Fiber Backbone Cabling

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This documents discusses backbone cabling system and also how usage of fiber in backbone has revolutionized the data transmission in current age.

Table of Contents

Introduction

In today's connected world, technologies that can communicate, transfer and analyse data are required in every infrastructure, right from Enterprises to Hospitals to Schools to Hotels to smart cities. At the heart of these is a structured cabling system that promises both high speeds and long-haul delivery.

Traditionally horizontal cabling have been predominately ruling as the most used method to support speeds up to 1Gbps. As network technologies have evolved and are in a constant push to achieve more data speed for end users backbone networks have become part of building infrastructures.

What is Backbone Cabling?

Backbone Cabling forms the core of networks that allows structured cabling infrastructure is an inter and intra building cable connections between the various subsystems of SCS.

Backbone cabling consists of the following components:

- Backbone cables
- Backbone Cable pathways which includes conduits, vertical shafts etc)
- Intermediate and Main cross-connects
- Mechanical Terminations
- Patch cords or jumpers used for backbone-to-backbone cross-connection.
- Cabling between buildings.
- Grounding and Bounding Devices

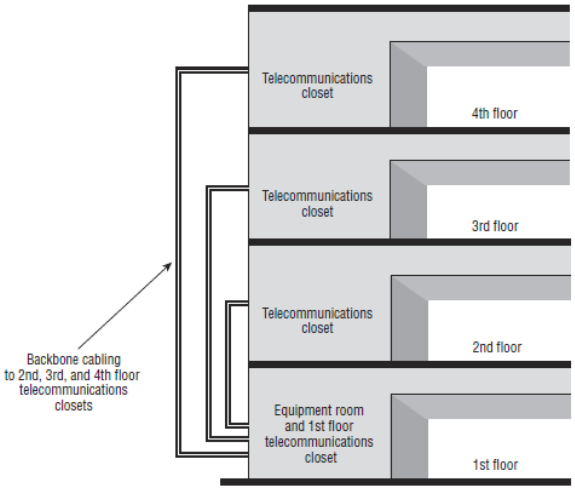
Backbone Cabling System Requirements

To be able to have a infrastructure that is able to withstand potential risks and threats, It is essential that a backbone system is able to support all necessary user applications in an infrastructure.

Designers must have through understanding and forward planning to be able to have a cabling system that grows with time providing high speed data and application availability per progressive technological needs.

As per the ANSI/TIA-568-B.8 , the backbone cabling is recommended to be laid out in a hierarchical star so that each horizontal cross connect is connected to the main cross connect or to an intermediate cross connect and then to a main cross connect.

It is advised to have no more than two hierarchical levels of cross connects in the backbone, No more than one cross connect should pass through between the horizontal cross connect and the main cross connect. This means that between any two horizontal cross connects, the signal must pass through 3 or fewer cross connect facilities.



Star Topology of Equipment Room and Telecommunication Rooms Connected

Backbone Cabling Distances

Maximum Backbone Distance			
Media Type	Main to Horizontal Cross Connect	Main to Intermediate Cross Connect	Intermediate to Horizontal Cross Connect
Copper (Voice)	800 m (2624 ft)	500 m (1640 ft)	300 m (984 ft)
Multimode Fiber	2000 m (6560 ft)	1700 m (5575 ft)	300 m (984 ft)
Single Mode Fiber	3000 m (9480 ft)	2700 m (8855 ft)	300 m (984 ft)

Additional Specifications for Backbone cabining system per ANSI/TIA-568-B.8

Twisted Pair Copper Cable

- Data: 100 solid conductor 24-AWG UTP or Screened Twisted Pair (ScTP) (Cat 6A, Cat 6 or Cat 5e).
- Voice: 100 solid conductor 24-AWG UTP (Cat 3 or Cat 5e).
- Multi-pair cable (25-pair, 50-pair).


UTP cable

Multimode Fiber Optic Cable

- 62.5/125m fiber.
- 50/125m fiber.
- 50/125m fiber (laser optimized).


STP cable

Singlemode Fiber Optic Cable

- 9/125m fiber.


Multimode fiber cable


Singlemode fiber cable

Backbone Cable Minimum Bend Radius

- 4-pair 100 UTP: 4x cable diameter.
- Multi-pair (25-50 pair): 10X cable diameter.
- Fiber cable: 15x cable diameter (with load)/10X (no load).
- OSP fiber cable: 20x cable diameter (with load)/10X (no load).

Jumper and Patch Panel Lengths

Main cross connect jumper and patch cords should not exceed 20 meters. Intermediate cross connect jumper and patch cords should not exceed 20 meters. Equipment jumpers should not exceed 30 meters.

Grounding and Bonding

Grounding should meet the requirements as defined in J-STD-607-A, the Commercial Building Grounding and Bonding Requirements for Telecommunications.

Backbone cabling speeds

Fiber-Optic technologies used for backbone cabling are able to support 100 Gbps speed making it the most efficient technology not just for data centres but also building backbones. To maximize and extend the use of Cat-5 and Cat-6 cables next-generation standards like 2.5GBASE-T and 5GBASET were developed to operate at 2.5 and 5.0 Gbit/s. As technologies are advancing so are the network interfaces. These interfaces rely heavily on the cabling infrastructure, and hence these must be designed to support bandwidth that are beyond 10gbps. Here is where the optical fiber plays an important role.

Why Optical Fiber?

Rapidly changing technology calls for a stable option like fiber that can carry more data for and sustain for a longer period of time. Since its properties remain unaltered by the interference of electromagnetic radiation, it makes it possible for transmission of information and data where copper wirings would otherwise cause more error and noise. A good example would be a manufacturing unit, as optic fiber is smaller and lighter it makes it easier to use in tight spaces, this helps in saving costs over copper wiring when the total cost of installation, support, etc. are included.

Multimode fiber optic cables for Backbone Cabling

OM1 cables usually come in orange colour and have a core size of 62.5um. The provide a data range of 1GB up to a distance of 300 meters.

OM2 cables also come in orange colour and have a core size of 50um. The provide a data range of 1GB up to a distance of 600 meters. Generally used for shorter distances**.**

OM3 cables come in aqua colour and have a core size of 50um. The provide a data range of 10GB up to a distance of 300 meters. Generally used for shorter distances**. T**hese are Able to run 40GB or 100GB up to 100 meters using a MPO connector**.**

OM4 cables also come in aqua colour and have a core size of 50um. The provide a data range of 10GB up to a distance of 550 meters. Generally used for shorter distances**. T**hese are Able to run 40GB or 100GB up to 150 meters using a MPO connector**.**

25Gbps and 40Gbps data transmission speeds are not supported by OM1 and OM2 and hence , OM3 and OM4 are primarily used to support 25G, 40G and 100G Ethernet. To support this next generation speed with advanced network technologies there was a need for cost effectives that was achieved using the OM5 fiber. OM5 cables are primarily used as they support Short Wavelength division multiplexing (SWDM) each carrying 25G of data to deliver 100G Ethernet using a single pair of multimode fibers.

1Gb Backbone vs 10Gb Backbone

The telecommunication industry has been developing in full speed, 10GbE switches were the most affordable and efficient backbone solutions for large organizations. Individuals and businesses that used the 10/100Mb switch and were only able to cash on a gigabit switch for 1Gb backbone. As we see diminution in prices and with an increased demand many SMBs and home users are now looking to access 10Gb switches.

A 1Gb backbone configuration has gradually become an obsolete technology since it is used to run 10/100Mb access layer switch with 1Gb uplink back to a central gigabit switch. A 1Gb uplink on the 100Mb switch receives the 1Gbps from the switch gigabit and this gets divided to 1Gb bandwidth to its terminal endpoints. This Restricts the port providing a max of 100Mb available for access points.

As opposed to a 1Gb Ethernet , 10Gb Ethernet offers data speeds up to 10 billion bps. These are used to create backbone connections using fast ethernet most often in data center applications. 10 Gbps backbones works on the concept of serial transmission. It typically uses the standard two-fiber duplex

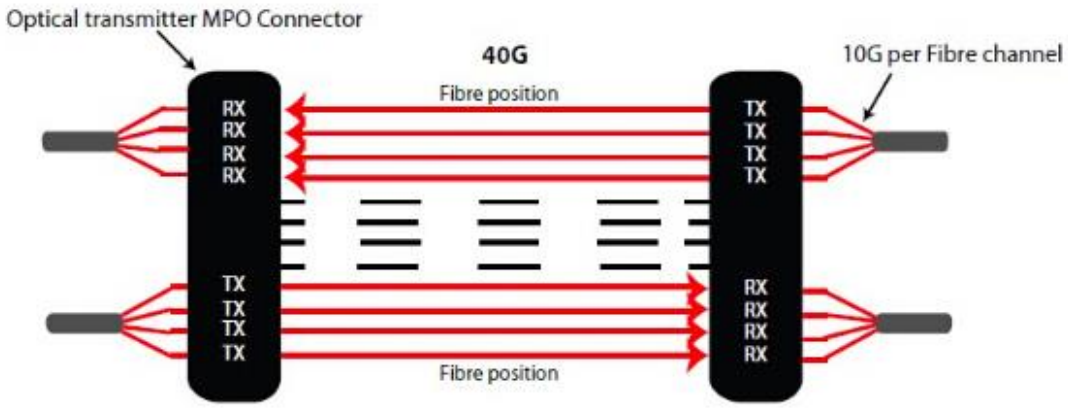
cabling, in which one fiber works to transmit and one fiber works to receive. Serial transmissions are preferred for long distance applications since they take longer time to transfer all the data in a sequential manner. Companies are now moving to 40Gbps and 100BGps multimode technologies that use parallel transmission of data.

Following are the **10 Gigabit Ethernet standards for optical cable** (both multimode and single mode fiber):

- 10GBase-CX4 (IEEE 802.3ak) - twin axial
- 10GBase-T – (IEEE 802.3an) Category 6 and higher - unshielded twisted pair (UTP) copper cable.
- 10GBase-*X (IEEE 802.3ae)
- SFF 8431 (SFP+ Fiber & cu)

40Gbs or 100Gbps Backbone

The 40Gbps backbone integrates 8 independent 10Gbit/s data fibers where 4 are used for transmission and 4 are used for receiving to provide 40Gbps aggregate bandwidth. A 100Gps backbone integrates 8 independent 25 Gbps fibers where 4 are used for transmission and 4 are used for receiving to provide 100Gbps aggregate bandwidth. To install multimode backbone channels capable of supporting 40GBASE-SR4 and 100GBASE-SR4 are typically deployed with MPO trunks, pass-through panels, and cords. The 40GBASE SR4 supports link lengths of 100m and 150m ron laser-optimized OM3 and OM4 multimode fibers. It primarily enables high-bandwidth 40G optical links over 12-fiber parallel fiber terminated with MPO/MTP multifibre connectors



Conclusion

The industry has seen a steep growth in data rates and how technologies are driving costs of infrastructure. The need of the hour is to have cabling systems like Backbone cabling to be able to provide speeds of 100Gbps. It is necessary that installation of these cabling systems are carried out with enough understanding to sustain long term usages.

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