Connecting Sun's Energy-Efficient Datacenters

Innovative best practices for cabling

Summary

- Datacenter consolidation can help reduce costs by providing an opportunity to put more computing resources within the same physical space.
- Energy-efficient Sun servers are ideal for consolidation, providing greater compute density.
- Greater compute density leads to a profusion of cables, increasing cable management expenses and adding to power and cooling costs.
- During new datacenter rollouts, Sun formulated innovative cabling methods that simplify cable topologies, cut costs, and provide flexibility and adaptability.
- Modular approaches to cabling conserve materials, reduce power and cooling requirements, and facilitate the mobility of datacenter equipment.
- Following Sun and CommScope's best practices can help better position datacenters for future technology.

> Today's organizations are consolidating datacenters to reduce costs, increase efficiency, and gain a competitive edge. Sun offers energy-efficient servers that provide maximum performance in a minimum amount of space, making them ideal for consolidation efforts. While consolidation delivers many benefits, it also packs more servers into less space, resulting in cabling issues that threaten to overwhelm many IT organizations. By devising innovative cabling solutions in its own datacenters, Sun, in partnership with CommScope, a global leader in structured cabling systems for business enterprise applications, formulated a set of best practices that can be used to solve the cabling nightmare so many companies face.

Datacenter challenges

Today's IT executives are pressured to increase computing power and provide more services while reducing the costs associated with datacenter operations, including reducing power consumption and cooling costs, easing system administration, and reclaiming datacenter floor space. Sun servers concentrate processing power in a smaller footprint, enabling businesses to save datacenter space by placing more servers into a single rack. Designed to consume less power and generate less heat, these energy-efficient servers provide greater compute density in the same amount of space, helping to reduce operating costs and create a more energy-efficient datacenter.

While enabling datacenter managers to save on the costs of operations and datacenter space, packing additional servers into the same footprint increases the number of connections to networks, storage, and system administration and management networks. The result is much denser cabling, which creates serious problems for IT staff. In many datacenters, cabling can become dense and block airflow, resulting in costly outages, higher cooling costs, and increased demand for power to generate sufficient cooling. In addition to the negative effects on cooling, data and electrical wiring must adhere to separation and spacing regulations to ensure that interference and other factors do not impact the flow of information in the enterprise.

"We completely rethought how we network the room. We moved the cable terminations above the racks to enable mobility in the pods, and installed extra rack-unit locations to allow for localized switches to minimize the amount of structured cabling we had to install. We simplified the situation, saved money, and ended up with a system that's easy to grow and manage."

Serena DeVito

Engineer, Global Lab and Datacenter Design Services, Sun Microsystems

Centralization creates its own problems

Traditional datacenter designs utilize a centralized model, with networking and system management connections running in a star topology from an intermediate distribution frame (IDF) to servers. Each IDF must contain enough network ports to accommodate the servers. With today's higher compute densities, it is expensive to terminate enough network ports to handle the number of server connections contained in a single rack. Furthermore, terminating large amounts of cabling in patch panel locations causes number sequence issues when adding ports in the future.

Blade servers present the same issues. While limiting cabling somewhat, blade server connections to InfiniBand, serial-attached SCSI storage, 10 Gigabit Ethernet (GbE), and other copper- and fiber-based networks can yield as many cable connections as one- or two-rack-unit (RU) servers.

Many systems require management ports such as console, out-of-band ports, and even Internet Protocol keyboard, video, and monitor (KVM) connections, adding more cabling to each server. In some cases, these management port connections can comprise as much as 50 percent of datacenter cables. In a centralized model, distance is a factor. Longer cable lengths are needed as new equipment is added further from the IDF, precluding the use of some technologies and limiting growth. These longer cables are more expensive, and the additional labor required for cable management, coupled with the potential for outages caused by working around the large cable bundles, adds to implementation and operating costs. Table 1 shows how cable density increases as the server size decreases.

Centralized models also have an impact on datacenter design parameters. Traditional raised-floor datacenters using plenum cabling have a finite amount of space under the floor, limiting the amount of cabling and servers that can be accommodated. As a result, the raised-floor datacenter cannot scale to handle the larger numbers of systems made possible by greater compute densities.

Traditional approaches don't work

Cabling design methodology can create a variety of issues within a datacenter depending on how it is approached. Simply terminating growing amounts of cabling between the centralized IDF and the server racks to accommodate increasing cable densities drives up initial and future costs substantially while limiting flexibility and growth.

Furthermore, linking different vendors' cabling components without regard for standards makes it difficult to pinpoint performance problems or scale to newer, higher-speed technologies. An ad hoc cabling methodology, coupled with the impact of dense cabling bundles in underfloor or overhead distributions, severely affects efficiency and limits datacenter agility.

Table 1. Cabling densities per rack

Server Size	Number of Servers per Rack	Number of Cables
18 RU	2	21
2RU	20	145
1RU	40	285

Applying standards

Standards-based cabling maximizes flexibility, facilitates equipment moves and other datacenter changes, and enables users to connect equipment from a variety of vendors. By utilizing standards-based cabling, organizations can implement voice, data, and building automation systems on the same network. Further flexibility can be achieved by installing sufficient cabling and outlets in a given area within the datacenter to increase the options for situating network devices.

A new approach to cabling

Structured cabling utilizes standards-based cabling to create a cabling system that can support major proprietary and nonproprietary standards and protocols. With support for voice, imaging, or data applications, organizations can formulate structured, modular networks that are easy to extend or modify.

CommScope's structured cabling provides redundancy and facilitates datacenter equipment moves and other changes. High-growth companies can utilize structured cabling principles to facilitate smooth, controlled expansion and reduce the incremental costs of adding new equipment and cable runs. Specifications for structured cabling limit the proximity to electromagnetic interference (EMI); recognize UTP, STP, and fiber media for cabling; detail acceptable wiring distances for various media; and specify the use of a hierarchical star topology for horizontal cabling.

Utilize a distributed infrastructure

Sun recently deployed several new energy-efficient datacenters with the goal of significantly reducing power and cooling costs. Through trial and error, the team designed a new approach that localizes communication equipment by creating IDFs that serve a group — or "pod" — of equipment to solve the problems caused by newer, higher-density equipment.

A pod is a self-contained group of racks and/or benches that optimize power, cooling, and cabling efficiencies to facilitate rapid and simple replication throughout the datacenter. Distributing IDFs in pods across the datacenter while utilizing modular connectivity solutions provides rapidly deployable high-density connections that enable cabling infrastructure to scale as more equipment or pods are added.

In this datacenter model, each pod functions as a port multiplier. With two switches and approximately 20 racks per pod, the pod contains an optimal number of ports for cabling distribution. The pod is connected to the IDFs by 10 GbE fiber uplinks. By localizing connectivity equipment to IDFs in the pod, it is possible to cut structured cabling needs as much as 50 percent.

For example, a rack full of high-density equipment like 1-RU Sun Fire™ T1000 servers can require more than 160 data connections. Since these connections are no longer running from the server all the way back to a centralized IDF, a much smaller amount of cabling is required.

Deploying pods solves the problems posed by centralized datacenter models. By leveraging distributed switching, the use of pods can halve the costs of cabling and materials and reduce the energy and environmental impact of manufacturing, transporting, and installing the cables. Furthermore, distributed pods provide increased flexibility and adaptability within the datacenter and minimize the negative impact of cabling on cooling pathways.

Best practices in IT infrastructure cabling design

No two datacenters use the same kind or amount of computing resources, or even deploy them in the same manner. However, many IT deployments can take advantage of Sun's experience in designing its own datacenters. Based on that experience, Sun and CommScope engineers formulated the following best practices:

- Use 10 GbE technology with both copper and fibre capability. While the technology can result in additional up-front costs, an approach that implements both mediums maximizes scalability and future growth. Maintaining the shortest possible cable lengths can help minimize the additional copper and fiber costs.
- Run cabling through the shortest distance between switch and device. The shorter the cabling, the fewer the resources consumed and the less expense incurred. Shorter cable lengths also make it easier to adopt technologies such as 10 GbE over copper.
- Rather than being placed in centralized network racks, cabling and switches should be moved out to the pod IDF to optimize flexibility and decrease the amount of cabling required. Each pod should be considered another room within the datacenter, with a self-contained infrastructure and high-speed uplinks back to the core.

- Patch panels should be installed at half capacity or additional U locations should be reserved within the pod rack termination locations and IDF to support growth and changing standards. Doing so maintains sequential order without requiring system downtime or the rerouting of cables.
- Distribute management systems such as console servers, out-of-band switches, or Internet Protocol KVM connections to pod IDFs along with access layer switches to reduce cabling quantities by as much as 50 percent.
- It is advisable to utilize standardized, industry-accepted cables when running cabling in the datacenter. While it may appear to be a good method of cutting costs, using non-standard cables can cause performance problems and outages that can cost much more in the long run.
- Modular, upgradable cabling extends the flexibility of the pods. Cabling locations should be independent of the rack locations and can be strung either above or below the equipment.
- For maximum flexibility within the datacenter, equipment-rack deployment should be modular, with no termination in the racks.

Best practices to support future trends

By utilizing a modular, mobile, adaptable design, organizations can prepare for and more easily incorporate new technologies as they become available. Datacenter architects may wish to keep a few developing trends in mind to help plan for future adoption while maintaining a flexible datacenter design and embracing best practices.

- InfiniBand is a high-bandwidth, switched network topology. Providing additional bandwidth through a point-to-point, bidirectional serial link, InfiniBand can be useful as a replacement for current limited PCI shared-bus interconnects. While these cables can provide higher bandwidth and decrease latency, they increase the cabling challenge based on size, bend radius, and distance limitations.
- Announced as a next-generation Ethernet standard, 100 Gigabit Ethernet is expected to emerge in the near future. The Institute of Electrical and Electronics Engineers (IEEE) 802.3 Higher Speed Study Group (HSSG) voted to develop the 100 GbE standard because it provides a tenfold increase in speed over 10 Gigabit Ethernet.
- Currently under consideration as a standard, 40 Gigabit Ethernet provides four times the performance of 10 GbE at a lower cost than 100 GbE. Until a standard is defined, prudent architects should make equipment selections that can enable the implementation of either speed once the standard emerges.

Sun and CommScope

CommScope, Inc. is a global leader in structured cabling systems for business enterprise applications. Specializing in the design and manufacture of cable and connectivity solutions for communication networks' last mile, CommScope provides enterprise, broadband, wireless, and wireline carrier distribution access. With an emphasis on strong research and development and more than 1300 patents and patent applications worldwide, CommScope combines technical expertise with global manufacturing capability to provide customers with high-performance wired and wireless cabling solutions.

Drawing on years of industry expertise, Sun continues to provide flexible, scalable, innovative, and cost-effective IT solution infrastructures and best practices that enterprises can use to create more energy-efficient datacenters. Incorporating the latest trends in high-speed interconnect technologies, next-generation processors, and improved reliability, manageability, and serviceability, Sun solutions facilitate the adoption of leading-edge, high-bandwidth infrastructures, service-oriented architectures, and services.

Learn More
To learn more about Sun's energy-efficient datacenters and additional design features, visit sun.com/eco. For more information on CommScope, visit commscope.com.

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