Structured Cabling Systems and Technology Integration ♥

The Distributed Data Center ♥

Martin H. Zuckerman
m.zuckerman@teswaine.org

It is the task of the Technology Integrator to design and build a Data Center that will serve the needs of business groups that by their nature require an efficient engine for optimum running speed, as well as the expectation to have a 100% in-service operation. The purpose of this article is to provide the Data Center designer with a conceptual outline that can take advantage of the new wave of technology as well as provide reliable support for corporate business applications.

Most of today's Data Centers are based upon a premise that includes centralized cabinets and a neatly placed row of frames. The typical designer will place the cabinets in rows, either vertically or horizontally or sometimes both. The cabinets will house servers, switches, modems, network control devices and other active components. In addition, they will also house some number of copper and fiber connections, depending upon the technologies being used. In most cases, the connectivity from the cabinets will be placed to a centralized frame row that has been designed to accommodate the number of cabinets and anticipated growth. Other connections, such as cabinets that require access to Network Storage, may have fiber placed to a Storage area within the Data Center. Market Data Services may have their own connections and yet others may need many voice grade connections for modem pooling or other types of voice grade data connectivity. The above premise may work with small Data Centers but will have difficulty coping with the augmentation and requirements that are the hallmark of the large Data Center.

The typical design, although well thought out in terms of a Day 1 exercise, will evolve away from its neat and orderly patterns on Day 2, due to unplanned growth and changing requirements. For example, additional cabinets or connections per cabinet require an additional frame row due the existing row's lack of capacity to accommodate the growth or changes in business applications. SAN requirements have grown, but the cabinets that allow connections to the SAN are filled. Other cabinets now require direct fiber links to the SAN area. Changes in technology require a refit of servers and connections to the frame, but this may also mean an interruption in service to the users should a mishap occur while changing or adding connections. Out of hours scheduling becomes the norm and with it, the resulting overtime expense

Changes may also impact the physical media standards for transmission that have been designed into the original plan. Patch cords may be extended beyond the average ten feet to thirty or more feet to accommodate remote frames and devices. Overhead cable trays are placed between rows and around walls to reach cabinets and frames that were never considered on Day 1. Patch cords may be placed under the raised flooring in order to expedite critical new systems. They begin to accumulate and pile up on pathways, overflowing existing tray work and patch cord managers. Patching fields that are wall mounted become morasses of intertwined cabling, hiding the connecting blocks and creating a scenario that is ripe for failure.

In the past few years, the industry has seen the wholesale replacement of the copper cable materials that have been installed into Data Centers, as Ethernet transmission speeds have soared from 10BaseT to 100BaseT and soon to 1000BaseT. The trends have seen the advent and move from category-3 copper cables and category-5 to category-5e and category-6. The future portends further change as the demands for data transmission speed, video and graphics transform the industry, and create situations that, to maintain market share and sustain business growth, will cause organizations to quickly migrate from existing to new technologies.

Although there are many anomalies that may add complication to the original design, they have one single and important factor in common. They add a layer of risk to the business; a risk that did not exist prior to the unexpected change and they expose the inability of the design to cope with the present and future situation. The IT staff endeavor to maintain the business' expectations and may fall just short of their goals.

User expectations are simple in their context [uptime and efficiency] but can be difficult to translate into actual practice. The design required to facilitate these requirements becomes complicated due to the very nature of technology, the growth and expansion of the corporation, and the balance of staff and expense. Along with this complication comes a level of risk, usually increasing as demand grows.

The Distributed Data Center uses the best of all Data Center features. It focuses on the operational needs of the technical staff and by its very nature will make their performance exceptional. It takes into consideration unexpected or expected growth and can easily cope with changes in technology. It allows for the re-distribution of any portion of itself without disturbance to its whole. It mitigates the risk inherent in today's corporate environment by providing a secure, efficient and constant technology platform for the business and in situations when uptime is a strategic advantage the Distributed Data Center offers the right technical solution.

The design is based upon a simple premise – the multi-building campus – and because of its "campus" structure, allows for the continuing integration, growth, change and migration of services that any single building of the campus would allow, without impacting the campus as a whole.

It features the use of a Universal Structured Cabling System to integrate disparate data center services, provision a global connectivity to all its parts and by extension, integration to the vertical structures that bring services to the various user groups throughout the facility.

Data Center Distribution

Just as a campus communications room would have its own service distribution frame, a Distributed Patching Frame (DPF) is established for each campus component of the Data Center to accumulate the required connectivity from active devices installed within the established area; which we will now term as a "segment". The number of Distributed Patching Frames is dependent upon the final segmentation of the Data Center into its "campus" structure. The sizing of any single DPF is dependent upon the maximum number of cabinets that may be installed into a "campus" segment, the maximum number of copper and fiber connections that will be required to support the cabinets and the DPF, and the estimated number of switches, terminal servers, and other active components that will support the cabinet devices, plus expansion. Using this concept, it becomes possible to extend the Data Center to another floor and not exceed the capacity of the Data Center Core or disrupt the activity of other segments within the Data Center.

Data Center Core

Similar to a campus environment where one building may act as the Network Services support area, the Primary Data Center and Core for LAN and WAN services, a Distributed Data Center will also have a Core area defined for the same purpose and features the following:

1. Voice and voice grade data services for horizontal and vertical distribution are accumulated to the Main Distribution Frame (MDF).

The MDF can be either wall mounted or free standing and is placed in proximity to the PABX and the Wide Area Network service providers. Voice grade service connections are distributed to the DPFs, the Central Patching Frame (CPF) and to the Central Fiber Patching Frame (CFPF). The number of connections should be sized according to the requirements established, leaving space for contiguous growth.

2. LAN based fiber services for horizontal and vertical distribution are accumulated to the Central Patching Frame (CPF).

The Central Patching Frame (the head-end distribution frame) must take into consideration the horizontal as well as vertical fiber requirements for LAN based services. Since these requirements are dependent upon the number of segments designed within the Data Center, it becomes a rather simple task to size the overall fiber requirements, take into account a 100%

redundancy for the backbone and design accordingly. The CPF will also house the Core LAN switches and a number of other active components, therefore the sizing of the CPF is based upon the LAN based fiber requirements, Core switches and connectivity to other frames within the data center, leaving space for contiguous growth.

3. Network Storage (SAN) based fiber services for horizontal and vertical distribution are accumulated to the Central Fiber Patching Frame (CFPF)

The Central Fiber Patching Frame (CFPF) is the head-end for Storage Area Network (SAN) fiber connections. The development of a generic cabinet specification, where each cabinet may have a SAN requirement, includes a placement of a fiber connection from the cabinet directly to the CFPF. SAN switches are also connected to the CFPF. The connectivity for the SAN is established similarly to the LAN where the storage area of the data center has a direct link to each cabinet in any segment.

4. Vertical and horizontal data grade copper cable are accumulated to the Central Copper Patching Frame (CCPF)

A number of services require a 4-pair category-5e or category-6 direct copper connectivity. These services include but are not limited to Audio-Visual, Multi-media, Market Data Service, Dealer Voice (trader turrets), and certain security services. To allow for the eventual migration of these services to an IP based system requires the establishment of a frame structure (the Central Copper Patching Frame) that can easily evolve and be replaced without interruption of other attached services. For example, Dealer Voice (turrets) that currently requires a 4-pair category-5e connection may be replaced by an available IP turret system. Migrating traders to an IP switch is simple when the Trading Floor has a Universal Structured Cable Design and the current trader turret equipment has been designed into the Distributed Data Center via the CCPF.

Open Architecture

Just as with a Universal Structured Cabling System, the Data Center should be designed using an open architecture and generic connector and cable types. This will provide you with the best selection of services and products and the leverage to obtain the best pricing from manufacturers, distributors and contractors.

The Physical Factor

The Data Center can be divided into manageable segments. The number and sizing of the segments is dependent upon a variety of factors.

1. The physical size and layout of the Data Center floor plan.
2. The need for resiliency or redundancy for critical systems.
3. Average number of servers per cabinet.
4. Security requirements
5. Vender requirements
6. Environmental systems (UPS, A/C, fire suppression, etc.)

It is imperative to have a realistic approach to server density per cabinet. Devices are either becoming larger and more powerful (energy consuming) or smaller and easy to dense pack (space and energy consuming). At times, there are efforts to design and build cabinets to house the current slate of active components rather than design and build for the possibilities that do not yet exist. Compromise is the only successful approach to implementing a successful Data Center. It is the balance of the physical requirements that will provide a safe, secure and operational working environment. This will translate into a risk-free platform for business applications and allow for the inherent capabilities ascribed to the Distributed Data Center.

Design Characteristics

1. Define the criteria for a generic cabinet.

2. Position the LAN switches into frames rather than cabinets as it becomes difficult to manage patch cords in a contiguous cabinet row.
3. Design the Data Center using Universal Structured Cabling concepts.
4. The Distributed Data Center Design begins with the horizontal endpoint and works inward to the central points of services [the network components] and the central points of connectivity, [the central frames previously described] rather than the opposite where the active components dictate the overall design. The purpose of the design is to make it acceptable for changes in technology, not changes in structure.

Design Criteria

It is important to have a comprehensive and global understanding of the service requirements delineated by the IT staff. It is imperative, however, that the physical relationships between power, air-conditioning, connectivity and density are outlined as the physical space is one of the primary dictates. Open Architecture, Physical Factors, Design characteristics and Design Criteria are four critical and technical design components. The fifth component and a significant factor in any Data Center design is the financial and the possibility of implementing a Data Center incrementally allows for transitional expenses over time.

Since the design concept is vendor independent and non-proprietary in scope, it will support any manufacturer's components, any protocols and all system specifications. Also, the changing nature of business applications will not impact the universal connectivity provided as a transmission media.

The efficiency of the "Distributed Data Center" will reduce costs for both materials and installation at the front end of a project and also decrease costs in MACs and maintenance for the long term.

The design mitigates the risk inherent in today's corporate environment by providing a secure, efficient and consistent technology platform for the business and in situations when uptime is a strategic advantage, the Distributed Data Center offers the right technical and financial solution.