Recently, many enterprises have begun adopting blade servers as part of an overall data center strategy focusing on consolidation, virtualization, and green IT initiatives. As part of this type of strategy, these enterprises may also consider parallel deployment of consolidated storage area network (SAN) arrays.

The Dell PowerEdge M1000e modular blade enclosure offers a number of advantages over typical rack-mounted servers, including increased density, rapid deployment, reduced power and cooling requirements, reduced cabling, simplified management, and an advanced integrated I/O module architecture. Dell EqualLogic PS Series Internet SCSI (iSCSI) SAN arrays, meanwhile, can also offer compelling benefits that make them well suited to support blade server deployments. These arrays combine an intelligent, automated management framework and a comprehensive set of enterprise data center services with a fault-tolerant hardware architecture designed to support all major non-mainframe operating systems. These arrays can provide an intelligent, automated management framework and a comprehensive set of enterprise data center services with a fault-tolerant hardware architecture designed to support all major non-mainframe operating systems. These arrays can provide a modular, cost-effective SAN solution designed for scalability, enabling small and midsize organizations to deploy storage in appropriate increments while still helping meet the needs of large enterprises requiring large capacities and high performance.

Successfully integrating a PowerEdge M1000e enclosure with an EqualLogic SAN requires advance planning, because as with other blade solution implementations, the available Ethernet I/O modules in the PowerEdge M1000e—the Cisco Catalyst Blade Switch (CBS) 3130G, Cisco CBS 3130X, and Dell PowerConnect™ M6220 switch—have a limited number of external "fan out" ports. These Ethernet I/O modules connect to networks outside the enclosure through four to eight Gigabit Ethernet ports (or up to four optional 10 Gigabit Ethernet ports) per switch. Because each EqualLogic array requires multiple Ethernet ports in an Ethernet-based SAN infrastructure, and the PowerEdge M1000e I/O modules provide limited numbers of external ports, administrators may need to use one or more external switches to connect PowerEdge M1000e enclosures to the EqualLogic SAN.

Administrators can take any of several approaches to combining PowerEdge M1000e enclosures with an EqualLogic SAN, each with its own trade-offs in cost, performance, complexity, and scalability. This article outlines three possible architectures and discusses the advantages and disadvantages of each architecture.

**STRATEGY 1: MULTIPLE TIERS**

The first option consists of a multitiered Ethernet switch infrastructure. In this design, the EqualLogic SAN arrays
and a set of external switches are on one tier, and the PowerEdge M1000e enclosures—with their integrated I/O modules and blade servers—are on a separate tier. These tiers are then connected using standard inter-switch linking technologies and link aggregation, allowing the processing of storage requests and data transfer between the SAN arrays and the blade servers. Figure 1 illustrates this architecture. For clarity, this figure shows only connections to primary array controllers; administrators should connect ports from the second array controller in each array to the storage tier switches in a similar fashion.

This design uses both the available stacking ports and the uplinking functionality of the I/O modules, along with external switches such as the Cisco Catalyst 3750-E or Dell PowerConnect 6248, to create a highly scalable SAN infrastructure. Stacking ports are used to link switches within each tier. To provide redundancy and bandwidth scalability, each tier is then connected by joining the I/O modules in the host tier to the external switches in the storage tier with uplinking ports configured into link aggregation groups.

This design strategy offers several advantages. In terms of scalability, the architecture enables administrators to easily add PowerEdge M1000e enclosures to the host tier by inserting the I/O modules for the new enclosures into the stacking loop without taking the EqualLogic SAN infrastructure offline. For example, because Cisco CBS 3130 switches allow up to eight switches to be combined in a single stack, up to eight PowerEdge M1000e enclosures can be integrated into the SAN. Similarly, using stackable Catalyst 3750-E switches in the storage tier enables administrators to add arrays to the existing switches (if ports are available) or add extra switches to the stack loop.

Attaching a full 12-array SAN requires as many as 48 ports per switch; including the ports required for the uplinks between the array tier and the host tier means that a 12-array SAN can be supported by two 48-port switches when using the optional dedicated 10 Gigabit Ethernet uplink ports.

However, using more than two switches may help increase performance for SANs with additional arrays by providing access to additional 10 Gigabit Ethernet ports. To connect the two tiers, administrators should aggregate the 10 Gigabit Ethernet ports for the external switches into a Port Aggregation Protocol (PAgP) or Link Aggregation Control Protocol (LACP) link aggregation group as shown in Figure 1, which helps maximize bandwidth and availability between tiers.

**STRATEGY 2: SINGLE TIER WITH PASS-THROUGH I/O MODULES**

A second option for integrating PowerEdge M1000e enclosures with EqualLogic SAN arrays is to use the PowerEdge M1000e Ethernet pass-through I/O modules with a set of Dell-recommended external stackable switches such as the Cisco Catalyst 3750-E or Dell PowerConnect 6248. Figure 2 illustrates this architecture. For clarity, this figure abstracts the connections between the enclosures and the switches; the actual connections from the enclosure pass-through ports should be evenly distributed between all external switches in the SAN to help provide full redundancy. As in the multitiered architecture, this figure shows only the connections to one array controller in each array; ports from the second array controller should be connected to the external switches in a similar fashion.

For organizations that do not primarily use Dell or Cisco switches, this option enables administrators to take advantage of existing third-party switches that support iSCSI—helping simplify management by allowing administrators to use the same management tools for SAN traffic as they...
do for general-purpose network traffic. One disadvantage of this strategy, however, is the number of cables required to connect the individual blades to the external switch infrastructure, especially if the environment must be fully redundant and use two network interface cards (NICs) on each blade. As Figure 2 shows, this approach can scale to support almost any number of PowerEdge M1000e enclosures and EqualLogic arrays; however, it requires a large number of switch ports and Ethernet cables between each enclosure and the switch infrastructure. For example, a single PowerEdge M1000e enclosure would require 32 cables, and therefore require 32 ports on the SAN switch infrastructure in addition to the ports needed for the arrays.

As with the multitiered approach, administrators can scale this architecture by expanding the external stackable switches as they add PowerEdge M1000e enclosures or EqualLogic arrays. Because of the large number of ports required for each PowerEdge M1000e, the SAN infrastructure typically requires more than two switches to support more than a few blade enclosures and a full 12-array SAN.

**STRATEGY 3: SINGLE TIER WITH STACKING**

The third option for integrating PowerEdge M1000e enclosures with EqualLogic SAN arrays relies only on the PowerEdge M1000e Ethernet switch I/O modules for the SAN. This architecture allows a single interface for network management similar to the architecture described in the preceding section, but is not as scalable as the other two architectures. Figure 3 illustrates this architecture. As with the other two architectures, this figure shows only the connections to one array controller in each array; ports from the second array controller should be connected to the array switches in a similar fashion.

Using Cisco CBS 3130X or CBS 3130G switches, this approach enables the SAN to scale to support a maximum of four PowerEdge M1000e enclosures and eight EqualLogic arrays, depending on which EqualLogic models are deployed. Because each array requires three or four ports per redundant switch and each CBS 3130 I/O module can have up to eight external Gigabit Ethernet ports available for array connection using Cisco TwinGig converter modules, each
enclosure can support up to two EqualLogic arrays. Administrators can use the switch stacking ports to integrate additional PowerEdge M1000e enclosures into the SAN; each additional PowerEdge M1000e enclosure would then enable them to add two EqualLogic arrays.

As Figure 3 shows, when adding PowerEdge M1000e enclosures, administrators should ensure that the connections from each EqualLogic array are redistributed so that each of the array’s active Ethernet ports connect to at least two different blade switches. Figure 3 shows only the active port connections for each array; administrators should use an identical connection plan to connect each array’s passive ports to the blade switches, helping ensure that a switch or enclosure failure does not break a connection to the EqualLogic arrays.

**CONSOLIDATED, HIGHLY SCALABLE INFRASTRUCTURE**

Each of the three strategies presented in this article has its own trade-offs in cost, performance, complexity, and scalability. Ultimately, successful integration of a Dell PowerEdge M1000e modular blade enclosure with a Dell EqualLogic iSCSI SAN hinges on a few criteria: the solution should provide full redundancy; enough inter-switch bandwidth to support hosting SAN traffic, inter-array management, and load balancing; and enough I/O and minimal latency between the blades and arrays to meet the requirements of the attached host applications. The PowerEdge M1000e enclosure with Cisco CBS 3130 or Dell PowerConnect M6220 I/O modules and Ethernet pass-through modules along with external Ethernet switches such as the Cisco Catalyst 3750-E and Dell PowerConnect 6248 can provide the flexibility and scalability necessary to build a high-performance virtualized storage architecture that can meet almost any storage need.

**Tony Ansley** is a senior storage consultant on the Dell iSCSI Solutions Marketing team with 24 years of experience in the computer industry. He has a bachelor’s degree in Information and Computer Sciences from the Georgia Institute of Technology.