COMMSCOPE®

Strategies for a connected and efficient data center

For anyone involved in data center management, there is no such thing as "maintenance mode" or "business as usual." The job itself is not unlike scaling a mountain—you advance bit by bit and, every so often, you find a precarious ledge on which to catch your breath before continuing the climb. All the while, the winds are shifting, the weather changes, and every move is critical.

According to the latest Cisco Visual Networking Index (VNI)[i], by the end of 2016, global IP traffic will grow 3-fold from 2015 to 2020 and, by 2020, global IP traffic will reach 2.3 ZB per year, or 194 EB per month. The number of devices connected to IP networks will be three times as high as the global population in 2019.

The increasing demands on IT and data centers, in turn, are being driven by even larger global megatrends that are having a profound effect across industries. According to Gartner Inc.[ii], these megatrends include massive digitalization, unprecedented demographic and social changes, urbanization and the rise of the megacity, and climate change—along with dwindling resources.

At the same time, the rising cost of network downtime and the increasingly important role the data center plays in the success of the organization have raised the stakes. Data centers must evolve and they must get it right.

At the highest levels, CTOs and CIOs are responding by re-evaluating their strategies regarding their IT and networking footprint, deployment options and resource allocation. However, making it work is up to the data center managers and others on the front lines. Here, too, the ground is constantly shifting as data centers look to deploy faster and more efficient optics; switch from the traditional three-layer vertical hierarchy to flatter, heavily meshed leaf-and-spine architectures; and migrate to higher lane speeds.

The changes within the data center environment are so frequent and rapid that data center managers often find themselves reacting to events and crises instead of implementing a proactive strategy. In fact, finding time to develop such a strategy—one that addresses critical elements like the best migration path to higher speeds, infrastructure management and scalability, and increased virtualization support—is difficult. But, to keep pushing forward, it is absolutely necessary.

CommScope has developed this paper as a resource to help data center managers prioritize and focus your efforts as you continue to formulate a proactive strategy for the evolution of your data center. We have identified three key areas that, we believe, should be part of a successful strategy:

- Migration to higher speeds
- Infrastructure management
- Cloud performance

The following provides a closer look at each of these critical areas—the key issues, questions and trends—as well as examples of the advanced technologies and some solutions from our own portfolio that are available to support your evolving strategy.

> *"Companies in North America lose up to $100 million per year to downtime related to information and communication technology."*
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> **IHS, Inc. report**
> February, 2015

Migration to higher speeds

The need for data centers to support increasingly faster speeds throughout the network is hardly a surprise. As shown in figure 1, Ethernet link speeds in the data center have grown 4,000 percent since 1980. The difference today is that there's far more at stake. People, businesses and the world are hyper-connected and always on. The ability for data centers to support 25G/40G/100G and beyond—with three, four and five 9s of availability—is non-negotiable.

Currently, 10G links are widely deployed within the data center rack; 40G links are between racks; and 100G is typically used for long spans and to connect to the wide area network (WAN). Until July 2014 and the creation of the 25G Ethernet Consortium, the accepted migration path was 10G to 40G to 100G to 400G. But that is changing. As interest in the soon-to-be-standardized 25G and 50G speeds rapidly builds, data center managers are rethinking their original commitment to 40G.

Whether you elect to go 25G, 40G or 50G, the fundamental question is: what type of infrastructure will be needed to support continued growth in link speed? The answer is multifaceted and must take into consideration the following.

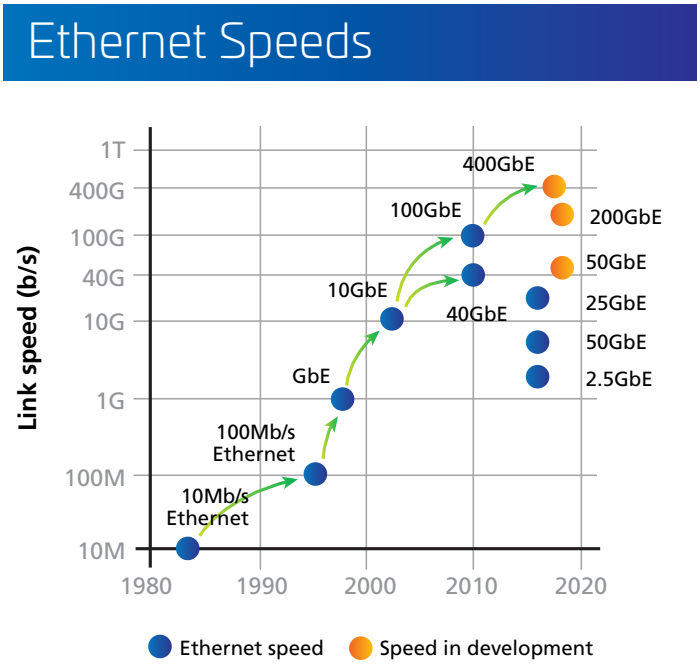

Figure 1: Ethernet standards since 1980 Source: Ethernet Alliance

Network architecture

Data centers are rapidly switching from the traditional three-tiered design to a flattened two-tier fat tree design that increases redundancy and decreases latency. One hallmark of this network topology is a high density of fiber ports in the spine switch layer. In addition to changing the overall network architecture, this model is also encouraging the use of more space-saving fiberconnectors and modules.

At the same time, more networks are now adopting a structured cabling approach rather than a point-to-point cabling approach. While point-to-point is intuitively easier, it quickly becomes unmanageable as the number of switches and assets grows. The structured cabling approach ensures scalability and can lower the data center's CapEx and OpEx in the long run.

Fiber selection

For data center applications, singlemode fiber has been a tough sell, given the high-priced optics required. Multimode fiber (MMF) continues to offer a more attractive balance of performance, density and cost for enterprise data centers. The challenge for MMF is distance. But emerging higher quality components and engineered links can provide the link capacity to support the longer distances and new data center topologies.

Recently, an improved option has emerged that may eventually provide the optimum solution for fiber migration. As discussed earlier, wideband multimode fiber is a new fiber type, recently approved under ANSI/TIA-492AAAE, classified by ISO/IEC as OM5, and expected to be recommended by ANSI/TIA-942-B. Introduced by CommScope in 2015, the technology extends the capacity of laser-optimized 50 µm fiber such as OM4 by using wavelength division multiplexing (WDM) for optimized operation at 850 nm and beyond. By multiplexing four wavelengths, one strand of OM5 can, over a practical distance, increase data capacity by a factor of four.

	TIA	ISO/IEC	CENELEC
Data center standard	**TIA-942-B**	**ISO/IEC 11801-5**	**EN 50173-5**
Fiber	OM4	OM3	OM3
	OS1a	OS1a	OS1a
Fiber connectors	LC (≤ 2 fibers)	LC (≤ 2 fibers)	LC (≤ 2 fibers)
	MPO (≥ 2 fibers)	MPO (≥ 2 fibers)	MPO (≥ 2 fibers)

Figure 2: Key cabling standards for fiber and connectors
Source: Data Center E-book, CommScope

Connector technology

The choice of connector technology is driven, in part, by the decision to deploy parallel or serial optics. Using parallel optics is often the most cost-effective way to support the higher transmission speeds. This suggests that the use of the well-known and proven MPO connectors will continue, but in what form? 8-fiber, 12-fiber and 24-fiber MPOs each have important applications, but the 12- and 24-fiber modules may be more versatile in supporting more high-speed fiber configurations.

Figure 3: MPO connector options

Migration planning

In terms of planning and implementing a migration to higher speeds, automated infrastructure management (AIM) systems are becoming more prevalent. AIM systems, such as CommScope's imVision®, can greatly assist in the process. An AIM system uses intelligent hardware and software components to collect specific data regarding the identity, location and status of every managed port in the data center.

This intrinsic information—regarding what is happening within the cabling infrastructure—enables data center managers and IT personnel to see and manage the connected environment in real time, discover networked devices, and pinpoint their physical location. This information is then used to help plan and execute the migration strategy.

Infrastructure management

As compute and storage demands inside the data center continue to grow, the number and density of servers, switches and devices mushrooms. In the U.S., the total server installed base is projected to increase by 40 percent from 2010 to 2020.[iii] With the any-to-any connectivity of leaf and spine networks (see figure 4), the infrastructure for even a small data center can quickly become unmanageable. The resulting cost—measured in longer mean time to repair, higher OpEx, and poorly executed moves/adds/changes—can quickly multiply.

Managing this increasingly complex infrastructure involves managing both the physical aspects of the cabling as well as the operational connectivity of the network.

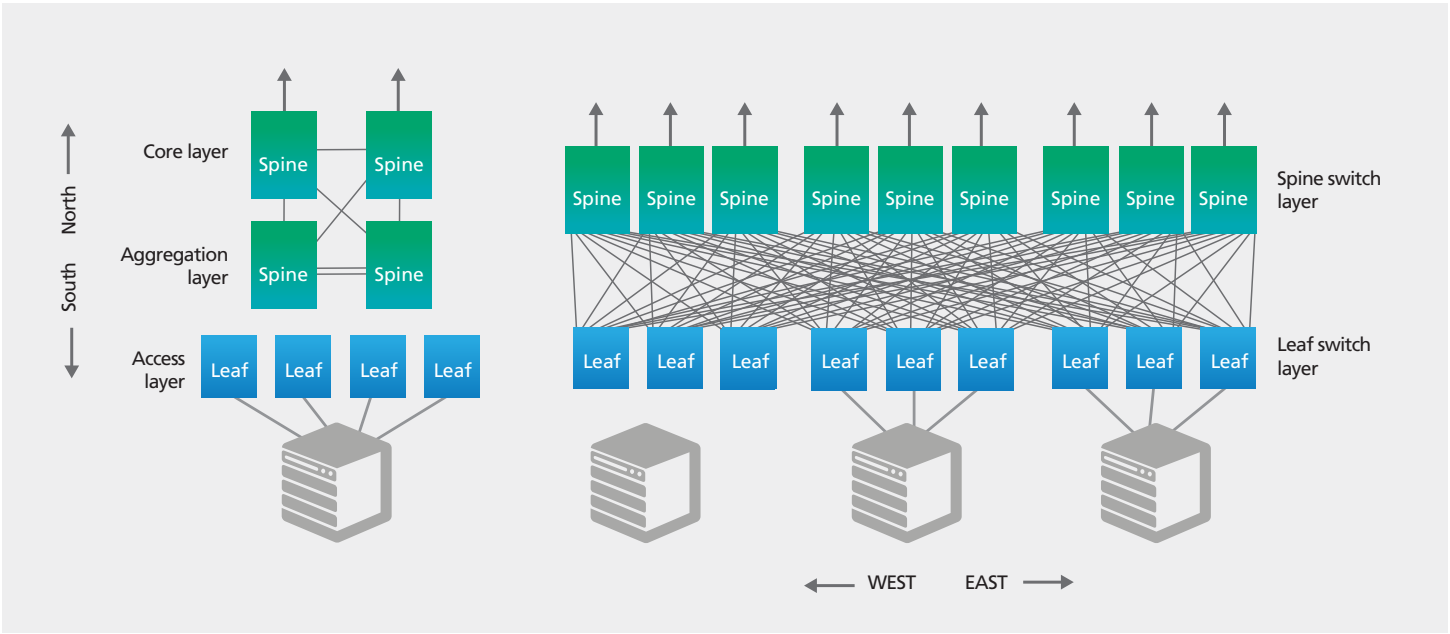

Figure 4: Move to Leaf-Spine Architecture
Source: Datacenter Journal, April 2016

Cable management and routing

As the port count has increased from a few hundred to several thousand, the cabling network has grown into a sprawling mass. Moves, adds and changes are more frequent and far more difficult, increasing the potential for mistakes and the mean time to repair. For decades, network managers relied on standard rack panels to manage their fiber terminations and connectivity, but these systems were not designed to support today's high-density optical networks.

As a result, data centers and central office facilities are deploying more optical distribution frames (ODFs). An ODF is typically used as the connection point between the outside plant network and the physical layer infrastructure inside the facility. Most ODF solutions integrate fiber splicing, fiber termination, fiber-optic adapters and connectors, and cable connections in a single unit.

As fiber density increases, ODF vendors continue to improve their system designs to accommodate growing fiber counts. 144-port/rack unit systems are now commonplace while CommScope's NG4access® ODF currently stands alone. With an alternating front-and-back port design, the NG4access is able to accommodate 288 SC connections and 576 LC connections, providing the density required in today's data center.

Cabling routing systems—used to guide fiber patch cords and multifiber assemblies between fiber splice enclosures, fiber distribution frames, and fiber-optic terminal devices—are evolving as well. Overhead tracks and troughs are no longer just containment solutions. As their maze of cabling multiplies, data center managers rely on their routing systems to help organize and protect thousands of individual cables as they snake through the facility. Systems like CommScope's FiberGuide® optical raceway system employ highly engineered bend management to maximize the optical performance of the fiber.

The available configurations for these cable management systems are quickly increasing, as dwindling space in the data center forces IT staff to get more creative when it comes to routing. The FiberGuide portfolio, for example, now features 38 different support structures, more than 75 fittings, trough sizes up to 4" x 24", and multiple drop options—enabling installers to take advantage of more routing options.

Connectivity management

Increased complexity in the physical layer infrastructure is prompting data centers to begin deploying more AIM solutions. In a structured cabling mesh network, a single server-to-server connection involves multiple patch cables and switches. The information contained within the AIM platform's databases provides crucial insight into the status of each connection and enables the data center manager to trace the entire circuit.

By adopting an AIM solution, network administrators can streamline provisioning and monitoring of network connectivity, gain an accurate view of what is connected where in the network, reduce downtime by real-time notification of unplanned changes, and produce up-to-date reports on the state of the infrastructure. For example, a full-featured AIM platform like CommScope's imVision can help ensure capacity is available when upgrading from duplex to parallel optics. Conversely, it can help identify surplus cabling and switch ports and make them available for parallel-to-duplex migration as new higher-speed duplex applications become available.

> *"Today, about 90 percent of IT networks are documented using manual tools like spreadsheets, which are laborious and prone to human error."*
>
> **Pipeline Magazine**
> Feb. 2016

Cloud performance

Finally, any data center tactical strategy must also address how the facility will adapt as the trend toward virtualization and cloud deployment continues to gain momentum. The cloud platform and infrastructure market generates roughly $21 billion in revenues and is expected to grow 20 percent a year—reaching $43 billion by 2018. By 2019, cloud applications will account for 90 percent of worldwide mobile data traffic.[iv]

Your ability to effectively migrate on-premise applications to either a private or public cloud will depend in large part on your physical layer infrastructure. But be careful how you plan. According to a recent article in Network Computing: "Cloud migration is not an infrastructure refresh in which you are ripping out old hardware and replacing it with new. It's an application landscape redesign that will change not only the way IT administrators interact with your systems, but also how your applications interact with one another and are delivered to your end users."[v]

So what infrastructure characteristics are needed to maximize the advantages of cloud-based computing? For starters, the platform needs to deliver low latency throughput. This underscores the importance of the flattened, two-tier architecture of the spine and leaf network. As previously mentioned, this approach features a high density of fiber links between the spine and leaf layers.

Having high- or ultra-high-density fiber panels is important, as is a connector design that ensures the highest possible utilization of every fiber strand.

The more fiber dense the environment, the greater the need for low-profile cabling and connector modules like the micro quad small form-factor pluggable (microQSFP). Having the same width as the existing single-channel small form-factor pluggable (SFP) connectors, microQSFP ports offer the industry a familiar module, but with up to four times the data capacity. The infrastructure must also scale easily while keeping the increased fiber density manageable. Figure 5 shows the progression of higher density multi-source agreements (MSAs) per the 2016 Ethernet Roadmap. This echoes the importance of a well-designed and flexible routing solution.

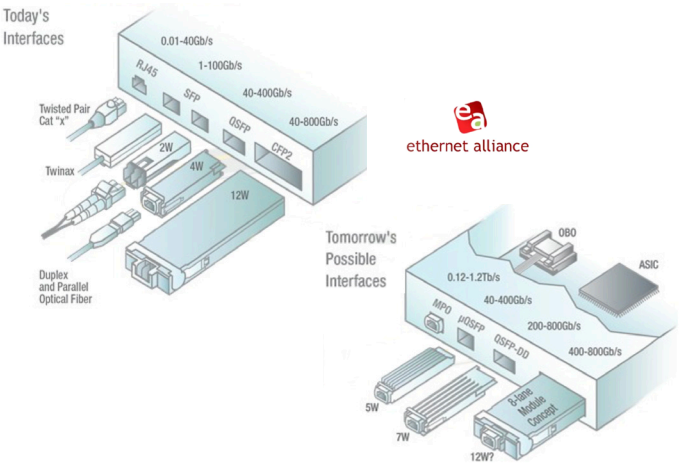

Figure 5: Multi-source agreement types
Source: Ethernet Alliance Deployment speed and accuracy also critical

Deployment speed and accuracy also critical

Beyond the three major areas discussed above, there are additional factors that should also be considered. Of these, the speed and accuracy of deployment may be the most important.

Studies, such as those cited in figure 6, show just how much the per-hour value of network uptime has increased over the past decade. While the average organization has cut downtime hours by 84 percent, the cost of outages has increased more than seven-fold.[vi]

Not surprisingly, human error is one of the leading causes of unplanned downtime, accounting for an estimated 22 percent of all outages.[vii] The numbers suggest a strong link between manual tasks and unplanned downtime. Few tasks are as labor intensive as terminating and installing new fiber cabling. Manual field terminations, troubleshooting, and error corrections mean extended deployment times, higher installation costs and increased downtime.

One of the ways data center managers are combatting this is by relying more on preterminated, pretested fiber assemblies. Compared to field-terminated fiber cabling, factory-terminated and -tested fiber has better optical performance and fewer installation costs. The precision and consistency of factory-terminated fiber cabling greatly improves the loss and reflection attributes of the connectors.[viii]

In determining the best fiber portfolio, plug-and-play capability is a key to decreasing deployment times and potential unplanned outages. The portfolio depth is also important. For example, CommScope's fiber portfolio features solutions like InstaPATCH® preterminated fiber and copper and SYSTIMAX® ultra low loss, which can be paired with LazrSPEED® OM5 wide band multimode fiber or TeraSPEED® singlemode fiber. It also features a range of complementary fiber panels and shelves—such as our SYSTIMAX high-density and ultra-high-density fiber shelves—both of which support CommScope's imVision AIM platform.

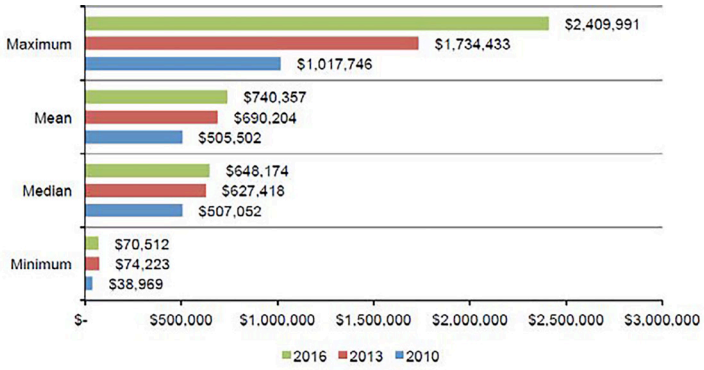

Figure 6: Rising cost of unplanned network outages
Source: Ponemon Institute, January 2016

The connected + efficient data center

A key enabler in designing and implementing a successful tactical strategy is the infrastructure partner. Even for a small enterprise data center, the process of designing, coordinating and selecting a best-fit infrastructure solution involves hundreds of moving parts and thousands of decisions. When brought into the process early, a well-equipped and experienced provider can prove invaluable in a number of areas.

Larger partners like CommScope provide a portfolio that includes most, if not all, of the components needed: multiple and complete lines of fiber and copper cabling; high-density racks, panels and ODF systems; cable routing and management solutions; and infrastructure intelligence platforms, including Automated Infrastructure Management (AIM).

Moreover, a partner like CommScope—which has experience in all aspects of network infrastructure design—tends to bring a more holistic approach to long-term tactical and strategic planning, design

and deployment. As a result, they see the data center as a single interconnected ecosystem that exists within the context of the organization. That broader view can often balance and complement the perspective of the data center manager who may have a more granular view of the issues and opportunities.

When well defined, thoughtfully executed, and supported with infrastructure solutions that have been pretested and field-proven, a solid strategy results in a data center environment that is:

- Simple to manage
- Efficient to operate
- Easy to scale

This environment offers a variety of tangible benefits, including lower operating costs, faster turn-up for new and upgraded services, accelerated mean time to repair, increased worker productivity, and reduced downtime—all of which translate to increased revenue for the organization.

For the data center manager, the cumulative effect is the ability to spend less time worrying over how to respond to changes due to growth, higher data rates, and network demands—and more time implementing the strategy, monitoring the results, and refining the plan going forward. Lower stress—higher productivity.

Conclusion

Creating a data center that is efficient, manageable and scalable means proactively addressing the key issues facing it: the constant evolution to higher data speeds; the ability to manage an increasingly complex infrastructure; and the understanding of how migration to the cloud will impact data center design and performance.

As enterprise and co-location facilities continue to grow in complexity, the most successful will be those designed and able to pivot quickly and easily in order to take advantage of new technologies and market opportunities. That ability cannot be dictated from the top down. It is created from the inside out—starting with the right physical layer infrastructure and an experienced, global partner who can help build it.

Sources

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