

White Paper

Next Generation Cisco MDS

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Contents

The Impact of Data Center Transformation on Storage Networks	3
Why Organizations Use Fibre Channel	4
Cisco's New MDS Platforms.....	6
ESG Lab Spotlight	7
The Bigger Truth	10

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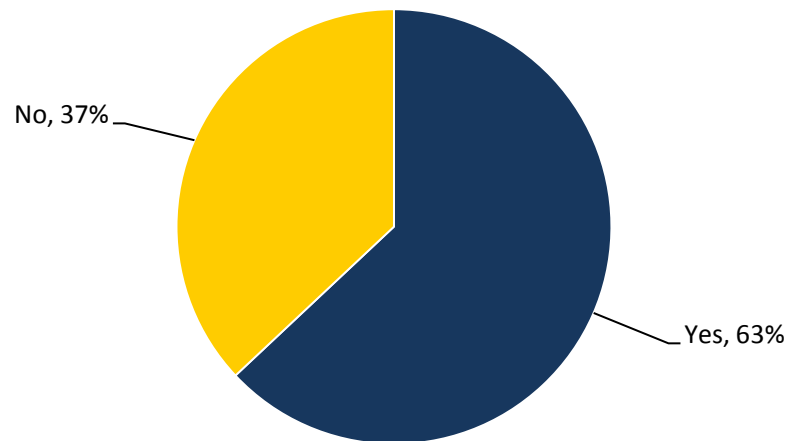
The Impact of Data Center Transformation on Storage Networks

In order to be more responsive in a highly competitive marketplace, organizations are transforming their data centers. This transformation is inclusive of both physical data centers and the technologies deployed within them. Organizations need 21st century data centers to be more agile and efficient in delivering centralized applications and services to a widely distributed workforce and customer base. These data centers must be able to provide consistent 24x7 availability. In order to accomplish these goals, organizations are consolidating data centers, adding virtualization technologies, and leveraging cloud architectures. These initiatives, along with others, are placing significant strain on storage networks.

According to ESG research, data center consolidation has been a top IT initiative for a number of years.¹ Organizations have been consolidating regional data centers into much larger and more complex “mega” data centers to reduce costs and increase efficiencies. In fact, a recent ESG data center networking research survey revealed that 63% of the respondents were either engaged in or had recently completed a data center consolidation project (see Figure 1).² Even more interesting, almost half of those respondents (48%) indicated that these new data centers would be multi-tenant to support different business units. Essentially, this means that enterprise data centers are starting to look more like service provider environments.

Figure 1. Enterprises Consolidating Data Centers

Is your organization currently engaged in - or has it recently completed - a data center consolidation project? (Percent of respondents, N=280)



Source: Enterprise Strategy Group, 2013.

Virtualization and cloud technologies are also proliferating in just about every data center. Indeed, server virtualization was the IT priority reported by the most respondents to ESG’s annual IT spending intentions survey for a number of years and is still in the top three responses provided in the most recent iteration, as seen in Figure 2.³ Server virtualization technology is capable of bringing a number of benefits, including rapid provisioning of services, mobility, and availability. However, in order to achieve many of the advanced mobility features, a networked storage environment is required. Organizations have continued to mature and advance their virtualization environments—moving into production and mission-critical environments, the networked storage

¹ Source: ESG Research Report, 2013, 2012, 2011, and 2010 IT Spending Intentions Survey.

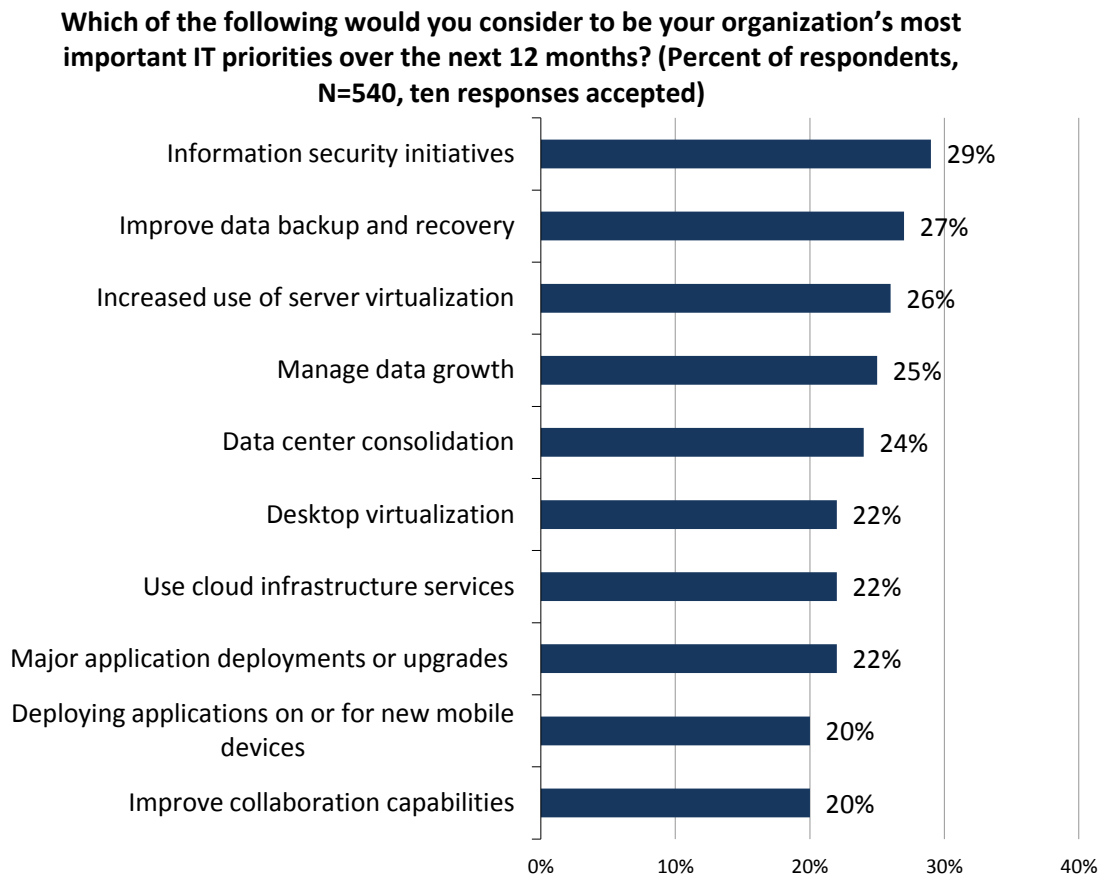
² Source: ESG Research Report, [Data Center Networking Trends](#), January 2012.

³ Source: ESG Research Report, [2013 IT Spending Intentions Survey](#), January 2013.

environment plays an even more important role in not only enabling virtualization features, but also ensuring availability. The proliferation of virtualization technologies has led to the rapid scaling of storage networks.

Data centers are also experiencing rapid data growth, and, as illustrated in Figure 2, trying to manage data growth was reported by 24% of respondents as one of their most important IT priorities.⁴ While much of the public attention is on the growth of unstructured data, structured data continues to grow.

Figure 2. Top Ten Most Important IT Priorities for 2013



Source: Enterprise Strategy Group, 2013.

As outlined previously, the data center is transforming, which is having an impact on the storage network. The key to transformation is to ensure that all the applications and services are available while the transition takes place. In order to provide the requisite reliability, scalability, and performance, organizations have traditionally deployed Fibre Channel storage networks.

Why Organizations Use Fibre Channel

Despite a number of new and emerging technologies like FCoE, 10, and 40 Gigabit Ethernet, organizations continue to use and deploy Fibre Channel (FC) SANs. Historically, Fibre Channel was the choice for mission-critical applications that required deterministic low latency networks to connect to shared storage. Fibre Channel SANs also got a boost from server virtualization efforts because, for a number of years, it was the only type of networked storage supported by VMware.⁵ Although other forms of storage, namely unstructured file storage leveraging Ethernet, have grown rapidly with so many mobile devices capable of generating files, Fibre Channel is still the

⁴ Source: Ibid.

⁵ VMware now supports iSCSI, Ethernet(2010) and FCoE(2011).

preferred choice in enterprise accounts. In fact, one only needs to look at the rapid transition from 8G or lower to 16G Fibre Channel as proof that this market is still robust. For close to 20 years, Fibre Channel has been deployed to support the most rigorous and demanding environments because of certain characteristics it possesses. Namely, Fibre Channel SANs provide:

- **Reliability** – CIOs worry about mitigating risks, lowering costs, and improving cycle time. The last two are given more or less weight based on the macroeconomic climate, but mitigating risk is always top of mind. Businesses can't afford any level of downtime, so any steps that ensure an enterprise can be highly available are not only welcomed, but also encouraged. Fibre Channel SANs are well proven and mature technologies that have demonstrated their reliability and availability in some of the most demanding application environments. Because of that, enterprises trust Fibre Channel to support their mission-critical environments.
- **Performance** – For most organizations, time is money, so when deploying transaction-heavy applications like ERP, e-mail, and e-commerce, they need deterministic networks to guarantee performance. Plus the addition of faster storage systems leveraging SSD requires a high-performing network link. The transition to 16G FC will enable organizations to deliver high-performance and higher capacity links for servers with increasing VM densities. In fact, ESG research indicates that organizations are maturing their virtualization environments, growing from an average of five to ten VMs per machine to over 20 VMs per machine.⁶ Organizations will be able to benefit from the higher capacity 16G links. The first use cases will be for ISLs and consolidation.
- **Scalability** – While data center consolidation means fewer locations, it results in much larger and more complex IT environments. As a result, organizations are finding that they need to be able to rapidly scale their environments to accommodate the workloads and traffic from a consolidated site. Because of their role supporting mission-critical applications, large scale environments are not new to Fibre Channel. However, moving forward, it will be imperative that these environments are capable of accommodating rapid scale. It should be noted that the ability to scale could include not only the number, speed and density of ports, but also port virtualization.

Modern data centers are also highly dynamic and will require:

- **Flexibility** – Given the rapidly changing IT environment, organizations understand that solutions deployed today may not be the most appropriate choice in the future. Therefore, care must be taken to ensure that the technology that organizations deploy is flexible, allowing for a variety of different configurations as well as the ability to support multiple storage protocols, even if they are not being used today. In a Fibre Channel SAN environment, this may include FCIP, FCoE, and FICON (for mainframe environments) to accommodate different service levels or transport over the WAN.
- **Simplicity** – In order to overcome the risk of increased complexity arising from rapidly growing and scaling Fibre Channel environments, simplified management solutions are required. Although Fibre Channel SANs have previously been described as being more complex due to the need for network admins to learn new tools, commands, and network protocols, that will need to change. Modern Fibre Channel SAN environments will have to have simple and intuitive graphical user interfaces (GUIs) to satisfy organizations that plan to merge or integrate their storage and data networking teams.

⁶ Source: ESG Research Report, [Data Center Networking Trends](#), January 2012.

Cisco's New MDS Platforms

Cisco entered the Fibre Channel market with great fanfare about a decade ago with the MDS product line introduction, which was technology developed by Cisco incubator company Andiamo. Cisco's approach to Fibre Channel storage area networking reflected its strong heritage in data networking, namely the concept of building a modular chassis that could be upgraded to incorporate future services without ripping and replacing the original chassis. Following a ten-year run with the initial MDS platform, Cisco is now introducing its next generation of Fibre Channel Platforms, starting with the MDS 9710 Multilayer Director and MDS 9250i Multiservice Fabric Switch. Again following Cisco's design philosophy, this next generation of SAN solutions has been designed to accommodate the next decade of storage networks.

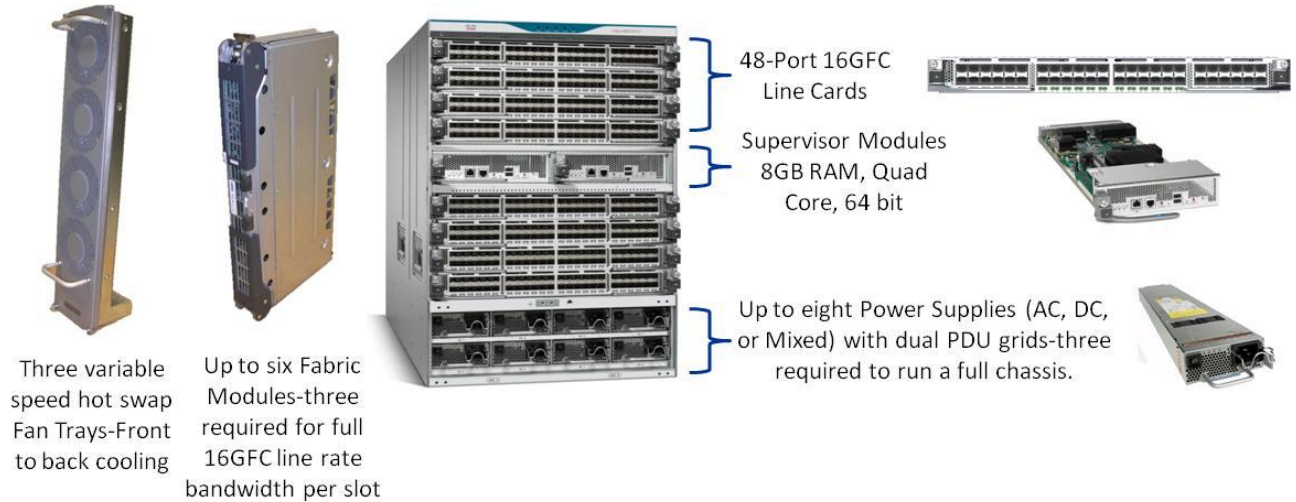
These new MDS solutions provide:

- **Enhanced availability.** Learning from its experience with the MDS 9500 as well as Nexus product line, Cisco has incorporated several enhancements in the MDS 9710 to provide even further reliability, including N+1 fabric modules and three fan trays with, yes, front-to-back air flow. The N+1 concept takes availability to the next level: Not satisfied with redundant power supplies, fabric modules, and fans, Cisco now enables organizations to utilize up to eight power supplies and up to six fabric modules. In addition to delivering higher availability, the N+1 approach to fabric modules will enable un-interrupted performance in the event of the loss of a single fabric module. It also ensures that for highly available environments, the risk of operating with a single point of failure is mitigated, along with the risk of running with degraded performance. With four fabric modules, one can be lost and the system will still have full 16G throughput.
- **Multi-protocol support.** The MDS 9710 Multilayer Director supports a range of Fibre Channel speeds, FICON (yes, there are still a lot of mainframes), and 10G FCoE. The MDS 9250i Multiservice Fabric Switch will accommodate 16G FC, 10G FCoE, 10G FCIP, or iSCSI and FICON. The MDS 9250i has been designed to help accelerate SAN extension, tape backup, and disk replication as well as migrate data between arrays or data centers.
- **High-density, high-performance storage director.** In order to handle the rapid scale accompanied by data center consolidation, the MDS 9710 Crossbar and central arbiter design enable up to 1.5 Tbps of FC throughput per slot. This is coupled with the 384 ports of line rate 16G FC. In addition, each MDS 9710 Multilayer Director will be capable of running Fabric Path and creating Virtual Data Centers by segregating traffic over VSANs.
- **Comprehensive and simplified management of the entire data center network.** Organizations looking to simplify management and integrate previously disparate networking teams, storage, and data should find the Cisco Prime Data Center Network Manager (DCNM) appealing. From a single management tool, they can manage Cisco MDS and Nexus platforms. The latter will allow for tighter integration with the server and network admins. A single resource should help to accelerate troubleshooting with easy-to-understand dynamic topology views and the ability to monitor the health of all the devices and filter on events that occur. DCNM is also integrated with VMware vSphere to provide a more comprehensive VM to storage visibility. Organizations should also be able to leverage and report on the data captured and plan for additional capacity more effectively.
- **Future proofing.** Preparing for the future is a difficult task, but there are steps organizations can take to better prepare for it. Cisco has designed the MDS 9710 to accommodate future technology advances, as witnessed with the MDS 9500 series. However, with the MDS 9710, it is also going to be adding support for its onePK API to enable future services access and programmability, essentially extending the concept of SDN into the SAN. In addition, the Cisco Prime DCNM will also have APIs and dashboard portals to help it integrate into existing operations centers.

ESG Lab Spotlight

ESG Lab tested the new MDS 9710 in a Cisco lab in San Jose, California to validate the reliability, flexibility, and performance of the new architecture. This section of the paper aims to highlight the most interesting enhancements in the new MDS platform and why they should matter to real customers. As seen in Figure 3, the MDS 9710 is a director class chassis that supports up to 384 16G line rate ports on eight 48-port line cards (16G FC today, 10G FCoE in the second half of 2013), with dual supervisor modules, up to six fabric modules, and up to eight power supplies. The Cisco MDS 9710 architecture has enough available backplane bandwidth to support 48 ports of full line rate 32G FC just by adding fabric modules, and is designed for a very long useful life.

Figure 3. The Cisco MDS 9710 Multilayer Director

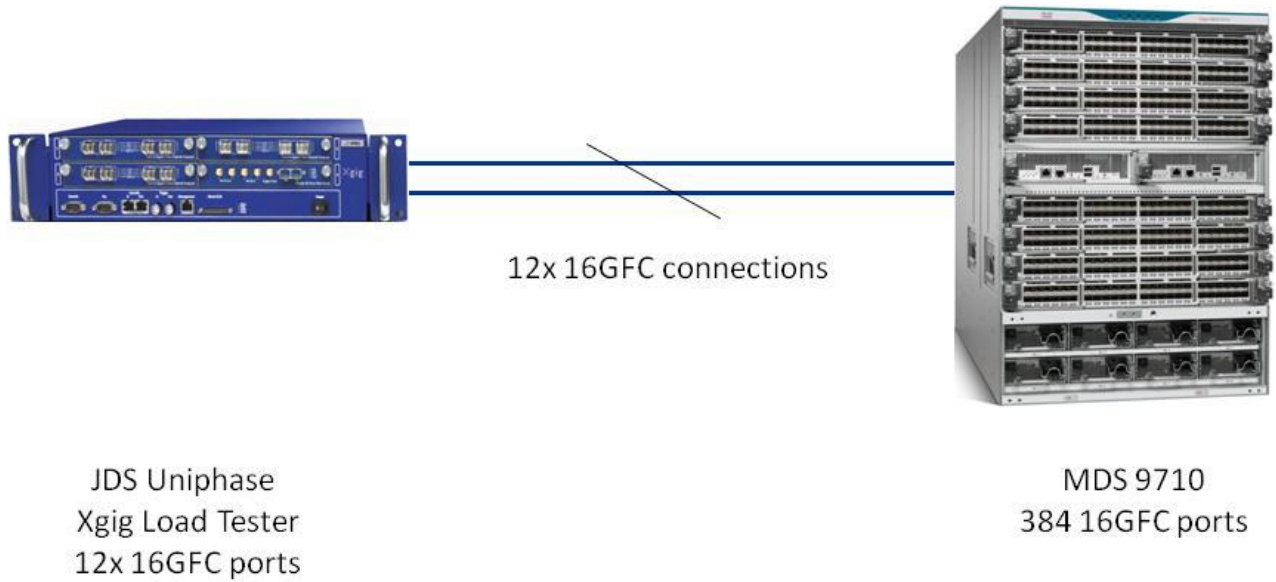


ESG Lab Testing

The purpose of this test configuration was to fully load all 384 ports with 16G FC traffic and verify that the system could sustain this rate through all tests.

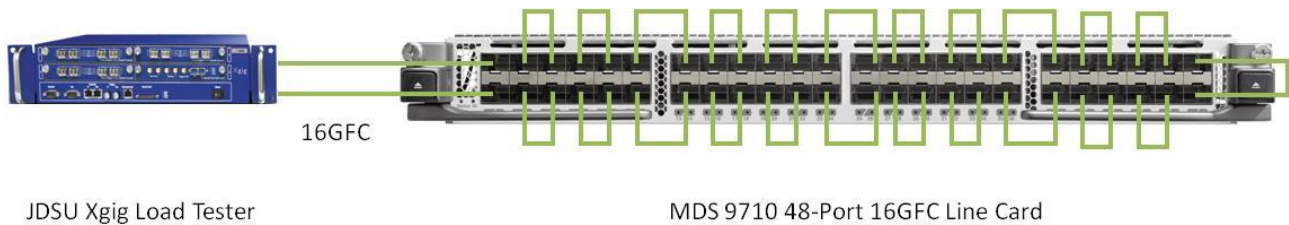
Testing was performed on a fully populated MDS 9710 chassis, with eight 48-port 16G FC line cards, six fabric modules, and dual supervisor modules. It's important to note that just four power supplies were installed in the chassis—three power supplies are required to power a full chassis, and the fourth was installed for redundancy.

Figure 4. The ESG Lab Test Bed



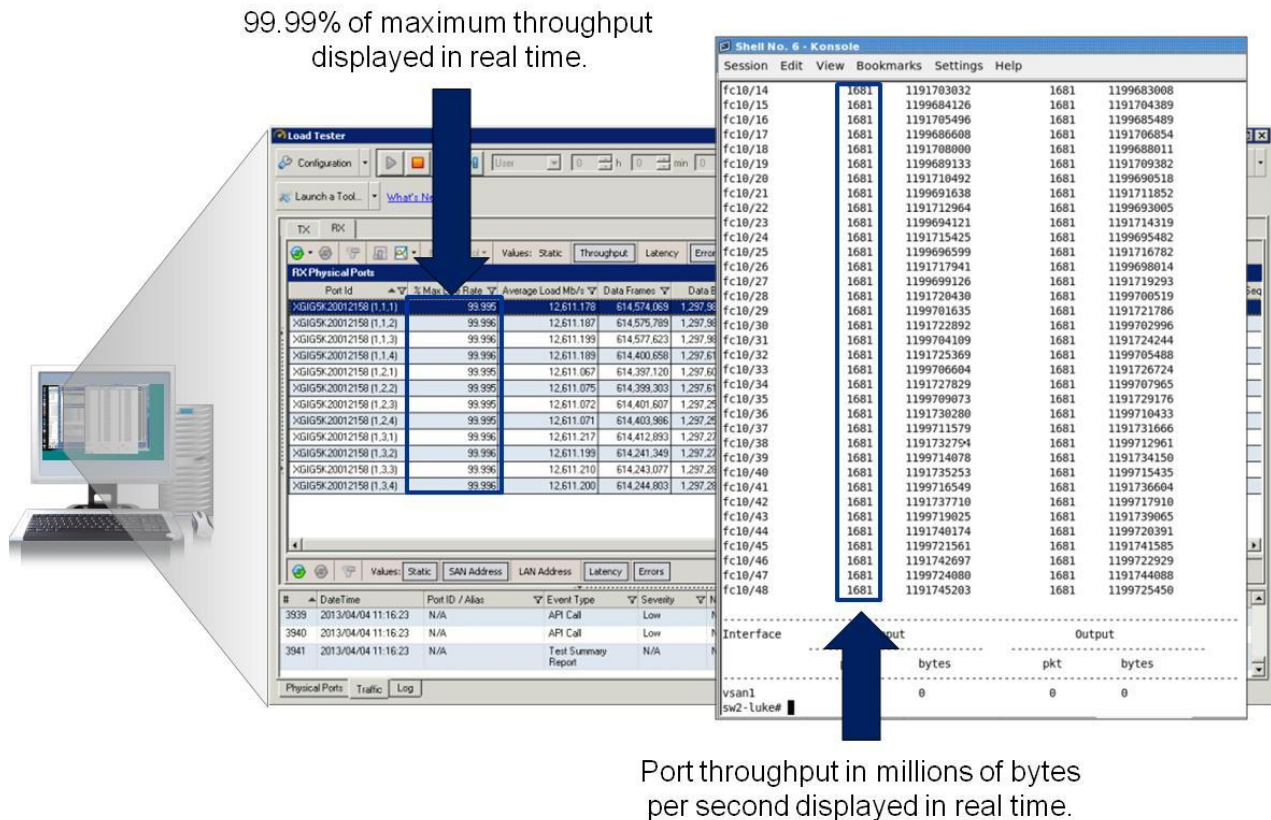
As seen in Figure 4, the MDS 9710 was connected to a single JDS Uniphase Xgig load tester via a total of six pairs of 16G FC connections. The ports on the eight MDS line cards were cabled in a serial configuration called a “snake” in which adjacent ports are interconnected. In Figure 5, the wiring of a snake configuration through a single line card is shown in detail, where two ports on the line card are connected to two ports of the JDSU load tester, and the remaining ports on the line card would all be connected to each other. In this test, bidirectional traffic is generated between the two ports on the JDSU tester, and traverses every port on the line card.

Figure 5. A Snake Configured Through One 48-port Line Card



There were a total of six snakes, each consisting of either one or two line cards to support the total of eight line cards with the six pairs of tester ports. The six pairs of tester ports generated full line rate traffic to the six configured snake configurations so that all 384 ports in the chassis would be utilized. When the load tester was started, ESG Lab confirmed that all ports were operating at line rate using the JDS Uniphase GUI, and the Cisco CLI, seen in Figure 6.

Figure 6. 16G Fibre Channel Throughput Test



While the test was running, the fabric utilization in the chassis was reported at 49%. ESG Lab then pulled three fabric modules from the chassis while the test continued to run. The ports continued to run at line rate, confirmed by both the load testers and the CLI. Fabric utilization was again checked and was now running at 98%. ESG Lab next pulled a supervisor module, by simply unscrewing the captive screw, pressing the ejector lock release button, and pulling the ejector lever. The supervisor automatically failed over flawlessly with no intervention required and the test continued to run.

Finally, ESG performed an in-service software upgrade (ISSU), as well as a downgrade while the system was running. ESG Lab also confirmed zero frame loss and zero frame errors throughout testing. This is a requirement in enterprise environments.

Power consumption in the fully populated chassis with every port running at full 16G line rate was examined. The MDS 9710 captures actual power draw and presents it along with the power budget, as detailed in Table 1.

Table 1. Power Budget and Consumption for a Fully Populated MDS 9710

Chassis	Actual Draw (Watts)	Power Budget (Watts)	Power Available (Watts)
MDS 9710 8x Line Cards 2x Supervisor Modules 6x Fabric Modules 3x Fan Modules	4,941	8,430	12,000

It's important to note that the entire chassis was drawing just over a third of its total capacity of 12,000 watts (using four 3000W power supplies) with every slot populated and running at full line rate with six fabric modules installed for N+N redundancy.

The Bigger Truth

Enterprise organizations are transforming their data centers to increase flexibility and agility in order to better respond to business needs. Data centers are becoming more consolidated and virtualized, resulting in fewer but much larger and more complex IT environments. As a result, the network is playing a more important role in connecting highly virtualized environments. And while the ability to react quickly to changing environments is critical, so is the ability to ensure high levels of availability.

Organizations need technology that will help them accelerate their transformation and enable growth while simultaneously mitigating the risk involved with such an effort. Cisco's new MDS platform has been designed to enable the storage networking environment to effortlessly handle demands resulting from this transformation.

ESG Lab found that the new MDS platform is designed to meet enterprise needs well into the future. The N+N fabric module design was able to support full 16G line rate traffic on all 384 ports in the chassis with just three modules running—with a full complement of six modules, the chassis will support 1.5 Tbps per slot for 384 full line rate ports at 32G. ESG Lab confirmed flawless operation, with zero frame loss and zero frame errors.

A large number of new features are designed to enhance the availability, manageability, and serviceability of the MDS platform while reducing risk of human error. From hardware and software interlocks that initiate failover before a supervisor module is physically ejected from the chassis, to LEDs that can be flashed to locate a specific chassis, module, and port that needs servicing, to front-to-back airflow and hot-swappable everything.

The new MDS 9710 and MDS 9250i represent a significant upgrade in capabilities. The new systems enable users to decide what level of availability they need while providing the scale and performance to support highly virtualized/cloud environments with built-in headroom to accommodate whatever the next decade throws at it. Cisco's onePK API offers the potential to deliver programmability to the storage network.

The MDS 9710 is a rock-solid, feature-rich, multilayer director that delivers outstanding SAN-attached connectivity and performance to enterprises and service providers looking for agile, efficient, and simple core connectivity in support of the unified data center.



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