

A PRACTICAL GUIDE FOR MOVING TO 25GBE IN YOUR DATA CENTER NETWORK



A Dell Technologies Networking white paper

Table of contents

1. Table of contents	2
2. Introduction	3
3. Changes and Challenges in the Data Center Environment.....	3
4. Quick primer on 25GbE.....	4
5. Moving to a 25GbE Infrastructure.....	5
5.1 Inventory your infrastructure	5
5.1.1 Platforms.....	5
5.1.2 Virtualization	6
5.1.3 Cloud applications	6
5.1.4 Management	7
5.2 Evaluate and Select 25GbE switches	7
5.2.1 Top-of-Rack Switches.....	7
Management	8
5.3 Start the migration.....	8
5.3.1 Defining the plan	8
5.3.2 Training with new 25GbE switches.....	9
5.3.3 Integrating with existing management tools	9
5.3.4 Running a pilot	9
5.3.5 Continuing the migration.....	9
5.3.6 Reviewing lessons learned	
6. Dell PowerSwitch 25GbE switches and their benefits.....	10
7. Summary	11

2. Introduction

The data center landscape for many organizations is constantly changing with the introduction of new technologies and economic drivers. Several technologies have been at the forefront of the planning and implementation efforts of many IT professionals that contribute to increases in network bandwidth and performance. Virtualization continues to be a major technology being implemented in data centers to help maximize usage of hardware resources in computing, storage and networking environments. Technologies like cloud computing and the Internet of Things (IoT) rely heavily on available network resources in order to fulfill their operations. On the economic side, fluctuations in the economy and tighter restrictions on spending has led to additional constraints on IT organizations such as showing a measurable return on investment (ROI) and combating dwindling space, power, and cooling resources in data centers.

This paper provides a brief overview of key changes occurring within data centers and the challenges they present to IT organizations. It then takes a closer look at 25 Gigabit Ethernet (25GbE) technology and how it can help overcome some of these challenges and provides some practical guidelines on introducing it into your data center. Finally, the paper will discuss some of Dell PowerSwitch 25GbE solutions and their benefits.

This paper is intended to help CIOs, IT and network directors, and managers gain a better perspective when planning for a shift to 25GbE within their data center infrastructure, realize the importance of a high-performance network infrastructure, and understand the types of 25GbE solutions that are available to help ensure an effective and efficient network environment.

3. Changes and challenges in the data center environment

Virtualization technology is pervasive within many data centers and is fundamentally changing the way people utilize computing resources. A common type of virtualization called server virtualization allows users to run multiple virtual machines on a single physical server, thereby sharing the resources of that single computer across multiple environments. The main incentive for organizations to use this type of technology is to make better use of the commonly underutilized servers which now feature multiple processors, and extensive memory. By consolidating multiple servers into a single physical server and optimizing the resources of that one server, IT organizations can reduce the number of physical servers within their data centers and increase resource utilizations (Figure 1).

There are additional virtualization technologies gaining acceptance in data centers, including desktop virtualization, storage virtualization, and even network virtualization. In each case, implementation of these technologies helps IT managers utilize the resources of specific platforms to their fullest extent. However, an often-unseen impact to the network from the implementation of virtualization services is the increased number of network connections within a virtualized device (e.g., server) and between different virtualized devices.

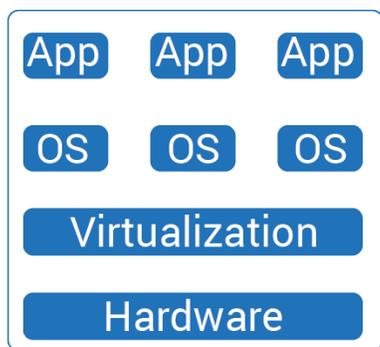


Figure 1: Server virtualization

Cloud computing is a growing practice within data centers where the delivery of computing services like servers, storage, networking, and even applications are delivered from remote platforms from across the Internet, rather than locally. There are many types of cloud computing, including private cloud, public cloud, and a rapidly growing offering called hybrid cloud that combines the best of both private and public cloud features. IoT is another growing trend across enterprises where a multitude of devices contain embedded technology whereby they can communicate information across a network without human interaction. Some examples include smart devices located in homes like thermostats, in cars with onboard sensors, and in healthcare with smart personal medical devices. In all of these cases, with cloud computing and IoT, their functions are based on continuously sending and receiving large amounts of information across a network environment. The key challenge is that most of the applications for these cases are expecting near real-time response rates across that network connection.

In addition to implementing new technologies, many IT organizations are tasked with decreasing their CAPEX and OPEX expenditures and resources. IT departments are taking a hard look at making their data centers more efficient and simplifying operational and maintenance activities across the board. The push behind these mandated reductions vary from changing economic conditions to government requirements for green initiatives.

The first step for many IT departments is taking inventory of expensive stand-alone systems (such as networking or storage devices) and then investigate how smaller, denser and converged platforms might help reduce costs, footprint and management. At the same time, organizations are assessing their Local Area Network (LAN) and Storage Area Networks (SAN) infrastructures and evaluating how they can consolidate the two into one multi- functional network.

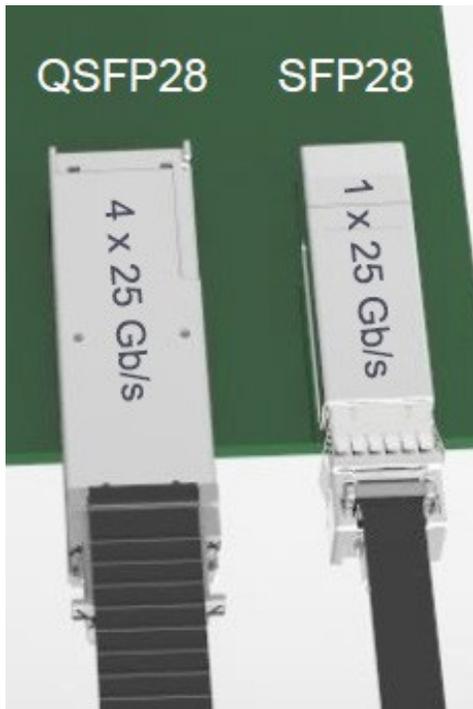


Figure 2: 25GbE form factors

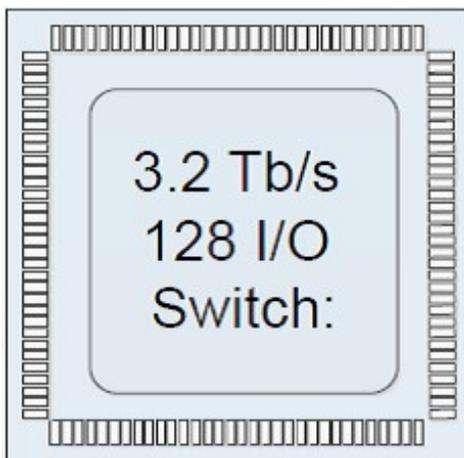


Figure 3

In the next section, we will take a high-level look at a promising technology called 25 Gigabit Ethernet that has proven capable of reducing many of the data center challenges we've just discussed.

4. Quick primer on 25GbE

From its introduction in the 1970s, Ethernet technology has been in continuous evolution, driven by the demand for faster rates of data transmission on LANs. Starting at 10Mbps, we have watched Ethernet technology move to Fast Ethernet (100Mbps) to Gigabit Ethernet (1000Mbps) and 100Gbps Ethernet and beyond.

In 2014, the 25G Ethernet Consortium released a specification that enabled data center networks to run over a 25 Gigabit per second (Gbps) Ethernet Link protocol. Then, in 2016, the Institute of Electrical and Electronics Engineers (IEEE) and IEEE Standards Association (IEEE-SA) published the IEEE 802.3by 25 Gigabit Ethernet standard to address growing server I/O connectivity demands above existing 10GbE. This standard defines a single lane 25Gbps PHYs, similar to 10GbE technology, for operation over electrical backplanes, copper twin axial cables and multimode fiber. Technologies like 40GbE and 100GbE require 4 lanes (4 x 10GbE and 4 x 25GbE) to achieve their connectivity.

This single-lane concept is critical because existing switch ASIC's have a limited number of I/O pins. This becomes important when comparing I/O pin and bandwidth maximization across 10GbE, 25GbE, 40GbE and 100GbE port speeds, where the ASIC I/O lanes can run from 10Gb/s to 25Gb/s. For example, let's look at these measurements when utilizing a switch ASIC than can handle 128 I/O's and 3.2Tbps in Table 1.

Most switches today offer two types of 25GbE interface form factors: (1) QSFP28 that can support 4 x 25Gbps and (2) SFP28 that can support 1 x 25Gbps, as seen in Figure 2. Another compelling factor for 25GbE is that it can run over an existing fiber optic cable plant designed for 10GbE so a customer will not have to replace their cabling infrastructure when transitioning.

The next section of this paper will cover some important considerations when moving your data center infrastructure to 25GbE and how you may want to manage the migration.

Port speed	Lanes/port	Lane speed (Gb/s)	Usable ports	Total BW (Gbps)
10GbE	1	10	128	1280
25GbE	1	25	128	3200
40GbE	4	10	32	1280
100GbE	4	25	32	3200

Dell Technologies and 25G migration

5. Moving to a 25GbE infrastructure

This section outlines some simple steps to follow when migrating to 25GbE within your data center. It starts with taking a good look at your current data center infrastructure, then goes into a discussion on the various types of 25GbE switches available on the market today and wraps up with some important considerations to help ensure a successful migration.

At the end of the exercise, if you find you have a growing amount of server or storage devices with embedded 25G I/O, or find the extent of virtualization or cloud usage at the high end of the spectrum, it might be time for you to consider making a migration to 25GbE.

For this paper, we will assume you are running a 10GbE infrastructure connecting servers and storage platforms to a 10GbE ToR switch within your data center. You may or may not be running a data center fabric core that is running at 40GbE or possibly 100GbE.

5.1 Inventory your infrastructure

The first step of moving to a 25GbE infrastructure involves looking at the equipment you are currently running within your data center. For this exercise, we'll organize the inventory activities into four main categories: (1) platforms, (2) virtualization, (3) cloud applications and (4) management.

5.1.1 Platforms

Both the technology and processing capabilities embedded in today's server and storage platforms are advancing quickly. It's not uncommon to find organizations utilizing servers with multi-core processors and all-flash storage devices which can overwhelm 10GbE I/O interfaces. As a result, some manufacturers are now shipping servers and Internet SCSI (iSCSI) storage platforms that include 25GbE I/O natively.

The first step of your inventory should be to list the current platforms that you are using within your data center and their respective network I/O ports, as seen in Table 2. This will help you to better understand what you're running today, if there are I/O bottlenecks, and how you will handle the migration to 25GbE. For this discussion, we'll limit storage devices to ones with iSCSI ports.

Platform	Type	Network I/O port speed
Servers	Web, email, application, other	1GbE, 10GbE, 25GbE
Storage	Direct attached, iSCSI SAN	iSCSI – 1GbE, 10GbE, 25GbE

Table 2: Platforms to inventory

5.1.2 Virtualization

IT departments everywhere are implementing server and storage virtualization to better leverage server processors and increase efficiency. It's probably a safe assumption that you've been implementing virtualization within your data center for a while now.

The next step in compiling your inventory will be to list out the types and breadth of virtualization being implemented within your data center, as seen in Table 3. This will help you better understand how much of an impact virtualization and resulting virtual connections may have on your current network infrastructure. The key types of virtualization in most organizations include server, storage, network, and desktop virtualization.

Platform	Virtualization type	Network I/O port speed
Servers	VMware, Microsoft, others	#VM's (10/100/1000+)
Storage	Software-defined storage (SDS), hyper-converged SDS	#VM's (10/100/1000+)
Desktop	Remote server-based VDI, local client-based VDI	# Virtual desktops (10/100/1000+)
Network	VMware NSX, Cisco ACI, Nuage Networks, others	# of logical switches, routers, firewalls, load balancers, and VPN's (10/100/1000+)

Table 3: Types of virtualization to inventory

5.1.3 Cloud applications

Many organizations are moving toward cloud-based services across many functions to take advantage of the cost-savings from both a CAPEX and OPEX perspective. Using cloud storage provides IT managers with a simple and scalable way to store, access and share data across the Internet. The current trend involves a hybrid cloud solution that incorporates the best of private cloud and public cloud technologies.

This section of your inventory involves listing out the types of cloud-based applications your organizations uses that will impact your data center network, as seen in Table 4. Basically, cloud applications can be broken down to ones that provide a service to departments such as Human Resources and ones that involve the storage of data critical to your organization's daily functions.

Function	Cloud applications	Extent of cloud use
Servers	ADP, SAP, Oracle, Linked-In, SQL, Salesforce.com, CRM	# of employees, customers, etc.
Data storage	File storage, block storage, object storage, backup, restore	# of bytes of data per type of storage

Table 4: Types of cloud applications to inventory

5.1.4 Management

The final part of your inventory should be to take a look at the types of device and network management tools that are being used within your data center. While there may be a variety of embedded device management tools in place for servers or storage devices, how are you managing your current switching environment? Do you have multiple or a single version network operating system? Are you able to manage all of your switching devices under one console-based network management tool? What type of enterprise management system are you using to keep track of all devices including servers, storage, and networking platforms?

There may be opportunities to implement management tools that can cover a wider spectrum of platforms that will help simplify operations and maintenance activities.

Port speed	Lanes/port	Lane speed (Gb/s)
Server	Server management tool(s)	Cross-platform management tool(s)
Storage	Storage management tool(s)	
Networking	Network management tool(s)	

Table 5: Management tools to inventory

After completing this inventory, you should have a better understanding of the I/O connectors, bandwidth requirements, and management tools within your data center. If several of these areas show potential bottlenecks, redundant networks, or complex management tools, then it's an opportune time to evaluate the capabilities of the leading 10GbE switches.

5.2 Evaluate and select 25GbE switches

The next step of your move to a 25GbE infrastructure involves looking at the various switches available, comparing their features and making a selection. Fortunately, 25GbE technology, price, and performance are now within reach for organizations of all sizes through several offerings. This section will provide some details on types of switches and features to look for.

5.2.1 Top-of-Rack switches

If your data center uses a rack-based environment for their servers, there are several 25GbE Top of Rack (ToR) Ethernet aggregation switches available. These high-performance switches help aggregate many 25GbE interconnects within the rack while also providing a 100GbE uplink to the data center fabric.

When looking for a ToR switch, be sure to choose one that provides port density, oversubscription values, CPU processing and OS choice to insure maximum network performance for your data center environment. Some key attributes to look for during the evaluation include (see Table 6):

Category	Feature	Benefit
Physical	1RU high density TOR switch with <ul style="list-style-type: none"> • 32 to 256 ports of 25GbE (both native and breakout) that are backward compatible with 10GbE • 32 to 64 ports of 100/400GbE that are backward compatible with 40GbE 	Conserve rack space while enabling denser footprints and simplifying migration
Redundancy	<ul style="list-style-type: none"> • Hot swappable redundant power supplies • Hot swappable redundant fans 	Optimize data center network efficiency and availability
Switching fabric bandwidth	From 6.4 to 51.2Tbps (full-duplex) non-blocking switching fabric	Delivers line-rate L2 and L3 forwarding capacity with ultra-low latency to maximize network performance

Category	Feature	Benefit
Software	Scalable L2 and L3 Ethernet switching with QoS and a full complement of IPv4 and IPv6 features	Optimizing network flexibility and efficiency
	Automated configuration and provisioning capabilities including VM-awareness	Simplify the management of network environments
Open Networking	Support of the Open Networking Install Environment (ONIE) and choice of disaggregated network operating systems.	Implement the network operating system that best meets your needs
Service and support	Global service and support	Ensure rapid response when needed

Table 6: Types of ToR switches to consider

Management

It is critical when looking at 25GbE switches to closely evaluate the type of management tools that are available (see Table 7). With a goal of simplifying management within your data center, you should be looking to run all of your networking devices on one operating system. Another good capability to look for is using a single embedded network management utility across your networking devices and a single console view across all of your enterprise platforms.

5.3 Start the migration

Once you have analyzed your data center and evaluated 25GbE switches that fit your organization's needs, it's time to map out your migration. This section will walk you through several steps that will help ensure a successful and smooth migration.

Category	Feature	Benefit
Embedded	Common management functionality and common user interface across all switching products	Makes operating the network easier and protects training investments
Console-based	Integrated web-based console that functions as a single window to all network management functions	Allows the quick and efficient deployment and management of all network switches
Enterprise-wide	System management console with an easy-to-use interface that can monitor the health of all enterprise platform devices (servers, storage, networking), update drivers and firmware on servers	Single place to go for a high-level view of your data center and simplify and automate essential hardware management tasks

Table 7: Key switch management features

5.3.1 Defining the plan

An ongoing challenge for many IT managers is how to implement new technology into their data centers with minimum disruption of daily services. To help ensure a smooth migration you should develop a plan that documents the key objectives, team members, evaluation and selection of the 25GbE switches. It's also important to identify the critical platforms to be migrated, and develop a migration schedule.

Deployment of 25GbE within your data center should include backward compatibility with existing switches, storage, and servers in the data center that are running 10GbE I/O's. While many 10GbE switches use the Small Form-Factor Pluggable (SFP+) connectors and fiber cabling mentioned previously, today's 25GbE switches offer connectors that are backward compatible with 10GbE switch connectors. This will allow you to keep costs down while implementing an easy migration path to 10GbE.

It is highly recommended that you enlist the aid of a recognized end-to-end systems provider like Dell Technologies or one of its certified partners to help you through this planning process.

5.3.2 Training with new 25GbE switches

After the migration plan is completed and you've chosen your 25GbE switches, it's important to have key team members responsible for their installation and operations to be thoroughly trained. This training will help members become familiar with the new switches and their respective management tools. Most switch manufacturers including Dell Technologies provide detailed training courses both on-site and at separate facilities to help train customers on key features and how to properly install, migrate, and operate their switches in the customer's data center environment.

5.3.3 Integrating with existing management tools

As in most data centers, you've already implemented one or more management tools to help your IT staff manage not only the network switches, but the server and storage platforms as well. Now is a good time to take a close look at the management tools accompanying the new 25GbE switches and to determine how they can integrate or possibly replace your existing management tools. Do your current tools provide extensions or application programming interfaces (APIs) for multi-vendor environments? If not, do the new management tools provide this so that you can simplify your management and operations tasks within the data center? In some cases new 25GbE switches offer Linux-based operating systems that enable use of common management tools across both servers and networking devices.

5.3.4 Running a pilot

It's a good idea to pick a smaller subset of critical platforms or perhaps a specific non-critical application as a pilot. This pilot activity will give you a chance to "practice" the upgrade from 10GbE to 25GbE switches in a controlled environment.

5.3.5 Continuing the migration

Once you're satisfied with the overall upgrade and ongoing operations, you will be ready for upgrading the next set of platforms in your plan. Based on your schedule and resources, you can conduct this migration at a speed that fits into your business plans and budget. As with running the pilot, it's recommended you move over sections at a time to help minimize large scale migration issues should they occur.

5.3.6 Reviewing lessons learned

While it's good business practice to hold a lessons learned session after the migration is completed, it might be helpful if you held a "mini" lessons-learned session after the initial pilot is completed. This will help make the follow-on migrations go smoother. Be sure to pull in all team players to the meeting and also include some IS folks to get a perspective on application and end user performance impacts with the migration.

6. Dell Powerswitch switches and their benefits

Now that we've taken a closer look at 25GbE switch solutions, this section will give a brief overview of Dell Technologies' 25GbE switching solutions. These solutions from Dell Technologies help provide a cost-effective and user-friendly path to a 25GbE infrastructure throughout your data center.

By integrating Dell PowerSwitch solutions, you start the move towards optimizing your data center with a 25GbE infrastructure that will help increase performance, reduce cost and simplify management.

Increase performance

Dell Technologies' high density switches will help to aggregate 25GbE traffic and to take advantage of embedded 25GbE I/O's shipping in Dell Technologies servers, and iSCSI and SAN storage. They will help stay ahead of increasing I/O connectivity and bandwidth demands from virtualization sprawl, cloud infrastructure and new storage caching functionality in servers. You will also be able to manage an easier migration from existing 10GbE to 2.5X the throughput with Dell PowerSwitch open networking switches.

Reduce costs and ease migration

The flexible options of Dell PowerSwitch offer native 25GbE, native 25/100GbE and 100 or 400GbE breakout connectivity so you can immediately start to take advantage of 25GbE in your data center. The 25GbE and 100GbE options are backwards compatible to 10GbE to simplify any migration plan. By leveraging the higher bandwidths of 25 and 100GbE, you can support next-generation server and storage solutions and reduce the number of switches and cables for space, power and cooling savings.

Features	S5x00-ON Series	Z9432F-ON	Z9664F-ON	MX Series
Best for	Low cost fixed form factor top-of-rack switch offering multiple options of 25GbE SFP28 ports for in-rack server and storage connections and 100GbE uplink ports	State-of-the-art, high density PowerSwitch 100/400GbE switch for demanding environments with 4X the throughput, 2X the price/performance and double the power efficiency of 100GbE platforms	State-of-the-art, high density access/aggregation open networking switch for Web 2.0, enterprise, and Tier1/Tier2 cloud service provider data center networks with intensive compute and storage traffic requirements	Rack-based modular chassis for PowerEdge MX kinetic infrastructure, designed to support new processor technologies, new storage types and fabric advances, providing the foundation for software-defined environments
Configuration	1RU/2RU fixed	1RU fixed	2RU fixed port	1RU fixed port
Port configurations	<ul style="list-style-type: none"> • S5212F-ON- 12x25GbE • S5224F-ON- 24x25GbE • S5248F-ON- 48x25GbE • S5296F-ON- 96x25GbE • S5232F-ON- 32x100GbE • S5448F-ON- 48x25/100GbE 	<ul style="list-style-type: none"> • 32x400GbE, 128x100GbE, 128x50GbE, or 144x25GbE 	<ul style="list-style-type: none"> • 64x100GbE, 256x100GbE, 256x50GbE, or 256x25GbE 	<ul style="list-style-type: none"> • MX9116n-16x25GbE • MX8116n-8x100GbE, 16x25GbE* • MX7116n-16x25GbE • MX5108n-8x25GbE • MXG610s-16x32G FC server facing ports
Switching capacity	<ul style="list-style-type: none"> • S5212F-ON and S5224F-ON= 2.16Tbps • S5248F-ON= 4Tbps • S5296F-ON and S5232F-ON= 6.4Tbps • S5448F-ON= 16Tbps 	<ul style="list-style-type: none"> • 25.6Tbps 	<ul style="list-style-type: none"> • 51.2Tbps 	<ul style="list-style-type: none"> • MX9116n=6.4Tbps • MX5108n=960Gbps • MSG610s=1024Gbps
Operating system	Enterprise SONiC Distribution by Dell Technologies, Dell SmartFabric OS10 and select 3rd party NOS	Enterprise SONiC Distribution by Dell Technologies, Dell SmartFabric OS10 and select 3rd party NOS	Enterprise SONiC Distribution by Dell Technologies, Dell SmartFabric OS10 and select 3rd party NOS	Dell SmartFabric OS10 and select 3rd party NOS

Table 8: Dell PowerSwitch 25GbE switches

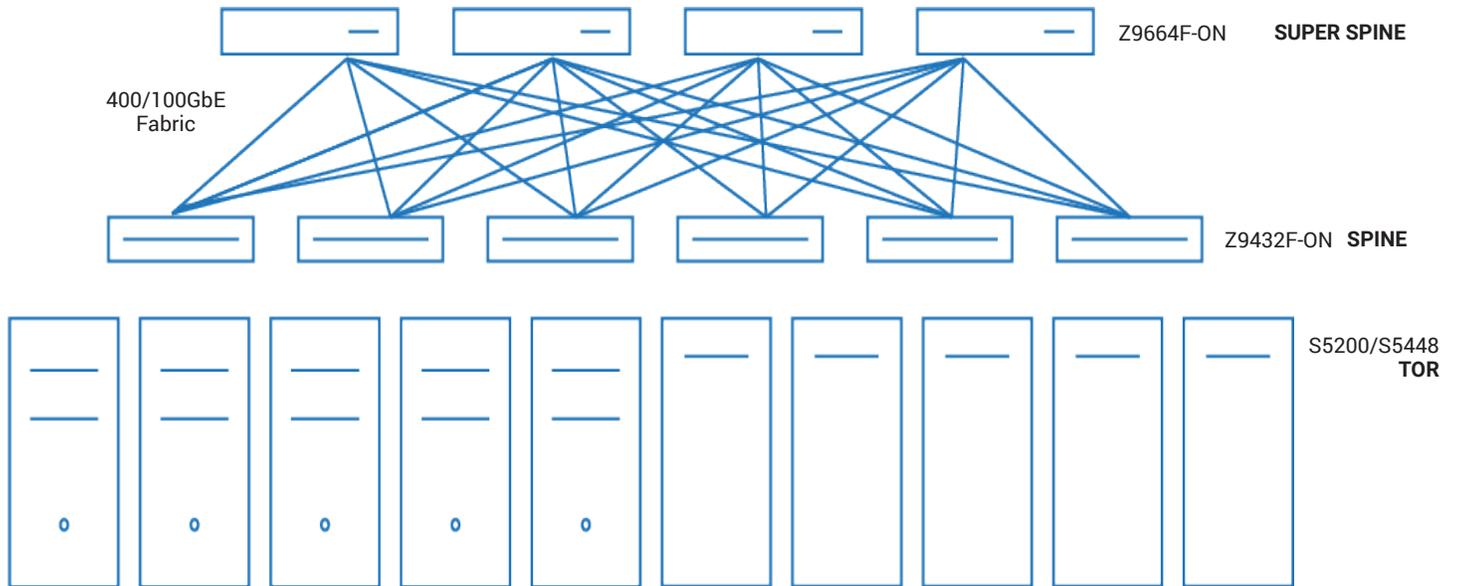
Simplify management

Dell PowerSwitch open networking switches use either Enterprise SONiC Distribution by Dell Technologies or Dell SmartFabric OS10 network operating systems based on the customer's unique needs with a command line interface (CLI) that is compatible with industry standard CLI language. You can manage all Dell PowerSwitches with embedded Dell OpenManage Network Interface (OMNI) for integrated fabric deployment, and automated fabric for compute and storage connectivity.

*Requires PowerSwitch Z9432F-ON for the uplinks.

Summary

It's safe to assume that data center landscapes will continue to change from the constant influx of new technologies and economic drivers. Virtualization has taken a strong foothold in data centers and its use will continue to grow due to the great savings it presents. Increased performance, higher densities, cloud and convergence technologies will allow IT managers to do more with less. Ethernet will expand to become the standard highway running through the data center providing on-ramps and off-ramps for increasing network traffic both within and between servers and storage platforms.



Fortunately, with improvements in 25GbE technology, price and performance is attainable by organizations of all sizes. The technology is proving to be a promising solution for many of the demanding challenges in today's data center. Now is the time for you to take a closer look at the systems within your data center environment, understand what the connectivity and convergence opportunities are, and start your careful migration toward a 25GbE infrastructure. There are a variety of choices to choose from based on your unique environment. When looking at 25GbE solutions, seek solution providers that can offer a wide selection of products, has products that help ease the 10 to 25GbE migration, and most importantly has the experience and services to provide an end-to-end solution.

At Dell Technologies, technology has always been about enabling potential for our customers. Our strategy is to help customers realize an optimized enterprise environment with an end- to-end approach that delivers superior performance and efficiency. Contact Dell Technologies to learn more about our expansive, unmatched portfolio of 25GbE networking hardware, software and services that will help accelerate positive results for your organization.



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