Creating the Data Center of Tomorrow

By David Kozischek and Ray Barnes

As the name implies, the data center is the data processing, routing and storage center in the network. If the data center is to the network what the brain is to the body, then our own neural network is to our efficient brain function what the data center cabling infrastructure is to the efficient functioning of the data center. Increased efficiency is becoming more and more important as data-intense applications come online. The workload that the brain of the network is required to manage is accelerating. With this, data center rack space, cable pathways, cooling, installation, maintenance and risk avoidance become increasingly important considerations when planning and designing the data center. Today's data center cabling infrastructure must be designed to offer a competitive advantage and a lower cost of ownership immediately. As a result, the evolution path to higher speeds such as 40G and 100G data rates, as well as next-generation applications such as cloud computing and virtualization, must be ensured early in the data center cabling infrastructure design and planning process.

Data center design in today's dynamic environment is challenging. Many of the challenges the designer will face pertain to the data center network infrastructure. If these challenges are not addressed early in the data center planning process, the result can be degraded performance and reduced longevity of the data center (Figure 1).

While many of these infrastructure-related problems will have an impact on the performance of the data center network, proper product selection can bring a positive impact. It should come as no surprise that a poorly designed or installed network cabling infrastructure can degrade network performance. However, when network-cabling infrastructure only represents 10 percent of the total cost of the data center, some designers may adopt the view that there are more important decisions to be made than which network infrastructure products to choose. As Figure 2 illustrates, in today's data center, change comes rapidly with respect to software, computers and servers. However, the same is not true for the network-cabling infrastructure, which is expected to last for 15 years or more. For this reason, proper product selection when building out the brain of the network is critical.

Figure 1 identified the problems and

Figure 1 - Challenges faced in the data center.

Area	Problem	Implications
Engineering, Design and Planning	Long, complicated cycle times	Structured wiring versus point to point Various system equipment solutions and fabrics to network
Network Deployment	Lengthy and difficult	Labor intensive, high scrap rate, special skill solutions Product lead time, staging, labeling and testing difficulties
Existing Infrastructure	Poor utilization of cabling paths and spaces	Limited headroom for data center expansion Poor air circulation, hot spots, increased cooling Cable remaining from MACs
Cable Management	Unreliable and difficult cable management	Inefficient handling of data center churn Increased network downtime and troubleshooting; decrease in port utilization
Network Scaling	Difficult to scale network to new technologies	100G Ethernet, 32G Fibre Channel, 120G InfiniBand. Parallel Optics technologies Higher density system equipment - SAN Directors and Blade Servers

implications facing the data center, but what does this mean? Essentially, these problems and implications contribute to five persistent and major issues facing the growing and evolving data centers of today.

These issues are:

- **Scaling**
- **Moves, adds and changes (MACs)**
- **Cable management**
- **Network reliability**
- **Powering and cooling**

We will look at each of these in more detail.

Figure 2 - Change comes rapidly with respect to software, computers and servers

Element	Percentage of Overall Cost	Expected Lifespan
SOFTWARE	40%	5 years
COMPUTERS	30%	3 years
SERVERS	20%	3 years
NETWORK CABLING	**10%**	**15 years**

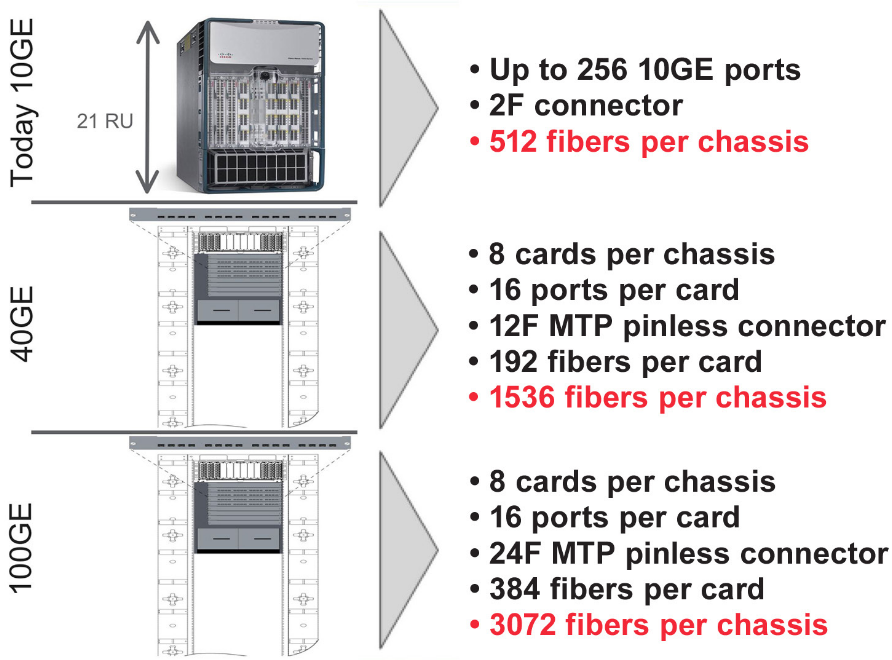
Source: Datalan-Network-Infrastructures

SCALING

The data center has always been the major hub for data storage and processing in the network. Now, as cloud computing and virtualization become more than vaporware, there will be an increase in the data transportation, storage and processing requirements demanded of the data center. Understanding these new applications and the system requirements they drive, particularly with respect to transmission speeds, is important to ensure that the data center can evolve and scale to support new platforms and data rates (Figure 3).

Today, we are seeing more and more 10 Gigabit Ethernet (GbE) deployments in the data center. These deployments scale up to 256 ports using two-fiber connections. This yields 512 fibers per chassis that have to be managed through rack-mountable network cabling infrastructure. Future deployments of 40 GbE and 100 GbE platforms will have to support as many as 3072 fibers in one chassis. Furthermore, these data rates will drive away from traditional duplex transmission to parallel optics. The 40 GbE and 100 GbE transmission rates will require the 12-fiber MPO-type connector and the 24-fiber MPO-type connector, respectively, for interface with electronics. The move to these higher fiber densities per chassis and to MPO-type connector-based patching will require unprecedented patch panel density and patch cable management at the interface between network cabling infrastructure and electronics. These higher fiber counts needed to support 40 GbE and 100 GbE will drive much greater cable density not only in terms of number of fibers per cross-sectional area, but also in terms of the number of cables that can be secured and managed at the patch panel interface. The most successful data centers going forward will be those that incorporate a high degree of density, scalability and flexibility into their network cabling infrastructure.

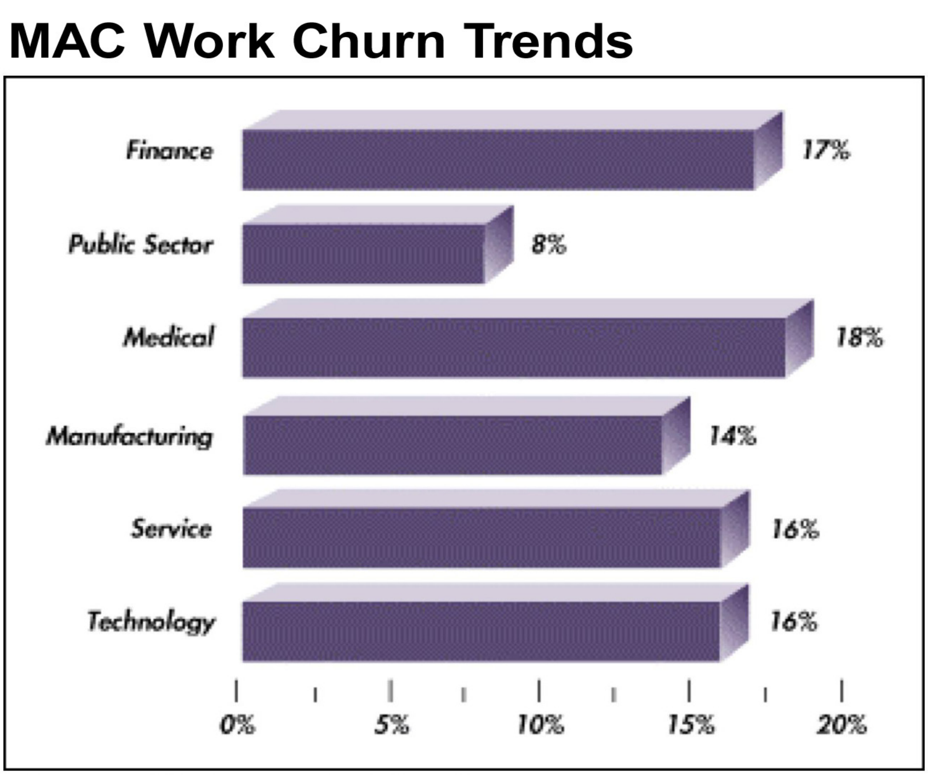
Figure 3 - Bandwidth demand will require an easy migration from 10G to 40G and 100G



MOVES, ADDS AND CHANGES (MACS)

Network churn is a key concern for network designers and administrators. Workstation relocations and network reconfigurations all increase the strain on the network. Making MACs easy is at the core of the structured cabling approach within a data center. Although the amount of churn and MACs varies by industry, it is safe to say that MACs are a reality that must be considered when choosing the network cabling infrastructure of tomorrow (Figure 4). One of the most effective ways to minimize the cost of churn and MACs in the data center is to design in manageability. During MACs, those products that allow for clear labeling and traceability of a circuit will lead to quicker MACs and a reduced chance of downtime related to misidentification of live circuits. Additionally, highly-scalable, swappable and modular components, patch panels that allow for quick and easy access to patch cord connections and patch panels that have built-in intuitive, tangle-free patch cord management will ensure that MACs are completed quickly and efficiently with minimal chance of disruptions to adjacent circuits.

Figure 4 - Office churn by industry.



Sources: AT&T Report On Office Churn, The Electrical Engineering Handbook, Richard Dorff, 1997 Wi-FI Handbook, Frank Ohrtman, Konrad Roeder, 2003 Network World, ROI of VoIP, Robin Gareiss, 2005

CABLE MANAGEMENT

Density

Today, data centers are growing and maturing, and cable management is becoming an important consideration. One aspect of cable management is driven by current patch panel hardware density in the datacenter: 96 fibers in one rack unit and 288 fibers in four units. These densities are sometimes achieved at the expense of finger access to patch panel connections and patch cord management at the front of the patch panel. With 40 GbE and 100 GbE driving even higher densities per rack unit, it is critical that the patching fields of tomorrow be designed to provide unencumbered access to both LC duplex and MPO-type connections. Furthermore, with increased duplex patch cord density and migration to patch cords with MPO connectivity, the patch panel of tomorrow should be designed with built-in, clearly defined and tangle-free routing and management of patch cords.

Cable Pathways

Another issue with cable management often arises when it becomes necessary to install new network trunk cabling infrastructure into a cable pathway or a tray that has become congested through the normal process of data center expansion and migration. To alleviate this issue, cabling solutions designed for placement into these congested pathways should require less space so that new pathways do not become congested and can be utilized throughout the life of the data center. This essentially means that cabling systems that increase the fiber count per cross-sectional area will help the data center designer mitigate the risk of over-filling available cable pathways and trays.

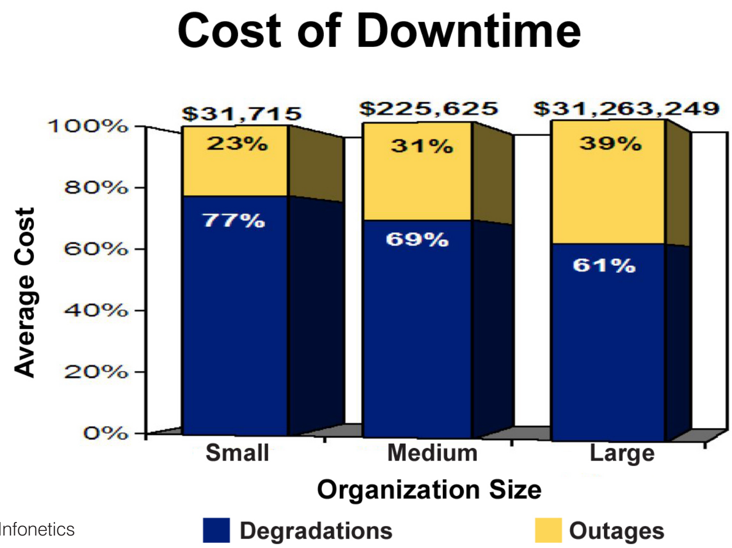
Polarity

Ideally, polarity should be amongst the network designer's highest concerns, but it should also be transparent. When designing the data center of tomorrow, polarity should be built into the system. System components should be selected so that polarity is maintained for any given link simply by using standard components. Polarity is a particularly important consideration as the transition to 40 GbE and 100 GbE becomes imminent. The reason for this is that a polarity scheme that allows for a transmitting fiber (TX) to go to a receiving fiber (RX) in duplex transmission may not ensure the same will happen with parallel optics where there will be four TX and four RX channels in each 12-fiber MPO-based link used for 40 GbE transmission, and 10 TX and 10 RX channels in each 24-fiber MPO-based link for 100 GbE. When selecting a data center network cabling infrastructure, the network designer should not only know and understand how polarity is managed for a given vendor; he or she should also select those solutions that provide for the most transparent polarity management for duplex circuits and that ensure a clear polarity management method that allows for migration to parallel optics.

Reliability

Perhaps one of the biggest concerns facing the data center administrator is system downtime. System downtime or degradation can lead to huge yearly losses (Figure 5).

Figure 5 – Average cost of system degradation and outages by organization size.

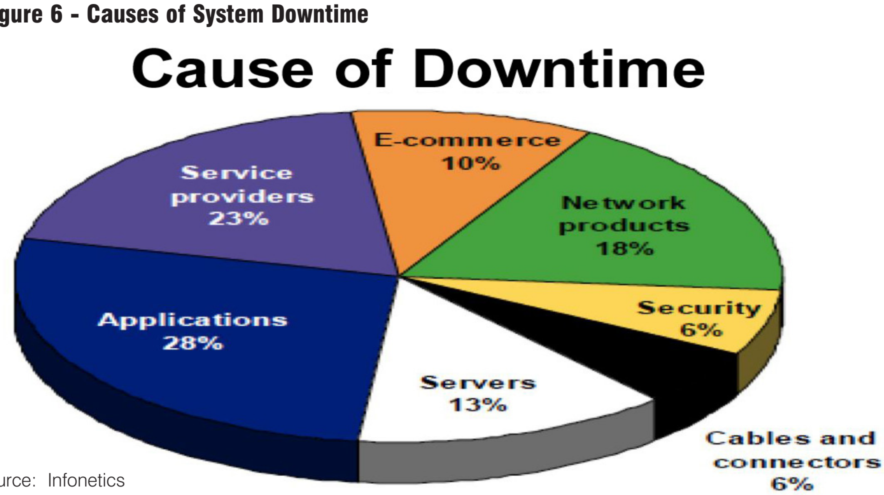


Source: Infonetics

The causes of system downtime can range from cable, connectors and network products to applications and security issues (Figure 6).

Although network cabling and connectors accounted for six percent of the downtime, cabling can affect the network products, security and servers. A properly designed cabling infrastructure should minimize the chance for network downtime. One aspect of data center design that will help mitigate the risk of downtime is the structured cabling approach to deploying network-cabling infrastructure. This approach allows for clear administration points in the network that allow for quick and efficient re-routing of network traffic in the event of an outage or degradation of service. Besides structured cabling, network infrastructure components also have an important role to play in mitigating downtime risk. One of the first moves the data center designer can make to combat network downtime is in utilizing a factory-terminated, cassette-based network-cabling infrastructure. These systems are factory-terminated and tested under strict procedures and quality control measures ensuring exceptional performance upon installation. Once the decision has been

Figure 6 - Causes of System Downtime



Source: Infonetics

Figure 7 – Data center challenges and needs.

Area	Needs to Be	Comments
Deployment	Faster	Faster to deploy to help streamline network deployment
Scaling	Denser	Double the density of existing solutions – 576-fibers/ 288 ports in a 4 rack unit space
Cabling	Smaller	Smaller cabling to reduce space to double the fill capacity of cable trays
MACs	Faster	Conduct faster data center Moves Adds and Changes to reduce yearly MAC cost
Reliability	Improved	Reduce network down time and network degradations caused by the cabling infrastructure
Cooling	Reduced	Reduce the cable tray load that blocks air circulation resulting in increased cooling efficiencies and decreased energy costs
Network Migration	40G/100G Ready	Migration to 100 Gigabit transmission

made to install a factory-terminated, cassette-based infrastructure, the next step is to choose a solution that provides clear labeling with easy and open access to system components.

POWERING AND COOLING

Data centers have doubled their power consumption over the last five years. While I.T. equipment uses the bulk of power required by the data center, 25 percent of the power budget is used for cooling in the data center (Figure 8).

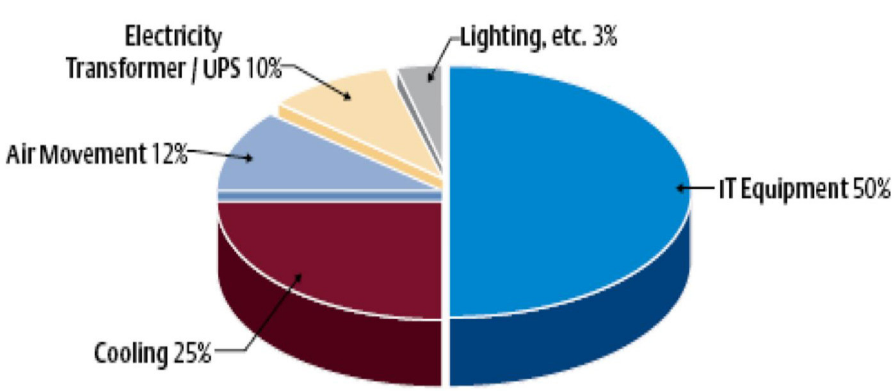
Customers have identified powering and cooling as critical issues in the design and operation of a data center. In order to minimize the impact of network cabling infrastructure on this major cost, the data center solution needs to be designed to free up cabinet and cable tray space to help improve airflow, thus reducing cooling costs.

SUMMARY

Each area of the data center cabling infrastructure has needs that should be addressed by the network designer. A well-planned network can mitigate all deployment, scaling, cabling, MACs, reliability, cooling and network migration.

Finally, given the challenges and issues facing the data center today, data center designers should install a cabling infrastructure that is ultra-dense, scalable, flexible and reliable. Ensuring that the cabling infrastructure chosen will meet these requirements, data center designers can rest assured that their data centers will evolve and grow to meet both today's challenges and the challenges that are just over the horizon. ■

Figure 8 – Sources of energy consumption in the data center.



Source EVP Missions Critical Facilities Inc., New York

With more than 15 years of experience in communications technology, David Kozischek currently serves as market manager, Data Centers for Corning Cable Systems. Kozischek joined Corning Cable Systems in 1990 and has held positions in Engineering Services as a senior field engineer and senior systems engineer; Strategic Planning and Business Development as technology manager; and Global Strategic Growth as a technology discovery manager.

With more than nine years with Corning Cable Systems, Ray Barnes currently serves as market development manager responsible for managing Corning Cable Systems' new product discovery process. Barnes has held several positions at Corning Cable Systems, including field engineer and applications engineer, and has a Bachelor of Science degree in Electrical Engineering from North Carolina State University.