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Direct Connect: A Cabling Architecture for Small and Medium Data Centers

White paper

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CommScope, Inc, June 2010

at work

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I. Executive Summary

Business pressures and Data Center constraints have driven the Data Center to transform from a traditional, rigid structure to an efficient, flexible environment. Organizations are now equipped to better support growth and innovation, integrate acquisitions, and reduce costs and risks while striving to achieve the next generation Data Center.

This white paper surveys a popular connectivity model - Direct Connect cabling architecture. In Direct Connect architecture, all networking equipment, e.g. LAN and SAN switches, are located at a centralized place. All servers and storage devices are connected to the centralized location through structured cabling. Direct Connect architecture is well suited for smaller and medium Data Centers.

A summary of the advantages and disadvantages of the Direct Connect architecture is displayed in the table below.

TABLE 1: ADVANTAGES AND DISADVANTAGES OF THE DIRECT CONNECT CABLING ARCHITECTURE

	Pros	Cons
Direct Connect	• Simple to design, implement, and maintain • Minimized network bottlenecks • Excellent switch port utilization • Easy network device management	• Lack of scalability • Large cable bundles • Difficulties in cable pathway design • Cable management

The Direct Connect architecture is widely applied in various Data Center types. A number of best practices are selected to illustrate the architecture. The architecture can be utilized to support applications such as server virtualization Cloud Computing and High Performance Computing.

CommScope's full portfolio of connectivity solutions can fulfill Data Center customers' needs when choosing the Direct Connect architecture. CommScope recommends the Direct Connect cabling architecture for small and medium Data Centers.

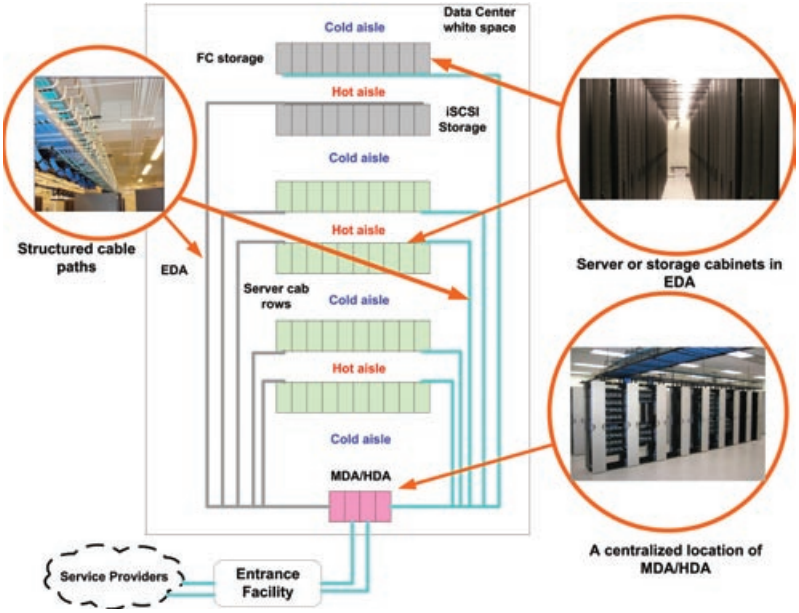
II. Architecture

The Direct Connect cabling architecture is popularly utilized in small and medium Data Centers. The implementation of this cabling architecture is commonly seen in storage networks also, particularly in Storage Area Networks (SANs) and Network Attached Storage (NAS) implementations.

The Direct Connect cabling architecture entails servers that are connected to switches located in a centralized Main Distribution Area (MDA) or Horizontal Distribution Area (HDA), depending on Data Center size and complexity.

In the Direct Connect model, cables run from all server and storage cabinets at Equipment Distribution Areas (EDA) directly to the MDA/HDA, as shown in Figure 1. The grey lines represent copper twisted pair cable and may be CommScope GigaSPEED X10D or XL solutions. The blue lines stand for fiber optic cables and may be CommScope LazrSPEED, InstaPATCH 360, TeraSPEED solutions.

FIGURE 1: PHYSICAL TOPOLOGY OF DIRECT CONNECT CABLING ARCHITECTURE



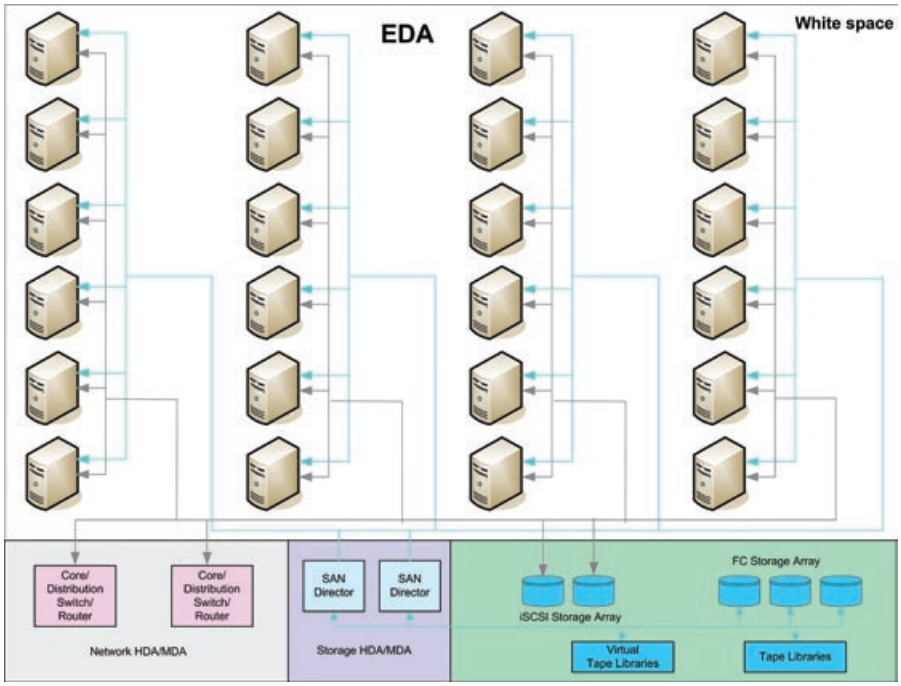
A network topology of the Direct Connect architecture is provided in Figure 2. The red lines in Figure 2 denote copper twisted pair cables while the blue lines represent fiber optic cables.

The Direct Connect architecture is simple to design and easy to implement and maintain. It provides the most efficient use of LAN and SAN switch ports because most switch ports are for servers and storage to access networks. Top of Rack or Zone architectures replicate access switches in many locations resulting in more unutilized switch ports. Switch port utilization can impact the overall cost of implementing a Data Center network.

All servers and storage devices are directly connected to the core/aggregation switches. The Direct Connect approach removes the need for an additional layer of switching between servers and the network core. The benefit of this architecture minimizes network bottlenecks and latency between servers and storage. The architecture also provides tight control of physical access as all switching equipment is centrally located in one physical location. An advantage of the architecture is that it requires less capital expenditure on networking equipment than the other two cabling architectures.

The lack of scalability is a disadvantage with the Direct Connect architecture. When more servers and storage are installed cable bulk increases. Large cable bundles could cause difficulties in cable pathway design, cable installation and management, and can cause congestion in cooling air circulation under the raised floor (if utilized).

FIGURE 2: LOGIC TOPOLOGY OF DIRECT CONNECT CABLING ARCHITECTURE



III. Use Cases

To further illustrate the Direct Connect architecture, the following best practices are identified.

Design

A computer manufacturer in the North America Region (NAR) designed one of its Data Centers using the Direct Connect architecture, as shown in Figure 3. All Core and Access Ethernet switches are centrally located at one side of the Data Center. The network row is denoted by a row of orange rectangles. The light green rectangles in rows represent server cabinets. The Data Center has 240 server cabinets. The smaller red boxes with "PP" stand for patch panels installed in each server cabinet.

This customer selected the Direct Connect architecture because it is easy to design, implement and maintain, and it provides excellent port utilization and network performance.

FIGURE 3: A DATA CENTER OF A COMPUTER MANUFACTURER

Horizontal Distribution Area (HDA)

A media company in the Asia Pacific Region has a Data Center of approximately 100 server cabinets. A network row is located in the middle of the Data Center. The back view of the network row is shown in Figure 4. The network row is the HDA of the Data Center. In this example, enclosed network cabinets instead of racks are used in order to gain better control of physical access to the switches. The Data Center uses CommScope GigaSPEED XL copper cabling solutions. A compelling reason for the end user to choose the Direct Connect architecture is that it is easy to design and implement.

FIGURE 4: THE HDA OF A MEDIA COMPANY'S DATA CENTER

Cable Pathway

Structured cables from HDA to EDA can run either in overhead space, under raised floor, or both. These two approaches are widely used around the world. Different regions may have their preferences based on the physical attributes of the space they are using.

With the overhead approach, the ceiling height of the Data Center building must be thoroughly examined through the entire white space. If the ceiling is high enough, multilayer installation is recommended as shown in Figure 5. The upper layer ladder rack carries fiber optic cables while the second layer ladder rack holds copper cables.

FIGURE 5: STRUCTURED CABLES IN OVERHEAD SPACE

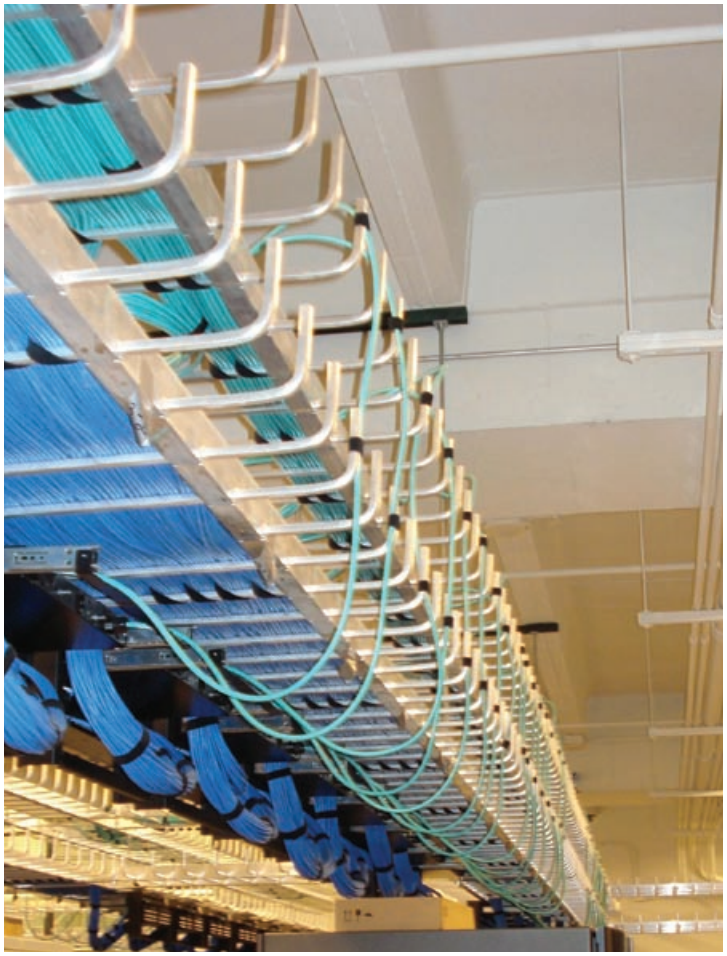


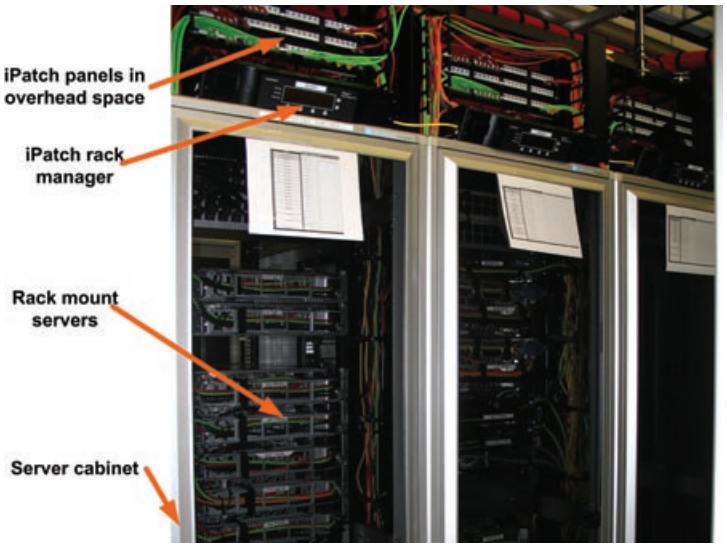
Figure 6 shows the approach of utilizing the space under a raised floor to deploy structured data cabling. Beside data cabling, the space under a raised floor can be utilized to accommodate cooling air pathway, chilled water or other utility pipelines, power cable conduits and grounding grid.

FIGURE 6: STRUCTURED CABLES UNDER A RAISED FLOOR

Equipment Distribution Area (EDA)

A best practice of cabling in server cabinets in the EDA is shown in Figure 7. It is in a Data Center of a health care product manufacturer in North America. The Data Center has more than 100 server cabinets. The end user wants to have complete control, monitoring and management of the Data Center for accurate executions of work orders. The Data Center administrator also desires to precisely locate physical assets and trace Keyboard/Video/Mouse (KVM) connections in server cabinets. The requirements of this Data Center seek the benefits of deploying the iPatch system in every server cabinet as shown in the figure. In this practice, iPatch® Intelligent Infrastructure Solution patch panels are installed on top of each server cabinet.

FIGURE 7: SERVER CABINETS OF A HEALTH CARE PRODUCT MANUFACTURER



Another best practice shown in Figure 8 has a patch panel installed inside each server cabinet. The patch panel sits at the top of each cabinet and faces the cabinet rear or hot aisle. The figure clearly shows how the horizontal cable enters into the cabinet from the overhead space and is nicely routed along the side panel. The Data Center in Figure 8 belongs to an IT service company in the Central America and Latin America (CALA) region.

FIGURE 8: SERVER CABINETS OF AN IT SERVICE COMPANY

IV. Applications

Server Virtualization and Cloud Computing

Server virtualization uses software to transform or virtualize the hardware resources of a computer to create a fully functional virtual machine. Server virtualization or virtual machine has become an established trend of deploying computing power.

Cloud Computing is the use of networked and shared infrastructure (server, network and storage) and software to provide resources to users in an on-demand environment. It is also called utility computing sometimes. Clouds provide a set of typically virtual machines which can provide users with the ability to start and stop servers or use compute cycles only when needed, often paying only upon usage

Server virtualization requires a flat network to implement virtual machine mobility, such as VMotion. A flat network is a single broadcast domain. In a flat network all server hosts can communicate with each other without going through a router. A flat network can be a physical LAN or a virtual LAN (VLAN).

The Direct Connect cabling architecture naturally forms a flat network for LAN. As shown in Figure 2, the large white square in which computers are located can be a flat LAN. Virtual machines can be easily moved across physical machines in a flat network environment.

The Direct Connect architecture physically organizes server hosts and storage devices in a pool. Pooled computing and storage resources provide the fundamental infrastructure for Cloud Computing applications.

High Performance Computing (HPC)

High performance computing (HPC) is the use of parallel processing for running advanced application programs efficiently, reliably and quickly. The programs for HPC are divided into little pieces so that each piece can be executed simultaneously by separate processors. The term HPC is occasionally used as a synonym for supercomputing.

HPC requires a great amount of parallel computing, which requires low latency communications among servers. One of the characteristics of the Direct Connect architecture is that there is only one hop of switching between any two servers. This architecture minimizes the latency in the communications between any two server hosts. With 10G Ethernet technologies available today, the Direct Connect architecture can provide an excellent choice for low latency, high performance computing applications.

V. Conclusions

The Direct Connect cabling architecture is one of the three primary cabling architectures in Data Center environment, providing simplicity in design, implementation and management. With the limitation of scalability, the Direct Connect architecture is well suited for small and medium Data Centers and is widely deployed around the world. The Direct Connect architecture can support Virtualization, Cloud Computing, and HPC along with many other applications. CommScope recommends the Direct Connect cabling architecture for small and medium Data Centers.

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