

# Best Practices for Data Center Infrastructure Design

## Cabling Distances and Space Planning

**W**hen designing and laying out a data center, understanding best practices as well the pros and cons for each type of data center is critical. The TIA 942 data center guidelines are very specific that horizontal and vertical cabling should be run accommodating growth, so that these areas do not have to be revisited. It is also specific about equipment not being directly connected unless it is specifically required by the manufacturer. This is in line with other standards documents such as ANSI/TIA/EIA 568-B that design for open systems architecture. So the question is raised: what is the best way to do this for a 10Gb/s environment?

There are considerations outside of the cable plant and number of connectors alone: usability, scalability, costs and the ability to perform Moves, Adds and Changes (MAC's). Additionally, some limitations exist based on the category of the cabling system. Copper and fiber distances may vary with the type of cabling system selected. We will discuss some of those parameters and their potential impact on data center designs.

All copper channels are based on a worst case, 100 meter, 4 connector model. ISO/IEC 24764 (draft), TIA-942, ISO/IEC 11801 Ed2.0 and recommendations from electronics manufacturers suggest that the fixed horizontal portion of the channel be a minimum of 15m (50 ft.). While some shorter lengths may be supported in other portions of the channels, there is a requirement in zone distribution and consolidation points for this minimum distance. When moving to 10Gb/s electronics, the 15m minimum will likely exist for all horizontal cables due to recommendations from electronics manufacturers and that all models within IEEE are based on a minimum 15m distance.

The 15m length is also dictated by signal strength issues as your signal is strongest in those first 15m. This can create issues with two connectors in close proximity. By providing at least 15m to the first connection point in the channel, you are allowing the attenuation to reduce the signal strength at the receiver or between components. In order to achieve the 15 m distance, two options exist: either provide space in the pathway to take up the distance or create service loops under the floor. Service loops should not be a loop, but rather a loosely configured figure 8 for UTP systems. However, this configuration is not a requirement for F/FUTP or S/FTP systems due to their inherent resistance to interference. Bear in mind that the additional cable will consume more pathway space.

Copper distances for category 6A twisted pair cabling are limited to 100m for all channels. 10GBASE-T running on category 6/class E cabling will be limited to less than 37m depending upon the scope of potential mitigation practices to control alien crosstalk. It should be noted that the purpose of TSB 155 is to provide parameters for the qualification of existing Cat 6/Class E applications for use of 10GBASE-T, TSB 155 should not be used for designing new installations.

Fiber channel lengths vary based on the grade and type of fiber and type of interface. Understanding these limitations will assist in the design and layout of the data center space. If you are utilizing 10GBASE-CX4 or Infiniband, you are distance limited to a maximum of 15m. The following chart summarizes the distances for all 10Gb/s applications and their associated cabling systems.

Application	Media	Classification	Max. Distance	Wavelength
10GBASE-T	Twisted Pair Copper	Category 6/Class E UTP	up to 55m*	
10GBASE-T	Twisted Pair Copper	Category 6A/Class E <sub>A</sub> UTP	100m	
10GBASE-T	Twisted Pair Copper	Category 6A/Class E <sub>A</sub> F/UTP	100m	
10GBASE-T	Twisted Pair Copper	Class F/Class F <sub>A</sub>	100m	
10GBASE-CX4	Manufactured	N/A	10-15m	
10GBASE-SX	62.5 MMF	160/500	28m	850nm
10GBASE-SX	62.5 MMF	200/500	28m	850nm
10GBASE-SX	50 MMF	500/500	86m	850nm
10GBASE-SX	50 MMF	2000/500	300m	850nm
10GBASE-LX	SMF		10km	1310nm
10GBASE-EX	SMF		40km	1550nm
10GBASE-LRM	All MMF		220m	1300nm
10GBASE-LX4	All MMF		300m	1310nm
10GBASE-LX4	SMF		10km	1310nm

\* As defined in 802.3an

## THE LAYOUT...WHERE AND HOW TO CONNECT

When designing a cabling infrastructure, too often cost is the deciding characteristic of the channel selected. However, once all elements are considered, a design with higher initial cost may have a lower overall cost of ownership to a company that has a lot of MAC activity. The most important concern is that designers are familiar with all aspects of the different configurations available to make the best selection possible. A listing of cost, flexibility and performance is listed below.

Model	Cost	Flexibility	Performance
2-Connector	Lowest	Lowest	Highest
3-Connector with CP	Medium	Medium	Medium
3-Connector with CC	Medium	Medium	Medium
4-Connector	Highest	Highest	Lowest

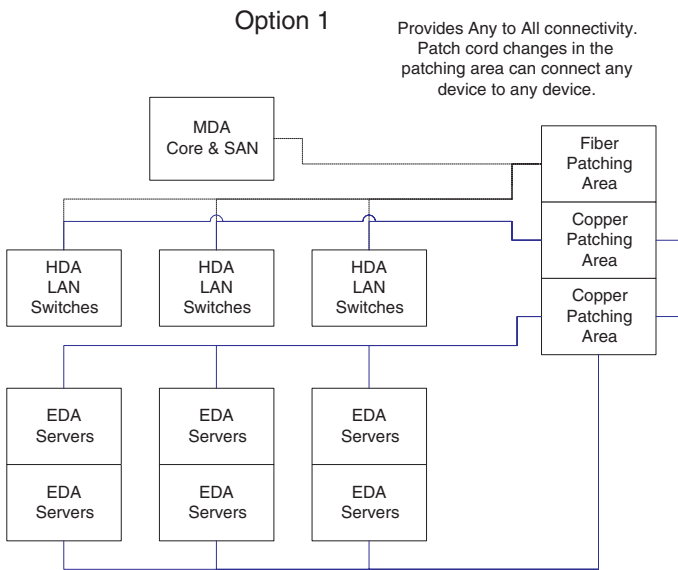
## SPACE PLANNING OPTIONS

The MDA (Main Distribution Area) is considered the core of the data center. Connectivity will be needed to support the HDA (Horizontal Distribution Area). Following TIA-942 recommendations and utilizing EDA (Equipment Distribution Areas) and ZDA (Zone Distribution Areas), we would like to present four design options for consideration.

### OPTION ONE

Option One is to run all fibers and copper from the core horizontal distribution areas and equipment distribution areas to a central patching area equipped with patch panels. This provides one central area for patching all channels.

There are several benefits to this design. First, all cabinets can remain locked. As patching is done in a central area – there is no need to enter a cabinet at any time unless there is an actual hardware change. For industries that are governed by compliance and security related issues, this may provide a greater benefit by reducing physical access to connections. Intelligent patching can be added to the patching field to increase security by automatically monitoring and tracking moves, adds and changes in that environment.



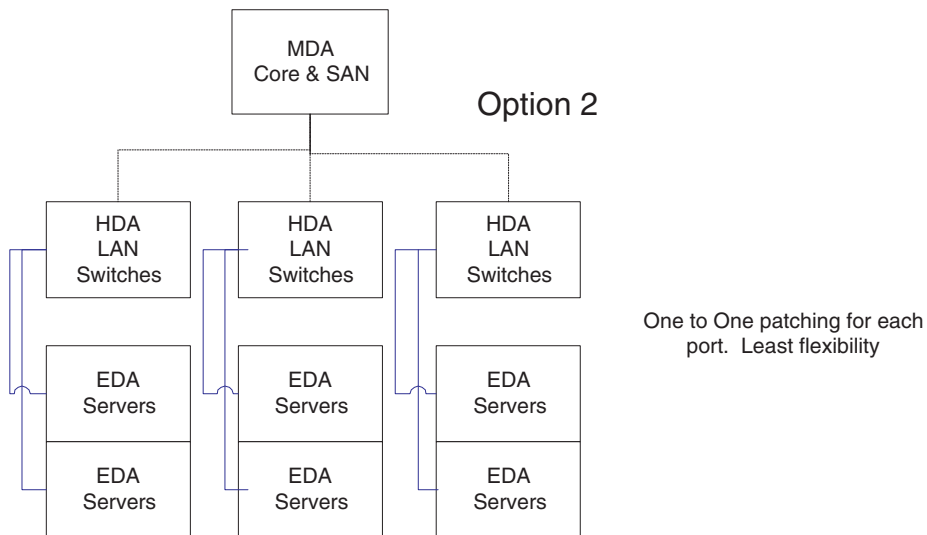
Another advantage is that all ports purchased for active gear can be utilized. With the ability to use VLANs, networks can be segmented as needed.

In other scenarios, entire switch blades are likely dedicated to a cabinet of servers. However, if there are insufficient server NICs to utilize all ports, then the idle ports become costly and inefficient. For instance, if a 48 port blade was dedicated to a cabinet at location XY12 but there was only 6 servers with two connections each, 36 ports were paid for but remain idle. By utilizing a central patching field, the additional 36 ports can be used as needed elsewhere in the network, thereby lowering equipment and maintenance costs which are far more expensive than the cable channels.

## OPTION TWO

Option Two is to place patch panels in server cabinets that correspond directly to their counterparts in the switch cabinets. In this scenario, switch blades/ports will be dedicated to server cabinets. This may be easier from a networking perspective, but may not provide the best usage of all ports in the active electronics. Extra ports can be used as spares or simply for future growth. However, if an enterprise is planning to implement blade technology where server density may decrease per cabinet, this may not be a cost effective option.

For the switch cabinets, the type of copper cabling chosen will be a significant factor due to the increased UTP cable diameters required to support 10GBASE-T. In reality, cabinets and cabling (both copper and fiber) are changed far less frequently than the active electronics. But with the new category 6A UTP cable's maximum diameter of .354 inches (9.1mm), pathways within the cabinets may not provide enough room to route cable and still provide the structural stability necessary. It is always recommended that fill percentage calculations be addressed with the cabinet manufacturer. Moving the patch panels to adjacent locations or implementing a lower switch density may be required. While moving switches into open racks with adjacent patch panels provides a solution, this is only recommended if proper access security processes exist and some form of intelligent patching or other monitoring system is used so that network administrators can be notified immediately of any attempt to access switch ports.

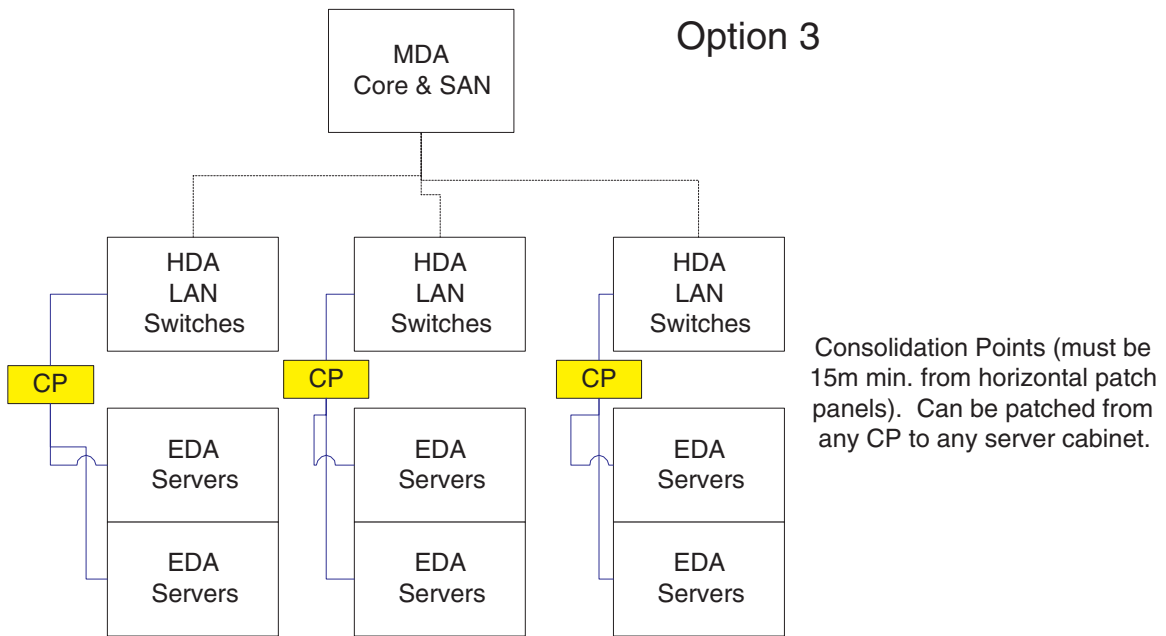


**Note:** Black lines are fiber Blue lines are Copper

## OPTION THREE

Option Three consists of providing consolidation points for connections. These can be either connecting blocks or patch panels. This allows for a zoned cabling approach, but may lead to higher moves, adds and changes costs. It is also difficult to design within the parameters of a 4 connector channel when using Zone distribution

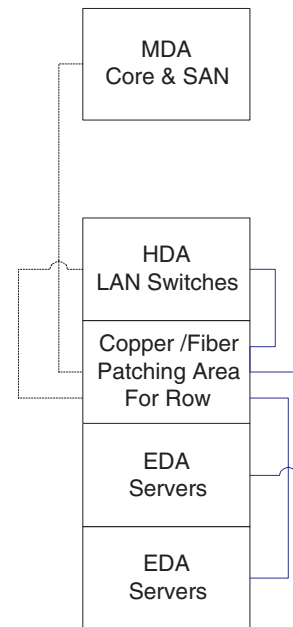
The other disadvantage to the consolidation point model is that the changes take more time than swapping a patch cord if the pair count changes. Depending on the location of the consolidation point, there may be additional risks from loss of static pressure under the floor when removing floor tiles ending up with more than 4 connectors in a channel, or harming existing channels during changes.



**Note:** Black lines are fiber Blue lines are Copper

## OPTION FOUR

A final option is to have all server cabinets and switch cabinets in a row ,terminating to a single patching field for the row, rather than to a central location. Core connections from the MDA are brought into this patching field. This option can work well in ISP or other environments where cross department/customer functionality is not desirable or tolerated. This option provides a bit of best of both worlds in that there will be some spare ports, but also the floor tiles will not have to be lifted to perform MAC work. While this is very similar to the first option, the segmentation can make it easier for network administrators and physical plant technicians to coordinate efforts. Additionally this style of design provides for flexibility in the ever changing environment of shrinking and expanding storage/networking requirements over time.



Option 4

All Patching done within respective rows.

**Note:** Black lines are fiber, Blue lines are Copper

## CONCLUSION

Whichever cabling choice or space option is made, the key step is planning. Siemon has resources to assist in the layout and planning or just as a second pair of eyes for any project. For more information, and additional resources go to [www.siemon.com](http://www.siemon.com).

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Carrie Higbie has been involved in the computing and networking for 25+ years in executive and consultant roles. She is Siemon's Global Network Applications Manager supporting end-users and active electronics manufacturers. She publishes columns and speaks at industry events globally. Carrie is an expert on TechTarget's SearchNetworking, SearchVoIP, and SearchDataCenters and authors columns for these and SearchCIO and SearchMobile forums and is on the board of advisors. She is on the Board of Directors and former President of the BladeSystems Alliance. She participates in IEEE, the Ethernet Alliance and IDC Enterprise Expert Panels. She has one telecommunications patent and one pending.

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