212
SVR13	192.168.201.113	192.168.201.213
SVR14	192.168.201.114	192.168.201.214
SVR15	192.168.201.115	192.168.201.215
SVR16	192.168.201.116	192.168.201.216
SVR17	192.168.201.117	192.168.201.217
SVR18	192.168.201.118	192.168.201.218
SVR19	192.168.201.119	192.168.201.219
SVR20	192.168.201.120	192.168.201.220
SVR21	192.168.201.121	192.168.201.221
SVR22	192.168.201.122	192.168.201.222
SVR23	192.168.201.123	192.168.201.223
SVR24	192.168.201.124	192.168.201.224
SVR25	192.168.201.125	192.168.201.225
SVR26	192.168.201.126	192.168.201.226
SVR27	192.168.201.127	192.168.201.227
SVR28	192.168.201.128	192.168.201.228
SVR29	192.168.201.129	192.168.201.229
SVR30	192.168.201.130	192.168.201.230
SVR31	192.168.201.131	192.168.201.231
SVR32	192.168.201.132	192.168.201.232

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