STRUCTURED CABLING

Voice, Data, Image
of office workstations

DESIGN & SPECIFICATION GUIDE

<NAME OF PROJET>

CONTENTS

Scope :

This document prescribes the technical specifications applicable for the design and the implementation of a video, data & telephone cabling system.
The specifications adheres to current date standards described in paragraph 1.
On very specific sites this general approach and basis for the design of the video, data & telephone network will have to be completed with a detailed technical description related to the installation conditions.

1 References, codes and standards :

The design, installation, and testing shall conform to the applicable requirements of the latest edition and supplements of the standards, codes, and recommended practice of the following organisations:

- **ISO/IEC 11801 :2002/A1:2008,** Information Technology—Generic Cabling for Customer Premises
- **ISO/IEC TR 14763-2:2000**, Information Technology—Implementation and Operation of Customer
- **EIA/TIA 568 A**, U.S. standard for Cat.5e
- **EIA/TIA 568 B.2-1**, U.S. standard for Cat.6
- **ANSI/TIA/EIA-568-B.3-1,** Optical Fiber Cabling Components Standard, Addendum 1—Additional Transmission Performance Specifications for 50/125 µm Optical Fiber Cables, 2002.
- **ANSI/TIA-568-C.2,** Balanced Twisted-Pair Telecommunication Cabling and Components Standard,August 2009.(Replaces 568-B.2-10)
- **ANSI/TIA-568-C3,** Optical Fiber Cabling Components Standard, June 2008.
- **ANSI J-STD-607-A,** Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications, 2002.
- **EN 50173**, European standard Class D
- **EN 50173-1**, European standard Class E
- **NF C 15 100**, high current (low voltage 230 V)
- **EN 50167**, horizontal shielded cables for digital transmission
- **EN 50168**, horizontal shielded cables for wiring to terminals
- **EN 50169**, backbone shielded cables for digital transmission
- **EN 55022**, EMC
- **F3i**, Recommended practices and State of the art rules for VDIE cabling systems.
- **CENELEC EN 50173-5,** Information Technology—Generic Cabling Systems—Part 5: Data Centres,2007.
- **ANSI/TIA/EIA-942,** Telecommunications Infrastructure Standard for Data Centers, 2005.
- **ISO/IEC 11801 Class E_A**

1.1 Applicable standards

Schneider Electric Network Connectivity products are manufactured according to ANSI and ISO/IEC-approved telecommunications cabling standards and comply to regulatory and safety standards pertaining to telecommunications networks. The applicable standards for this chapter are listed below.

1. American National Standards Institute. ANSI J-STD-607-A. Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
2. American National Standards Institute/Telecommunications Industry Association/Electronic Industries Alliance. ANSI/TIA/EIA-526-14-A-98. 0FSTP-14-A. Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant.
3. ANSI/TIA/EIA-568-B.l. Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements.
4. ANSI/TIA/EIA-568-B.1-2. Commercial Building Telecommunications Cabling Standard,
Part 1: General
Requirements, Addendum 2, Grounding and Bonding Specifications for Screened Balanced Twisted-Pair Horizontal Cabling.
5. ANSI/TIA/EIA-568-B.1-3. Commercial Building Telecommunications Cabling Standard,
Part 1: General
Requirements, Addendum 3, Supportable Distances and Channel Attenuation for Optical Fiber Applications by Fiber Type.
6. ANSI/TIA/EIA-568-B.1-4. Commercial Building Telecommunications Cabling Standard,
Part 1: General Requirements, Addendum 4, Recognition of Category 6 and 850 nm Laser-Optimized 50/125 urn Multimode Optical Fiber Cabling.
7. ANSI/TIA/EIA-568-B.2. Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components.
8. ANSI/TIA/EIA-568-2-1. Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components, Addendum 1, Transmission Performance Specifications for 4-Pair 100 Ohm Category 6 Cabling.
9. ANSI/TIA/EIA-568-B.3. Optical Fiber Cabling Components Standard. Arlington, Va.: Telecommunications Industry Association/Electronic Industries Alliance, 2000.
10. ANSI/TIA/EIA-569-B. Commercial Building Standard for Telecommunications Pathways and Spaces.
11. ANSI/TIA/EIA-606-A. Administration Standard for Commercial Telecommunications Infrastructure.

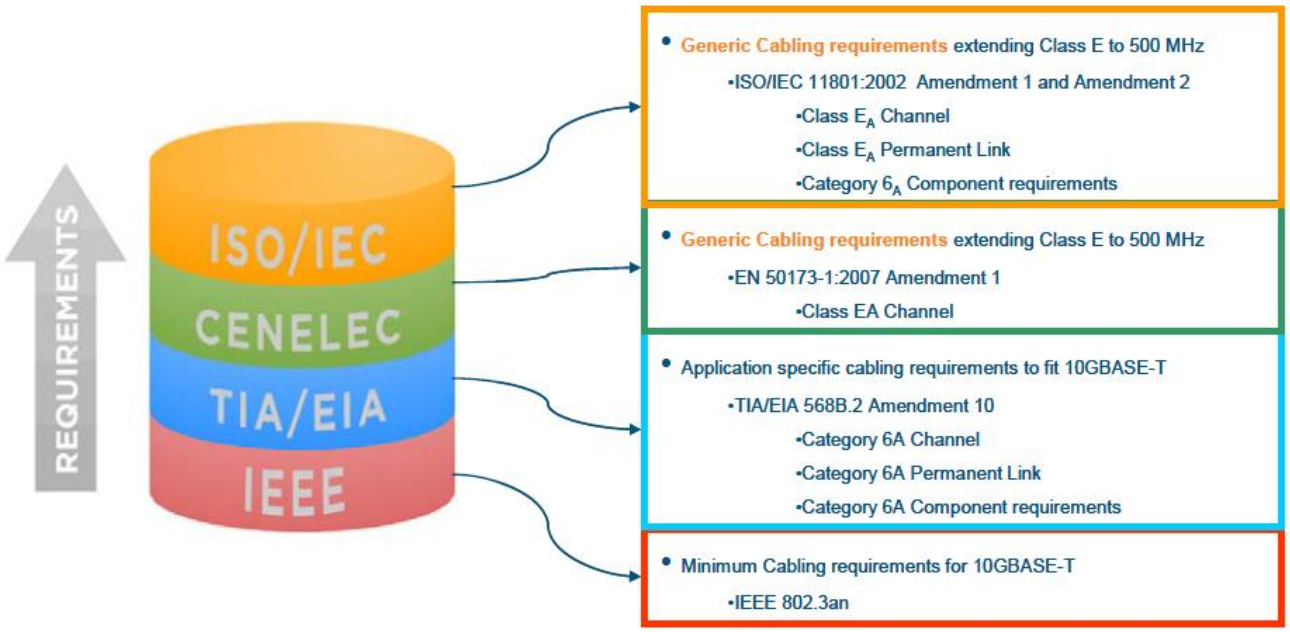
1.2 Institute of Electrical and Electronics Engineers, Inc.® (IEEE®)

Includes:
- **IEEE 802.1™:** LAN/MAN Bridging and Management (Active)
- **IEEE 802.2:** Logical Link Control (Hibernating)
- **IEEE 802.3™:** Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method (Active)
- **IEEE 802.11™:** Wireless LANs (Active)
- **IEEE 802.**3af : Power Over Ethernet
- **IEEE802.**3at : Power Over Ethernet Plus

1.3 Differences between ISO/IEC, CENELEC and ANSI/TIA/EIA standards.

STANDARDS	CONFIGURATION	CAT.6 250Mhz	CAT.6A 500 Mhz	CAT.7 600 Mhz	CAT.7A 1000 Mhz
	CHANNEL	11801 Ed 2.2	11801 2nd Ed Am.1	11801 Ed 2.2	11801 2nd Ed Am.1
ISO/IEC	PERMANENT	11801 Ed 2.2	11801 2nd Ed Am.2	11801 Ed 2.2	11801 2nd Ed Am.2
	COMPONENT	11801 Ed 2.2	11801 2nd Ed Am.2	11801 Ed 2.2	11801 2nd Ed Am.2
	CHANNEL	EN 50173-1:2002	EN 50173-1:2002 Am.1	EN 50173-1:2002	EN 50173-1:2002 Am.1
CENELEC	PERMANENT	EN 50173-1:2002	EN 50173-1:2002 Am.2	EN 50173-1:2002	EN 50173-1:2002 Am.2
	COMPONENT	EN 50173-1:2002	EN 50173-1:2002 Am.2	EN 50173-1:2002	EN 50173-1:2002 Am.2
	CHANNEL	TIA/EIA-568-C.2	TIA/EIA-568-C.2	N/A	N/A
TIA/EIA	PERMANENT	TIA/EIA-568-C.2	TIA/EIA-568-C.2	N/A	N/A
	COMPONENT	TIA/EIA-568-C.2	TIA/EIA-568-C.2	N/A	N/A

Requirements of each standard



Each standard organization has is own requirements. For instance, ISO/IES and CENELEC have chosen to define a generic structured cabling able to support all type of applications, and the ANSI/TIA/EIA has chosen to apply to the IEEE minimum recommendations defined (for instance 10GBASE-T)

CABLE TYPE

How to choose?

The new baseline installation selects Category 6, and most new project specifies Category 6_A. Note that when you specify the cables, the corresponding connecting hardware and patch cords be rated in the same category as, or higher than, the horizontal cable. The cabling system bottleneck will be the weakest link of the installation. i.e. if you mix Cat 5e, Cat 6 and Cat 6_A components, the overall system bandwidth will be limited to Cat 5e performances.
SCHNEIDER ELECTRIC does not advise a mixing of categories and our warranties will only cover single class product installations.

2 Components requirement :

The cabling components have to be ACTASSI type from Schneider-Electric or equivalent. Equivalent products have to reach same quality and performance levels as ACTASSI ones as well as offer same features.

Standards rule following components and equipment :

1) A terminal outlet using RJ45 modular jack (access point at the workstation)
2) Consolidation point (used for indirect wiring through raised floor or false ceiling)
3) Horizontal cable, also called capillary cable, made of four twisted pairs
4) Floor Distributor (FD) also called sub distribution frame (SDF)
5) The Building Distributor also called Main distribution Frame (MDF)
6) Multi-pair copper backbone cables linking the FD to the Building Distributor (BD) for telephone application
7) Cables (FO or copper) linking FD to BD for data network applications

2.1 CAT6A CABLING INFRASTRUCTURE

Telecommunication Outlet

All the wiring devices should be taken in the same range as infrastructure cabling system, no mather which installation method is chosen, the wiring devices will be compliant to IEC 60364 / and HD384 series international standards.
The protection level following the IEC 60529 or l'EN 60529, should be minimum : IP 20
The shock resistance following the IEC 62262 or l'EN 62262 should be IK 02.
The wiring device should never exceed the local standard (ie : 45mm in France, Belgium)
The wiring device will be compatible with every outlet without any adaptor or dismantling.
The wiring device should be mounted next to each other without any space in between.
Every wiring device must have a clipsing mechanism without any tool. All telecommunication outlet must be trivialized.
A minimum of 2 outlets per work area is recommend in case of use of IP-TELEPHONY. Otherwise a complementary outlet should be considered.
The telecommunication outlets including or not 1 or 2 RJ45 will be ISO 8877 compliant, defined by ISO IS11801, and TIA/EIA 568 TSB40, which description is done in (29.1.2 RJ45 Connector)

RJ45 Connector

All the range of connectors have to be compliant with all the last international standards. A valid certificate must be provided by third party laboratory (type :DELTA).

Each connector of the family is available in UTP or STP one piece device compact and simple locking termination without any loose part, to avoid the installer to lose pieces , and to make it easier to handle.

The connector has to be tooless, U-Shaped cable entry, with a smart bridle with elastomer insert for cable. Easy access for all cables. Automatic 360° earthing with spring-loaded locking and earthing bridle.

The STP connector must have integrated earth-drain contact for the drain wire connection, and double earthing for the STP version at the front.
The U shape entry is the same concept, S/FTP or F/FTP cables to enable them to keep their structure intact (screens and foils are not damaged) transmission performance is safe. No risk to tear and roll up the screen.

The connector must have at least a 750 connection/disconnection. It has to be manufactured in EUROPE.

Figure 1 : U-shaped cable entry

SMART BRIDLE

The U-shaped cable entry should be considered for reducing risk of damaging connections. For the S/FTP et F/FTP (easy access for all cable)

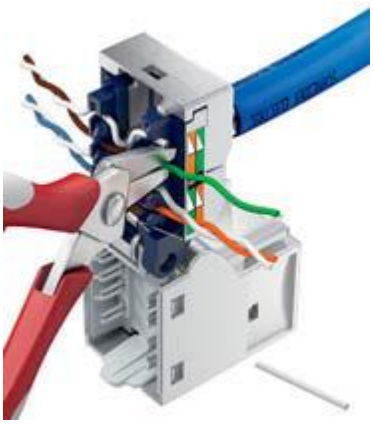


Figure 2 : Protected IDC contacts

DONE

Insulated plastic IDC housing eliminates short-circuit between conductors and metal body.
The crossing of pairs is implemented before the cable's introduction into the connector for easy, secured and efficient wiring. The pair foil can be as near as possible to the IDC.

The earth drain wire is inserted in an horizontal groove with entire security and is terminated vertically down on the side of the connector. Secured integrated guiding parts to enable reproductive position.

The connector has to be labelled on each side the colour coding from the standard EIA 568 A & B.
The connector has to be smooth design with rounded edges, and touch –friendly materials to avoid injuries.

The connector has to be able to Re-open in two clicks, and audible in opening and closing.

Performances :

The level of performance has been certified by an independent laboratory Delta with the EIA/TIA and ISO 11801:2011 Ed2.2 Class E permanent link and channel. All the parameters required have been surpassed by far during the test.

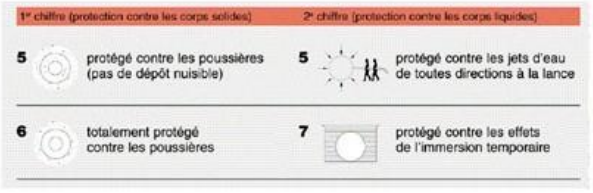
The test method « Direct Probing » will warranty the interoperability of the connector at 500Mhz, and met the requirement of the international IEC60512-99-001 ed 1 POEP standard.

RJ45 WATERPROOF

The RJ Protek faceplate are specially design for industrial or laboraty environment, surgery rooms where chemical, dust, humidity constraints are usual).

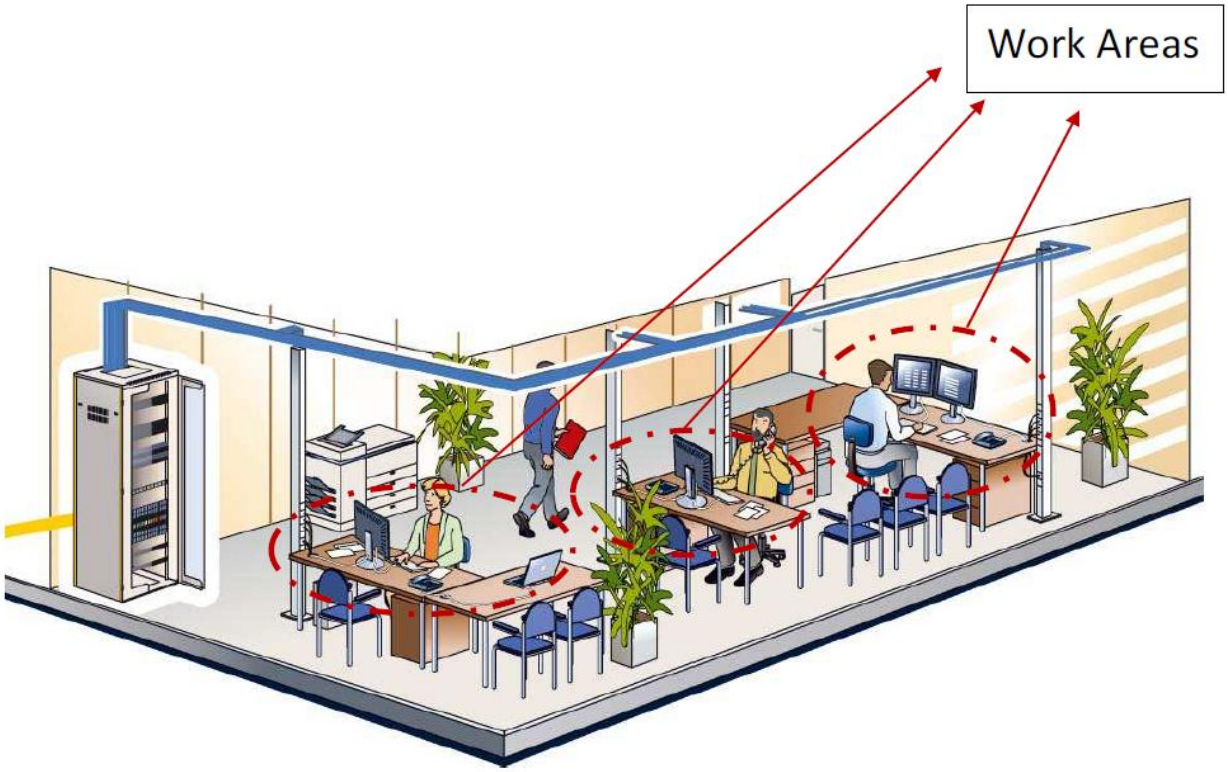
For Heavy steel industry vibration plants this RJ45 has improved resistance against unplanned disconnexion due to high vibrations.

The Waterproof of the RJ45 is secured by the turn&lock, and this gives a IP55 in surface mount and up to IP67 in flush mount.



2.1.1 WORK AREA

In this chapter, we shall learn about cabling components located in work areas, with references to the second edition of ISO/IEC 11801 Ed.2:2002 (equivalent to AS/NZS 3080 for Australia and New Zealand) and the ANSI/TIA/EIA-568-B series of standards.



DESIGN CONSIDERATIONS

Guidelines for planning the location of telecommunications outlet boxes in the Work Area:

1. Each work area shall have a minimum of ONE telecommunications outlet box location. TWO telecommunications outlet box locations should be provided and located for future additional telecommunications outlets.

2. Work area telecommunications outlet box size.

ANSI/TIA/EIA-569-B, specifies the *following*:

3. Telecommunications outlet boxes may require supports for attaching the box and a suitable faceplate to support the telecommunications outlet/connectors that are housed by the work area telecommunications outlet box.

• Outlet boxes shall be no smaller than

Width: W	Height: H	Depth: D
50 mm, (2 in)	75 mm (3 in)	64 mm (2 1/2 in)

The work area telecommunications outlet box should be located near an electrical outlet (e.g., within 1 m [3 ft]) and installed at the same height if appropriate.

5. Floor-mounted telecommunications outlet boxes and monuments (pedestals), and the cables extending from them, can present a tripping hazard. The location of these telecommunications outlet boxes should be coordinated with furniture to minimize such hazards.
6. Cabling system performance may be sensitive to the arrangement and organization of cable slack located behind the telecommunications outlet/connector. Sufficient space must be provided in the telecommunications outlet box or equivalent space so that minimum cable bend radius requirements are not exceeded.
7. The location, mounting, or strain relief of the telecommunications outlet/connector should allow pathway covers and trim to be removed without disturbing the cable termination. Care should be exercised to ensure that telecommunications outlet/ connectors are mounted in such a way that they do not significantly reduce the required pathway cabling capacity.
8. Open office furniture openings provide for mounting faceplates containing one or more telecommunications outlet/connectors. Two standard sizes of openings are specified:

WORK AREA SUBSYSTEM

The work area refers to spaces where occupants normally work and interact with their telecommunications equipment. The work area subsystem refers to the components that extend from the telecommunications outlet/connector at the end of the horizontal cabling system to the work station equipment. This equipment requires a patch cord plugged into the telecommunications outlet/connector.

All four pairs in the cable shall be terminated in an 8-position modular outlet/connector at the work area. These connectors may be x/xTP, as described in the above section.

Two wiring schemes are specified in the ANSI/TIA/EIA 568-B.1 Clause 6.2.1. The pin/pair assignments for T568A and T568B are shown in Figure 1.19b depicting the front view of each telecommunications outlet/connector.
T568A is the preferred wiring scheme, and T568B optional if necessary to accommodate certain pre-existing 8-pin cabling systems.

When selecting a connector, make sure it is specified and tested to meet ANSI/TIA/EIA-568-B.2.
Connecting hardware should be marked to designate transmission performance at the discretion of the manufacturer or approval agency. The markings, if any, shall be visible during installation. It is suggested that such markings consist of:

Category 6A components: “Cat6A”

WORK AREA CABLES

Work area cables (known also as “Patch cords”, “equipment cords” or “station cords”) extend from the TO or MUTOA to the work area equipment. To assure adequate flex-life, cables used for UTP patch cords shall have stranded/solid conductors. Depending on the application, a cord with identical connectors on both ends is commonly used.
Note that a maximum length of 5 m (16 ft) of work area cord is allowed for the horizontal link.
Patch cords used in the work area shall meet or exceed the performance requirements in ANSI/TIA/EIA-568-B.2 and ANSI/TIA/EIA-568-B.3.
When application specific adaptors (eg. Baluns) are needed at the work area, they shall be external to the telecommunications outlet/connector (EIA/TIA 568-B.1 clause 4.2).
Due to insertion lost and impedance mismatch, work area cabling often becomes the bottleneck or the “weakest link” in the channel. The transmission performance of the entire channel will be reduced to that of the work area cable. ANSI TIA/EIA 568-B recommends the use of factory assembled work area cables.
Work area cables and other equipment cables connecting to the horizontal cabling shall meet or exceed the performance requirements described in ANSI/TIA/EIA568-B and ISO/IEC 11801 Ed.2:2002 cabling standards.

2.1.2 CONSOLIDATION POINT :

One consolidation point is permitted between a FD and any TO.
The installation of a consolidation point in the horizontal cabling between the floor distributor and the telecommunication outlet may be useful in an open office environment where the flexibility of relocating TOs in the work area is required.
The consolidation point shall only contain passive connecting hardware and shall not be used for cross-connections. In addition, where a consolidation point is used :

a) the consolidation point shall be located so that each work area group is served by at least one consolidation point;
b) the consolidation point should be limited to serving a maximum of twelve work areas ;
c) a consolidation point should be located in accessible locations ;
d) the consolidation point should be located so that there is at least 15m from it to the floor distributor ;
e) CP cables are to be of the same type than capillary cable and are to be equipped with RJ45 plugs recommended by the manufacturer.
   • Category 6A (see 3.3 Chapter)
   • Optical fiber …….. (see 3.3 Chapter)

When using adapters (e.g., installing a balun), the adaptors must be external to the telecommunications outlet/connector or MUTOA. For further information, see Cabling Adapters in CORE-2: Horizontal Distribution Systems. The cabling infrastructure designer needs to be aware that these work area equipment-specific adaptors may or

may not offer the same level of transmission performance as the cabling systems to which they connect.

• Active adapters (e.g. Fiber Optic transceivers) that may be needed when connecting devices that use different signalling schemes.

• A special cable or adapter is required when the equipment connector is different from the telecommunications outlet/connector.

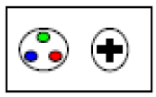
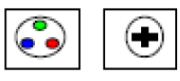
The maximum horizontal cable length of 90 m (295 ft) is based on a maximum length of 5 m (16 ft) of work area cable. The combined length of equipment cables, work area cords, and patch cords in the telecommunications room (TR) or equipment room (ER) shall not exceed 10 m (33 ft), with the exception of MUTOA where longer work area cables are used. In the case of MUTOA's, the horizontal cable length is reduced when the work area cords exceed 5m.

OPEN OFFICE CABLING

Modern offices today adopt flexible layouts for supporting collaborative work by small teams. From time to time, changes in individual work or group work results in re-arrangements to office settings in which much of the available work area space is divided by modular furniture and partitions rather than by fixed walls.
To accommodate such changes without disturbing horizontal cable runs, EIA/TIA 568-B recommends that these partitions and furniture typically provide for the use of:

- Multi-user telecommunications outlet assembly (MUTOA).
- Consolidation point (CP).
- Cable pathways.
- Telecommunications outlet/connector.

Each of these open office distribution system components will be covered in some detail throughout this chapter.

Minimum Distance between Data Cabling and Power Lines of up to 5 kVA Power Lines		**UTP**	**FTP**
Unshielded Power Lines with No Separation from Data Cable		127 mm (5.08")	50 mm (2")
Unshielded power Lines Separated from Data Cable with Grounded Metallic Elements		64 mm (2.56")	30 mm (1.2")
Power Lines and Data Cables Enclosed in Separate Grounded Metallic Conduits		0mm	0mm

Bending Radius and Max. Pulling Force for various cables:

TYPE Of CABLE	BENDING RADIUS (mm)	MAX PULLING FORCE (N)
2 core Fiber Zip Cord	35	100
8/12/24/36-core indoor Fiber	30	500
8/12 Loose Fiber	225	1250
8/12/24/36-core Armoured Loose Tube Fiber	225	2500
4-pair UTP (Cat5e/Cat6)	4 X OD	100
4-pair FTP (Cat5e/Cat6)	8 X OD	200
4 pair UTP (Cat6A)	4 X OD	110

CABLE PULLING

The maximum pulling tension for a 4-pair balanced twisted pair cable must not exceed 25 lbf (110N). Exceeding this tension will result in transmission degradation and may affect the system's ability to pass certification testing.

		5e	6	$6A_1$
Average OD		.185"	.230"	.330"
Cable Tray*	2" x 6"	111	72	35
	4" x 8"	298	192	93
	6" x 20"	1116	722	350
Conduit**	3/4	6	5	1
	1	11	8	4
	1 1/4	19	14	6
	1 1/2	25	19	9

Typical tray and conduit capacity (number of cables)

CONDUIT FILL

A maximum conduit fill ratio of 40% is recommended by TIA-569 standards to accommodate cable bundle bend radius requirements and allow for future expansion.

CABLE TRAY FILL

TIA-569 recommends 25% fill at initial installation and up to 50% with unplanned additions. If a single cable tray will also carry power cables, a physical barrier is required to comply with the NEC. Finally, ensure tray support spacing is sufficient to prevent excessive sagging. Consider solid bottom tray for higher density applications.

CABLE TRAY SIZING

Step	Instructions	Example
1	Determine cable diameter and total number of cables	.30" diameter each, 100 cables total
2	Square the cable diameter	.30 x .30 = .09
3	Multiply result by number of cables	.09 x 100 = 9
4	Multiply result by .785 to factor for cable roundness (This result is the total cross-sectional area of your cables)	9 x .785 = 7.065 sq in
5	Multiply result by 4 to obtain pathway size at 25% fill	7.065 x 4 = 28.26 sq in

CONSOLIDATION POINTS & ZONE ENCLOSURES

TIA standards allow an optional consolidation point (CP) within a permanent link. Consolidation points may be mounted into a zone enclosure, which are available in several styles:

• Ceiling- or floor-mount
• Plenum-rated
• Active or passive equipment rated

Zone enclosures also accept patch panels and/or active equipment, and are then considered telecom enclosures (TEs).

STRAIN RELIEF

Cables shall be free of physical stress over the entire length of the run. Use of cable supports, Velcro ties are recommended for strain relieving. Do not over tighten straps or tie-wraps to avoid damage to the cable.
Velcro ties shall always be used for bundling cables properly in channels and raceways.
Cables distributed to the same work area zone may be bundled together.
The maximum number of cables per bundle shall not exceed 50 cables.

DEFINITIONS

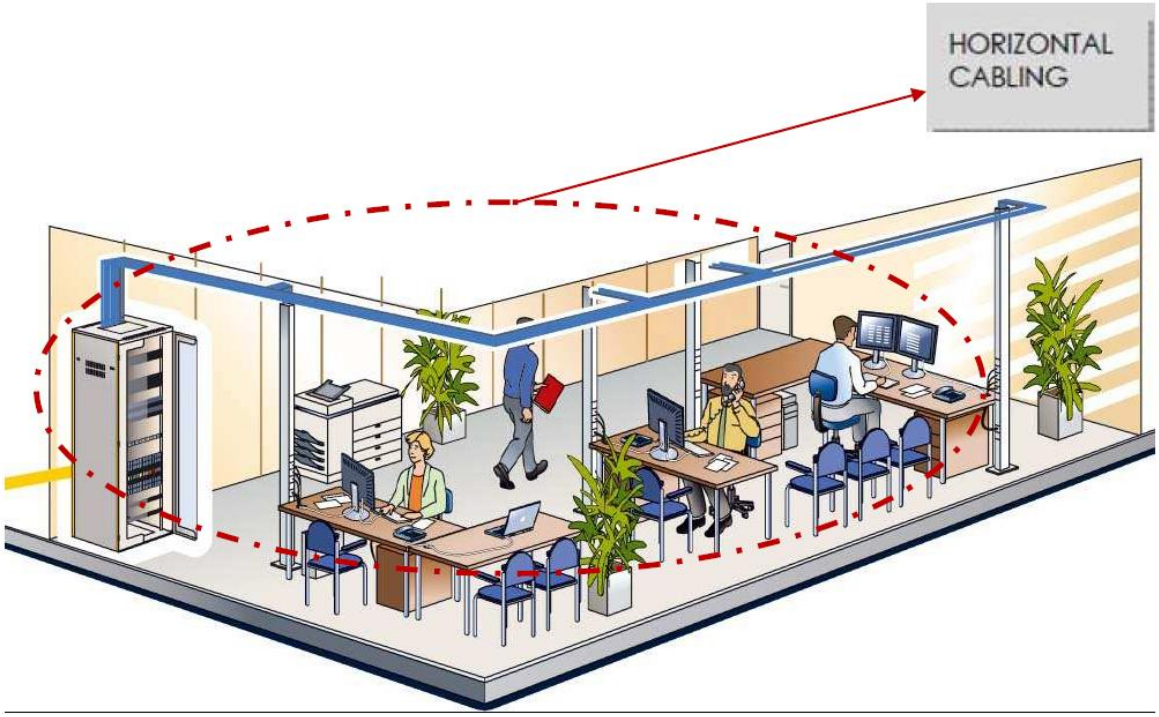
CP: Consolidation Point - a location for the interconnection between horizontal cables that extend from building pathways and horizontal cables that extend into work areas.
MUTOA: Multi-user Telecommunications Outlet Assembly - a grouping in one housing of several telecommunications outlets/connectors.
Open Office - a floor space division provided by furniture, movable partitions, or other means, instead of building walls.

2.1.3 HORIZONTAL CABLING SYSTEM

The specifications in this section make specific reference to the horizontal cabling requirements stated in ANSI/TIA/EIA-568-B.l, Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements.
The internationally recognized standard for premises cabling is ISO/IEC 11801 Ed.2:2002.
In this section, the Students will learn
1) The definition and Scope of the Horizontal Cabling System.
2) Primary design objective of the Horizontal Cabling Design.
3) Key Design Considerations of the Horizontal Cabling System.

Definition and Scope of the Horizontal Cabling System

The horizontal cabling is the portion of the telecommunications cabling system that extends from the work area telecommunications outlet/connector to the horizontal cross-connect in the telecommunication's closet. It includes
a) Horizontal cables;
b) Telecommunications outlet/connector in the work area,
c) The mechanical terminations,
d) Patch cords or jumpers located in the telecommunications closet and
e) May include multi-user telecommunications outlet assemblies (MUTOA's) and consolidation points (CP's).



Design goals

A good cabling plant design always considers possible changes in user requirements in the future. The horizontal cabling is often very inaccessible after the building is completed and can incur high cost of changes and result in disruption to occupants and their work.

Electromagnetic Interference (EMI)

Sources of EMI should be considered when selecting types of horizontal cabling and designing the layout of horizontal pathways.

Potential sources of EMI include:
• Electric motors and transformers that reside in close proximity to telecommunications cabling.
• Copiers that share space with telecommunications cables and equipment.
• Electrical power cables that support such equipment.

Avoiding EMI

1. Maintain physical separation between possible sources and the telecommunications cabling.

Types of Power Line/Equipment	<2 kVA	2 to 5 kVA	> 5 kVA
Unshielded	127mm	305mm	610mm
Unshielded with cable enclosed in a grounded metallic conduit	64mm	152mm	305mm
Lead sheathed power lines with cable enclosed in a separate grounded metallic conduit.	38mm	76mm	152mm

1. Optical fiber and shielded cable should be used for buildings with high levels of ambient EMI.
2. Balanced twisted-pair cabling, such as Category 5e or better (Category 6 recommended), can offer a certain degree of noise immunity that ensures reliable transmission in most environments (e.g., electrical field intensity less than 3 volts per meter [V/m]).

Grounding and Bonding Considerations

For FTP or STP cable used in the horizontal cabling system, Schneider-Electric recommends that the telecommunications grounding/bonding installation shall conform with ANSI J-STD-607-A and ANSI/TIA/EIA-568-B.1-2, Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements, Addendum 2, Grounding and Bonding Specifications for Screened Horizontal Cabling.
Note: ANSI/TIA/EIA-607-A: Commercial Building Grounding and Bonding Requirements for Telecommunications are
superseded by J-STD-607-A.

In General, the following guidelines shall be followed,
a) An approved ground shall be made available at the TC for
– Patch Panel frames.
– Equipment Racks and Cabinets.
– All Active Equipment.

b) The shield of FTP cables shall be bonded through a conducting path to the telecommunications grounding bus-bar (TGB) in the telecommunications room.
c) Shielded connections at the work area are accomplished through a FTP patch cord.
d) Grounding at the work area is usually accomplished through the equipment power connection.
e) At the work area end of the horizontal cabling, the voltage measured between the shield and the ground wire of the electrical outlet used to supply power to the work station shall not exceed Vrms.
f) All patch panel and RJ45 connector have to be direct earthing.

Administration

Schneider Electric Network Connectivity requires proper and systematic methods and procedures for labelling and management of horizontal cabling. The guidelines and requirements for the administration of horizontal cabling systems comply to and make references to ANSI/TIE/EIA-606-A.
1) All cabling must be identified at both ends of the run.
2) Markings on the cable must be:
a) Clearly visible after installation.
b) Easily distinguishable from any manufacturers marking on the cable.
c) Can last the full duration of the warranty

Standard Horizontal Cabling Configuration

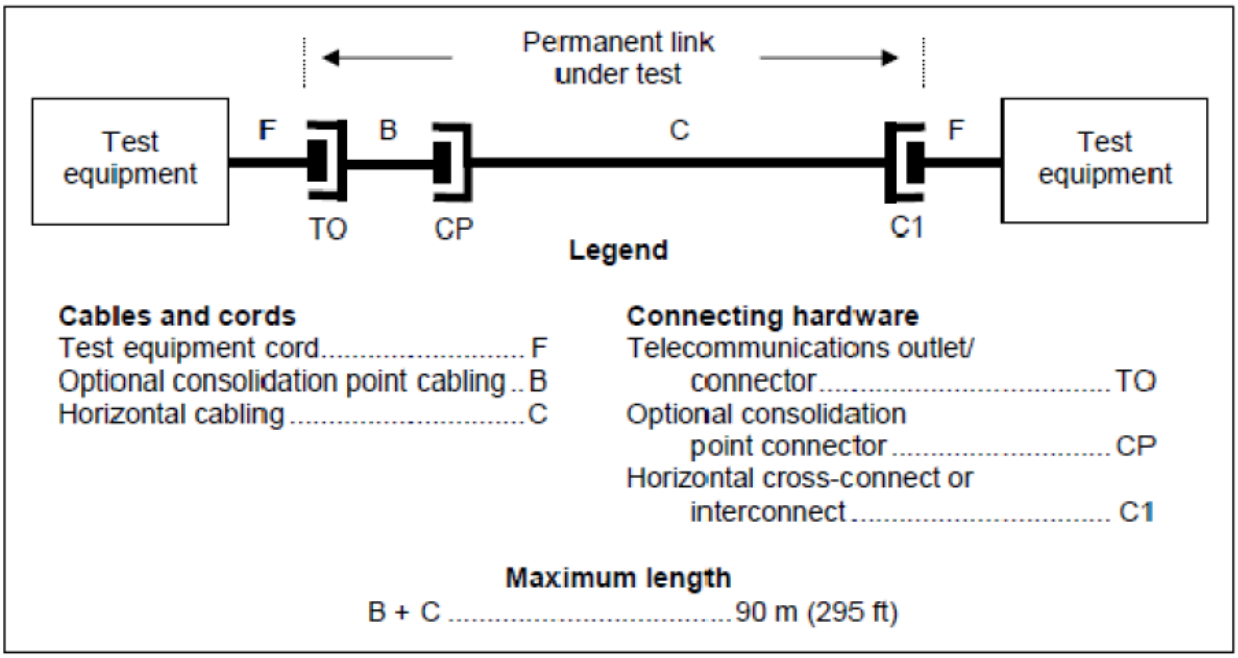


Figure 1.8a: Permanent Link
(Extract from ANSI/EIA/TIA 568-B.2-10)

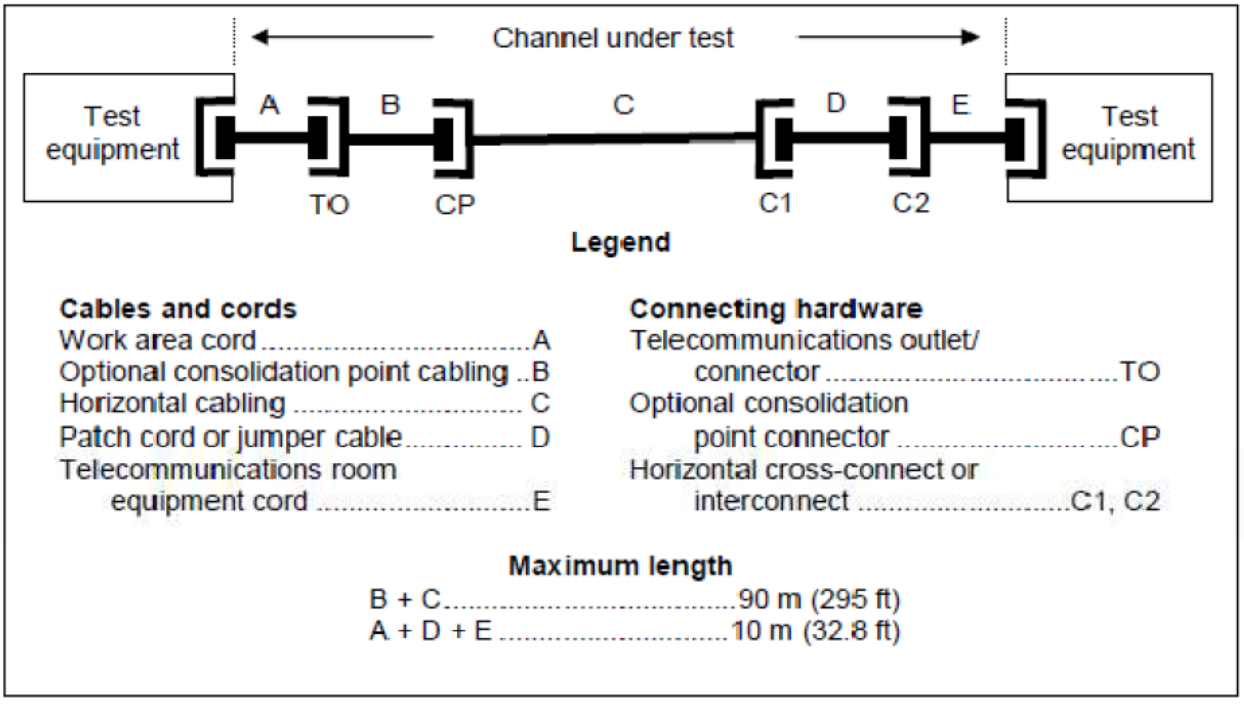


Figure 1.8b: Channel
(Extract from ANSI/EIA/TIA 568-B.2-10)

Connection Schemes

For horizontal cabling, there are 2 recognized schemes for making connections:
1. Cross-connection — A connection scheme that uses patch cords or jumpers that attach to connecting hardware on each end.
2. Interconnection — A connection scheme that facilitates the direct connection of individual cables to another cable or to equipment without a patch cord. The two connection schemes are as follows:

Recognised horizontal cable types

For the link and channel configuration, the recognized horizontal cable type varies depending on standards. The following table summarizes the difference between the various standards.

Horizontal Cable Types	ANSI/TIA/EIA-568-B	ISO/IEC 11801 Ed.2:2002	CENELEC EN 50173 .1:2002
COPPER	100 ohm	100 ohm Class D, E, E_A, F	100 ohm Class D, E, E_A, F
FIBER	50 or 62.5 µm MM Optical Fiber 8 -10 µm SM Optical Fiber	50 or 62.5 µm MM Optical Fiber OM1, OM2, OM3, SM fiber OS1	50 or 62.5 µm MM Optical Fiber OM1, OM2, OM3 SM fiber, OS1

- OM1 62,5µm is not anymore used on the market.

Copper performance categories

There are several performance categories for 100 ohm balanced twisted-pair cable and connecting hardware categories specified in the ANSI/TIA/EIA-568-B series and addenda or ISO/I EC 11801 Ed.2:2002.
The connecting hardware and patch cords used for a horizontal run must be rated in the same category as the cable, or higher. The various category definitions are found in the following table:

Category	Definition
Category 3	Cables and connecting hardware are specified up to 16Mhz Cat3 performance correspond to application CLASS C as specified in ISO/IEC 11801 Ed2:2002
Category 5e	Cables and connecting hardware are specified up to 100Mhz Cat5e performance correspond to application CLASS D as specified in ISO/IEC 11801 Ed2:2002 and ANSI/TIA/EIA-568-B series
Category 6	Cables and connecting hardware are specified up to 250Mhz Cat6 performance correspond to application CLASS E as specified in ISO/IEC 11801 Ed2:2002 and CENELEC EN50173-1
Category 6_A	Cables and connecting hardware are specified up to 500Mhz Cat6_A performance correspond to application CLASS E_A as specified in

	ISO/IEC 11801 Ed2:2002 and CENELEC EN50173-1:Ed2/A1
Category 7	Cables and connecting hardware are specified up to 600Mhz Cat7 performance correspond to application CLASS F as specified in ISO/IEC 11801 Ed2:2002 and CENELEC EN50173-1
Category 7_A	Cables and connecting hardware are specified up to 1000Mhz $Cat7_A$ performance correspond to application CLASS F_A as specified in ISO/IEC 11801 Ed2:2002 and CENELEC EN50173-1 Am2

NOTE: Categories 2, 4, and 5 cables are not recognized

Category Mixture

Multiple-category balanced twisted-pair system can be confusing and costly to maintain. Schneider Electric endorses the use of single category of cabling components, selected for use in a cabling system. Schneider Electric system warranty does not recognize the use of mix and match categories in a installed cabling system.

Crossovers/Polarity

When there is a need to connect a transmitter on one end and a receiver on the other, a cross over cable is required of the copper pair or fiber cores.

Copper

– If crossover cables are required for copper based cable application, they may be used only outside of the horizontal cabling system. Active equipment will provide the right polarity if need (MDI/MDI-X).

Optical Fiber

– The optical fiber cabling link shall be installed in a pair-wise crossover orientation in which the optical fibers of a pair identified as Position A and Position B at one end are reversed and identified as Position B and Position A (respectively) at the other end.

– This pair-wise crossover for optical fibers is achieved by using connector polarity and labelling methodologies that apply to horizontal cables, patch cords, equipment cords, and duplex optical fiber adapters.

Horizontal Connecting Hardware

General

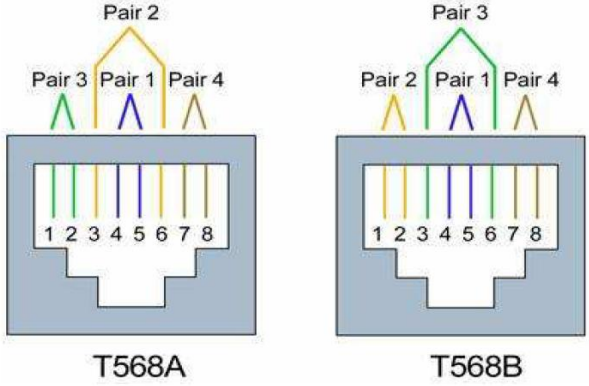
Connecting hardware for horizontal cabling includes:

• Telecommunications outlet/connectors.
• Connectors used in the HCs (FDs).
• CP connectors (optional).

All connecting hardware used for horizontal cable connections must meet the requirements for reliability, safety, and transmission performance specified in the:

• ANSI/TIA/EIA-568-B series or ISO/I EC 11801 Ed.2:2002.
• NEC in the United States.

Figure 1.19b: Eight-position jack pin/pair assignments (front view of connectors)



NOTE: The colours indicated are associated with horizontal balanced twisted-pair cable. Colour coding for equipment cables, work area cords, patch cords, and jumpers may vary.

Centralized Fiber Cabling

Centralized optical fiber cabling is designed to support centralized communications equipment.

Centralized cabling connects the work areas to the centralized cross-connect by allowing the use of interconnect, pull-through cables, or a splice in the TR.

Length limitation

1) The installation length limit of 300m applies to the interconnection and splice methods. It is based on the combined length of horizontal cable, backbone cable, equipment cables, cross-connections, and patch cords.

Within the 300 m limit, multimode cabling system will support gigabit services using centralized networking devices with appropriate optical fiber cable.

2) The cabling length limitation of 90m is associated with the pull-through method. It is based on the length of horizontal cable from the MC (CD) to the TO/WA.

The total allowable length of additional equipment cables at the MC (CD) and equipment cables in the work area is 10m with the pull-through method.

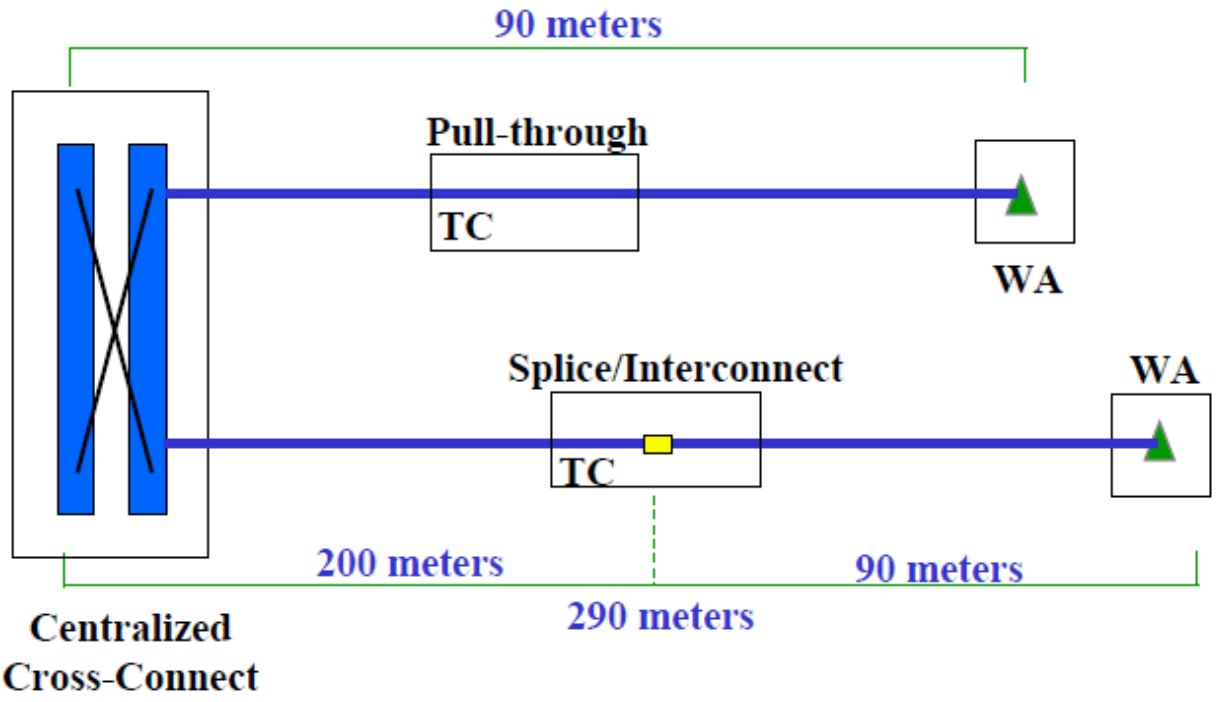


Figure 1.6.1a: Example of centralized optical fiber cabling.

2.1.4 FLOOR DISTRIBUTOR (FD)

They are used to connect between the horizontal cable and other cabling subsystems or equipment. A minimum of one floor distributor should be provided for every floor ; for floor spaces exceeding 1 000 m², a minimum of one floor distributor should be provided for every 1 000 m² of floor space reserved for offices. If a floor space is sparsely populated (for example a lobby), it is permissible to serve this floor from the floor distributor located on an adjacent floor.

A floor distributor combines :
• Identification and management of the horizontal links (through a clear labelling)
• The cross-connection for data networks by mean of copper patch cords and/or fiber optic jumpers. Horizontal (19" panels) and vertical (rings) patch cords routing accessories are compulsory to facilitate a clear organisation of the cross-connections inside a single cabinet.
• The housing of active equipment intended for concentrating, switching or supervising, Data, Video and access control networks.

2.1.5 19" FLOOR STANDING CABINETS :

COMPLIANCE WITH THE STANDARDS

Standard	Title	Use
IEC 60297-3-100	Mechanical Structure for Electronic Equipment	- Dimension of Mechanical structures of the 19”
EIA-310-E	Cabinets Racks Panels and associated Equipments	- US cabinets and racks standard
IEC60529	Degrees of protection provided by enclosures (IP code)	Degree of protection against liquids and dust to enter the enclosure. - IP 20
IEC62262	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)	Degree of protection from solid bodies to enter the enclosure. - IK10 For plain door - IK08 for glass door

SPECIFIC REQUIREMENTS

2.1.6 ENCLOSURE :

Floor-standing cabinet made of galvanized steel symmetric uprights and following dimension Height:1200, 1400, 1600, 1800, 2000, 2200, Width: 600/750, 800, Depth: 600/800,1000, 1060,1200. Cabinet should be coated with epoxy-polyester powder hot polymerized in textured RAL 7035 for better corrosion resistance.

All the side panels must be flush with the framework to avoid surprises during the installation process. For joined enclosures the total length of the set must be the sum of the individual enclosures that form it to avoid surprises during the installation.

For easier installation and maintenance the cabinet must allow installation of doors on front and back sides (without special accessories) and installation of 2 doors in the same upright.

In case that two or more enclosures are installed together the doors should be able to open without interfering with the adjacent enclosures.

Doors:
Sheet steel plain / transparent door , provided with foamed-in polyurethane gasket and front door opening. Door shall be provided of adjustable reinforcement frame for increased ruggedness and assembly of accessories.

Door shall be supplied with an opening handle to allow easy door managing when equipped, and shall be provided with a closing system locked by a key number 333.

The impact strength as per IEC 62262 shall be IK10. For enclosures with transparent door must not have any effect on IP degree however, IK08 is acceptable.

Enclosure should allow door opening change. For safety reasons the door must not fall off when totally open and the pins are off the axis of the hinge. Door opening of 180º for easy maintenance.

Accessories:
Enclosure shall be supplied with 19" uprights, 100mm / 200mm / no mm base/plinth, with/without document pocket, earthing straps, with/without 19" profiles, eyebolts / lifting brackets / lifting bars, with/without door switch & lamp.

OPERATION & MAINTENANCE

2.1.7 QUALITY ASSURANCE

All materials and products shall be new, sound and uniform in quality, size, shape, color and texture.
The assembler shall be responsible for ensuring that the required standards of quality control as mentioned in relative sections are maintained for the proposed enclosures.
If requested by the client, the supplier shall provide proof of application of a quality procedure complying with standards. This means:

- Use of a quality manual approved and signed by a management representative.
- regular updating of this manual so that it reflects the most recent applicable quality control procedures,
- ISO 9001 or ISO 14001 certification

2.1.8 PRODUCT DELIVERY, STORAGE and HANDLING

- Deliver, store, protect and handle products to site as per manufacturer's instructions.
- Store enclosures in clean and dry space. Inspect for exterior damage. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris and traffic.
- Lift only with lugs provided for the purpose. Handle carefully to avoid damage to enclosure and finish.

2.1.9 SUSTAINABLE DEVELOPMENT

- Production site organisation shall be non polluting and certified to comply with ISO 9001 and ISO 14001 standards.
- Enclosures shall be designed according to Eco-design and the materials shall be of halogen free type.
- Enclosure painting process shall be complying with environmental directives RoHS and REACH.
- Packaging ecological and re-usable as a must.

EQUIPMENT ROOM (ER) SPECIFICATIONS

The Equipment Room houses electronic equipment (PBX, video, computing equipment, etc.) serving building occupants. Many of the TR's installed today can be classed as ER's because they may contain active electronic equipment and need to provide space and

maintain a suitable operating environment for large telecommunications and/or computer equipment.
ER's are different and are generally considered to serve a building, a campus, a tenant, or a service provider (SP), and are connected to backbone pathways that run both within and between buildings.
ER's typically contain active equipment, terminations, interconnections, and cross-connections for telecommunications distribution cables.

LOCATION OF THE ER

Consider the following when choosing a location for the ER,

- Distance from telecommunications cable pathways
- Space required for the equipment.
- Expandability
- Cater for access for large equipment and cables.
- Facilities that serve and are served by the ER.
- Service Provider (SP) equipment requirements.
- Distance from electrical service and mechanical equipment.
- Sources of electromagnetic interference (EMI).

CEILING REQUIREMENTS

The recommended height of the ceiling in an ER is at least 3 m (10 ft). Ceiling protrusions (e.g., sprinkler heads) must be placed to assure a minimum clear height of 2.4 m (8 ft) that is clear of obstructions, to provide space over the equipment frames for cables and suspended cable trays.
Some equipment may require additional ceiling clearance, depending upon the manufacturer's specifications.
The ceiling finish must:
• Minimize dust.
• Be light coloured to enhance the room lighting.

For fewer than 200 work areas, the minimum ER size shall be no less than 14 m_2.

Number of Workstations	Estimated Equipment-Room Floor Space
1 to 100	15 m^2
101 to 400	40 m^2
401 to 800	80 m^2
801 to 1,200	120 m^2

ER shall have access to the main HVAC 24 hours per day, 365 days per year.
• Temperature will be controlled to 18°-24°C (64°-7 5°F).
• Humidity shall be in the range of 30 to 50%. Both humidity and temperature will be measured 1.5m off the floor.

LIGHTING

• Provide a minimum equivalent of 500 lux (50 foot-candles) measured 1 m above finished floors.
• Avoid dimmer switches.
• Coordinate closely with the rack placements.
• Light fixtures mounted min 2.6m above finished floor.
• Emergency lighting is recommended. Place emergency lighting to ensure that the loss of power to normal lights will not hamper an emergency exit from the ER.
• Power for lighting should not come from the power panel inside the ER. At least one light should be on normal power, and one light should be on emergency power, if available.

FIRE SAFETY

Appropriate portable fire extinguishers shall be kept in ER near the entry or exit.

Electrical Power Requirements

Active equipment and systems have strict electrical power requirements. To ensure adequate electrical power closely follow the following:
• Dedicated, non-switched, 3-cable, 240 volt (V) alternating current (ac) duplex electrical outlets for equipment power to prevent interference and accidental power-off for critical equipment.
• Electrical outlets must be on non-switched circuits (electrical outlet power must not be controlled by a wall switch or other device that may lead to inadvertent loss of service).
• Comply with equipment manufacturer's requirements and guidelines.
• Comply with local electrical code requirements.
• Branch circuits for equipment power that are protected and cabled for 20 A (240V) capacity.
• Separate duplex 240 Vac convenience electrical outlets (for tools, field test instruments, located at least 150 mm (6 in) above finished floor and spaced at 1.8 m (6 ft) intervals around perimeter walls.
• Light switch locations should be easily access upon entry.
• Consider providing emergency power to the ER with automatic switchover capability. Consider UPS backup for essential active equipment.
• Distribution panels that serve telecommunications equipment should be separate from those that serve lighting fixtures.
• At least one electrical outlet should be on normal power, and one electrical outlet should be
on emergency power, if available.

Power Conditioning

The sensitivity of telecommunications equipment to electrical power fluctuations is a significant issue in assuring system reliability and longevity. Assess the need for power conditioner before telecommunications equipment is installed. Many UPS devices will provide the required power conditioning.

2.1.10 BACKBONES :

Telephone building distributor (TBD)

It is the link between the Private Block Exchange (PBX) and the telephone network, it permit the allocation of telephone extensions to any floor distributor by the only mean of cross connections.
Telephone lines within building distributor can be either terminated on 8 pairs modules or dedicated RJ45 patch panel (ref. VDIG141501 Schneider-Electric). The TBD is to be located next to the PBX in an area with no electromagnetic disturbances.

Telephone backbones :

As these cables are designed to carry only telephone signals at 64 Kbits cat.3 performance level is sufficient. They will consist of VDIC235212 (Schneider-Electric) Multi-pair cable (128 pairs).
Note : To comply with the principle of standardisation of horizontal links, capillary cables will address the general performance requirements of the cabling system (cat.5^{e} of above).

Data backbones :

Data backbone cat.6A F/FTP :

The cat.6A backbones will compulsory be made of 4 pairs cat.6A cables (ref. VDIC64X218 Schneider-Electric). Multi-pair cables are not to be used.

copper cable colour: should be either green or blue. A white colour is allowed for LSFROH (IEC60332-3C) cable only.

Fiber optic backbone :

Several type of fiber may be used depending on the site specificity :

- For indoor use, the fiber cable will be non-armoured. An anti-rodent protection may be included. It should have a tight buffered structure.
- For outdoor use, the fiber cable will be armoured and provide an anti-rodent protection. It should either have a tight buffered or loose tube structure.

Further fiber optic specificity :

LAN fiber optic cables are multimode 50/125 µm type OM3 or OM 4 in a tight buffer structure, connected to SC, ST or LC connectors. For greater sites, the use of dedicated fiber cables (12 or 24 cores) is advisable (ref. VDIC52412T or VDIC52424T)

2.1.11 CLASSIFICATIONS OF COPPER BY FUNCTIONS

Standard copper LAN cables for your day-to-day installations, based on U/UTP and F/UTP cables, from category 5 to category 6_A. The CL-C cables are reliable and well-known, with good performance.

High-end copper LAN cables for performances from category 6 to category 6_A 500 Mhz. While exceeding international standards by 3 dB minimum on NEXT & RL, the cable should have better resistance to the mechanical constraints.

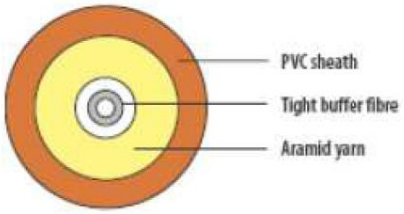
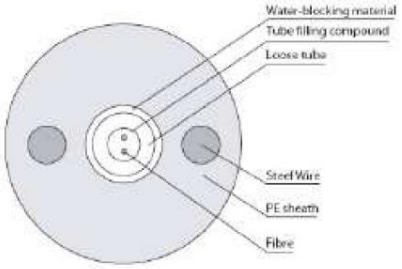
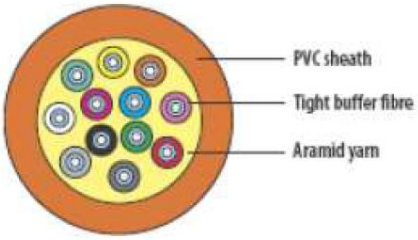
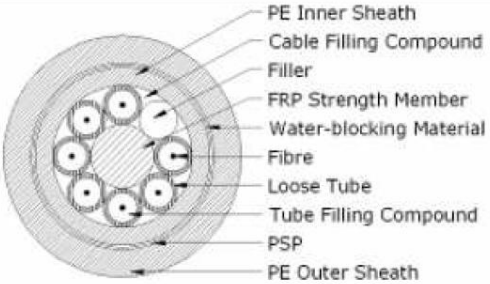
LAN copper cables for category 6_A with a single-foil metallic cross-filler, providing high performance and reliable shielded installations. While exceeding international standards by 3 dB minimum on NEXT & RL, the cable must provide superior shielding, faster installations and increased efficiency.

Also, in order to facilitate cable laying, the cables should be available in dual version. This will allow only one operation to install two cables.

Classifications of fiber by Buffering mechanism.

The two types of buffering mechanisms for optical fiber cable are:
• Tight buffer (inside plant and underground OSP cables).
• Loose buffer (OSP and some inside plant cables).

CHARACTERISTICS	
Tight Buffer	**Loose Buffer (Tube)**
More sensitive than loose-buffered cables to: • Adverse temperatures. • Mechanical stresses.	Can operate in wider range of temperature and mechanical stress.
Increased physical flexibility.	Less flexibility due to higher fiber count.
Smaller bend radius for low fiber count cables.	Bigger bend radius
Distribution design: Single jacket protecting all the tight-buffered optical fibers.	
Breakout design: Individual jacket for each tight-buffered optical fiber.	

TIGHT BUFFER	LOOSE BUFFER(TUBE)
CABLE STRUCTURE 	
CABLE STRUCTURE 	
Constructed of materials that meet building fire code requirements.	Constructed of materials that meet outside plant requirements.
Unfilled	Filled
Used as intra-building backbone.	Have a 900 µm plastic coating applied directly to the fiber.
Used in horizontal distribution.	Used for interbuilding backbone distribution.
Used for making patch cords and equipment cables.	

Certificates

All LAN cables from Category 6 have to be certified at a component level by the independent third-party laboratory Delta. Certificates are regularly updated to be compliant to the latest and highest international standards.

Category 6_A F/UTP 550Mhz cabling :

Horizontal cables will be made of 4 or 2x4 twisted copper pairs cable cat.6_A UTP. The screens will provide a perfect protection against electromagnetical disturbances. They will consist of CL-MNC cable (100 ohms) from Schneider-Electric or equivalent.
These cables will be made of halogen free compound and should offer a shielding made of an Aluminium foil laid longitudinally throughout the cable. The foil (or the foils) should respect the Snail technology features to improve EMC.
A central cross has to be included in the cable. Among other features, this cross has to be asymmetric and should have an integrated pair blocking system (DCBS technology).
The total length of a single link should not exceed 90 meters.
Cable sheath should be blue or green, and the NVP should be printed.
ELFEXT 10dB > 54,8 dB

Category 6_A U/FTP 550Mhz cabling :

Horizontal cables will be made of 4 or 2x4 twisted copper pairs cable cat.6_A FTP. The screens will provide a perfect protection against electromagnetical disturbances. They will consist of CL-MNC cable (100 ohms) from Schneider-Electric or equivalent.
These cables will be made of halogen free compound and should offer a shielding made of an Aluminium foil laid longitudinally throughout the cable. The foil (or the foils) should respect the Snail technology features to improve EMC.
A central cross has to be included in the cable. Among other features, this cross has to be asymmetric and should have an integrated pair blocking system (DCBS technology).
The total length of a single link should not exceed 90 meters.
Cable sheath should be blue, and the NVP should be printed

Category 6_A F/FTP 550Mhz cabling :

Horizontal cables will be made of 4 or 2x4 twisted copper pairs cable cat.6_A FTP. The screens will provide a perfect protection against electromagnetical disturbances. They will consist of CL-MNC cable (100 ohms) from Schneider-Electric or equivalent.

These cables will be made of halogen free compound and should offer a shielding made of an Aluminium foil laid longitudinally throughout the cable. The foil (or the foils) should respect the Snail technology features to improve EMC.
The total length of a single link should not exceed 90 meters.
Cable sheath should be blue, and the NVP should be printed

Category 6_A X/FTP 550Mhz cabling :

Horizontal cables will be made of 4 or 2x4 twisted copper pairs cable cat.6_A FTP. The screens will provide a perfect protection against electro-magnetic disturbances. They will consist of CL-MX cable (100 ohms) from Schneider-Electric or equivalent.
These cables will be made of halogen free compound and should offer a shielding made of an Aluminium foil laid longitudinally throughout the cable. The foil (or the foils) should respect the Snail technology features to improve EMC.
A patented metallic cross-filler for superior EMC and reduced installation time has to be in the structure of the cable
The cable should have superior headroom and bandwidth, exceeding international and local standards.
Improved safety in case of fire
The outer-sheath of the CL-MX should be available in LSFRZH to comply with IEC 60332-1 and 60332-3c standards. This means reduction of the emissions of opaque

smoke and acid gases. Thus helps reducing damages to equipment and allows people to escape from the building more easily.

LSZH

LSZH (Low Smoke Zero Halogen) sheath according to test methods IEC 61034 (smoke density), IEC 60754-1 (gas toxicity), IEC 60754-2 (gas corrosiveness) for Tight buffered and Loose tube cables.

Flame retardant

Flame retardant (self extinguishing) according to IEC 60332-1 for Tight buffered and Loose tube cables.

Fire retardant

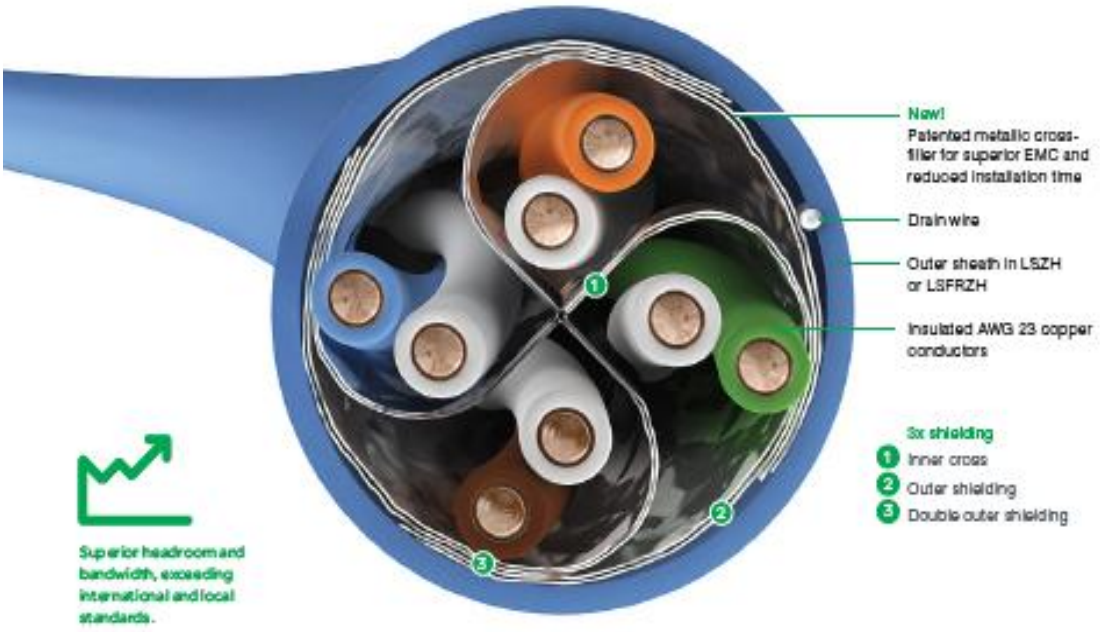
Fire retardant (no fire propagation along the cable) according to IEC 60332-3C for Tight buffered cables.

The CL-MX cable is wrapped in one single foil, this means less cutting and improved quality of cable preparation.

The total length of a single link should not exceed 90 meters.

High-speed transmission protocols beyond 10Gbit/s highlight ANEXT sensitivity and noise immunity as key performance factors for efficient, secure and robust installations. The single-foil structure of the metallic cross filler acts like a triple screen protection around the copper twisted pairs. This specific design enhances EMC performances to reach grade 1 on the transfer impedance parameter, which is better than a shielded design with braid.

Cable sheath should be blue, and the NVP should be printed



Category 7_A F/FTP 1000Mhz cabling :

Horizontal cables will have an overall shield plus an individual shielding on each pair. They will be made of 4 or 2x4 twisted copper pairs cable cat.7A FTP. Screens on each pairs will provide a perfect protection against electromagnetic disturbances. They will consist of CL-MNC cable (100 ohms) from Schneider-Electric or equivalent.
These cables will be made of halogen free compound and should offer a shielding made of an Aluminium foil laid longitudinally throughout the cable. The foil (or the foils) should respect the Snail technology features to improve EMC.
The total length of a single link should not exceed 90 meters.
Cable sheath should be blue, and the NVP should be printed.

Category 7_A S/FTP 1000Mhz cabling :

Horizontal cables will have an overall shield plus an individual shielding on each pair. They will be made of 4 or 2x4 twisted copper pairs cable cat.7_A FTP. Screens on each pairs will provide a perfect protection against electromagnetic disturbances. They will consist of CL-MNC cable (100 ohms) from Schneider-Electric or equivalent.
These cables will be made of halogen free compound and should offer a shielding made of an Aluminium foil laid longitudinally throughout the cable. The foil (or the foils) should respect the Snail technology features to improve EMC.
This design enhances EMC performances to reach grade 1 on the transfer impedance parameter.
The total length of a single link should not exceed 90 meters.

Cable sheath should be blue or white, and the NVP should be printed.
The outer-sheath of the CL-MX should be available in LSFRZH to comply with IEC 60332-1 and 60332-3c standards. This means reduction of the emissions of opaque smoke and acid gases. Thus helps reducing damages to equipment and allows people to escape from the building more easily.

LSZH

LSZH (Low Smoke Zero Halogen) sheath according to test methods IEC 61034 (smoke density), IEC 60754-1 (gas toxicity), IEC 60754-2 (gas corrosiveness) for Tight buffered and Loose tube cables.

Flame retardant

Flame retardant (self extinguishing) according to IEC 60332-1 for Tight buffered and Loose tube cables.

Fire retardant

Fire retardant (no fire propagation along the cable) according to IEC 60332-3C for Tight buffered cables.

2.1.12 CLASSIFICATIONS OF FIBER BY FUNCTIONS

Intra-building Backbone

The Actassi Indoor and Indoor//Outdoor LSZH Cable is a low smoke zero halogen (LSZH) cable that provides excellent anti flame performance. The need for splicing between indoor and outdoor cables can be eliminated. The buffered tubes are surrounded by Aramid yarns and covered by a low smoke, flame-retardant jacket for protection. A direct outdoor to indoor transition can be completed with this single cable.
The Actassi Indoor LSZH Tight buffered Cables pass most of the following tests:
1) IEC 60754 part 3, Acidity/Corrosively based on pH and Conductivity Measurements
2) IEC 60332-3C, Fire Retardant
3) NES 713, Toxicity Index
4) IEC 61034, Smoke Emissions

The Actassi Indoor/Outdoor Loose tube LSZH Cables pass most of the following tests:
1) IEC 60754 part 3, Acidity/Corrosively based on pH and Conductivity Measurements
2) IEC 60332-1, Flame Retardant
3) NES 713, Toxicity Index
4) IEC 61034, Smoke Emissions

I. Eight fiber-type performances:
a. Normal offer: Multimode OM1, OM2, OM3, OM4; Single-mode OS1,OS2 (G.652D).

The Fiber indoor/outdoor must have a green sheath colour.

2.1.13 BACKBONE CABLING – MULTI MODE FIBER

Fiber

All fiber shall be complete with graded index optical fiber waveguide with mode field diameter of 50um ± 0.5um and cladding diameter of 125um ± 2 um;
Optical fiber shall conform to the OM3 standard defined in ISO-11801 2nd Edition, to support 10Gb Ethernet over increased distances;
Optical fiber shall be in compliance with IEC 60793 and TIA/EIA 492 specifications;
Each fiber shall be contained in a colour-coded nylon jacket for easy identification;
The jacket of each fiber shall ensure colour retention, minimize micro-bending losses, improve handling and be mechanically strippable;
The non-circularity of the core and cladding of each fiber shall be less than 6% and 2% respectively;
The core/cladding concentricity error of each fiber shall be less than 3 um;
All fibers shall operate in both 850nm and 1300nm optical windows with maximum attenuation of 3.1dB/km and 1.3dB/km respectively;
All fibers shall have its minimum information transmission capacity for 850nm and 1300nm optical windows as 200 MHz-km and 500 MHz-km respectively;
Each overall cable diameter shall not exceed 16mm;
All fiber cables shall be of a dry and dielectric construction. No gel or metallic content shall be allowed;
The cable shall have water swell able yarn located with the fibers to prevent the migration of water should the sheath material become punctured;
The minimum allowable bending radius of the cable shall be 10D and 20D during and after installation respectively where D stands for the overall cable diameter;
The cable marking shall include traceable part numbers from the manufacturer packaging to assist in quality validation of the installed cable;

Copper

The cable should be a 4 pair or 2x4 pairs categorie 5e , U/UTP.
The screen will be made of aluminium in order to maintain the Electromagnetic Immunity robustness and to meet the quality and performance criteria for high frequencies during all the warranty time of the system.
In case of fire, the sheath of the cable shouldn’t produce toxic fumes (HALOGEN FREE) and flame retardant.

All cables shall be 4-pair unshielded Twisted Pair (UTP) cables meeting or exceeding the quality and performance requirements for Category 6 UTP cables stipulated in EIA/TIA-568-B.2-1 standard. Each Category 6 UTP cable shall be terminated on an 8-conductor Category 6 jack in accordance with the EIA/TIA-568B wiring code;
The cable shall be solid or stranded copper conductors of 23 AWG insulated with high density, PVC or LSZH sheath. **Cross filler with optimized design and micro-blades, is preferred**
The cable shall be accompanied with traceable serial numbers from the manufacturer indicated on the packaging to assist in quality validation of the installed cables;

The cable shall provide the guaranteed channel performance specifications of the Category 6 Channel complies to EIA/TIA-568-B.2-1 standard.
Each pair should have an impedance of 100 Ohms, with+/- 15 Ohms, tolerance.

A valid certificate should be delivered by the manufacturer in order to demonstrate the ISO/IEC 11801: 2002 or au standard TIA/EIA 568 B2-10 standard compliance.

Cords (Copper – Fiber):

All patch cord should be RAL 7035 colour coded, pre-wired and tested in factory. These patch cords have to be delivered with colour clip identifier. The connector of these patch cords have to be snag-free to protect the plug-clip from breakage.
For performance purpose, all the patch cords must comply to :
ISO/IEC 11801 Ed 2.2
DELTA Certified
EN 50173 Ed.3.
EIA/TIA 568-C.2
IEC61935-2
For security purpose, all patch cord must be LSZH compliant

Patch cords or work area cords, category 6A U/UTP 550Mhz:

Cords are to be of the same manufacturer than cables and connectors used in horizontal links to obtain optimal performances and prevent crosstalk incompatibilities in category 6. They will have an individual shield on each pair and have an impedance of 100 Ohms (ref. VDIP181X46020 Schneider-Electric for a 2m length).
Cords must always be as short as possible to ease their management inside cabinets and higher the global performances of the horizontal links.
Cords have to be compliant with : ISO / IEC 11801 Ed 2.2 and third part, updated Delta certified - EN50173ed.3. , EIA/TIA 568 - C.2, IEC 61935-2
Specifications Low Smoke Zero Halogen (LSZH), 4 pairs, 100 ohms, pre-wired and tested in factory, with light grey colour design (RAL7035)
Connectors with grey over-moulding, Snag-free connection to protect the plug-clip from breakage. In order to identify, a pair of COLOR clips Covering either shielded or unshielded will be provided. Each patch cord will be delivered in individual packaging.

Patch cords or work area cords, category 6A S/FTP 550Mhz :

Cords are to be of the same manufacturer than cables and connectors used in horizontal links to obtain optimal performances and prevent crosstalk incompatibilities in category 6. They will have an individual shield on each pair and have an impedance of 100 Ohms (ref. VDIP185X46020 Schneider-Electric for a 2m length).
Cords must always be as short as possible to ease their management inside cabinets and higher the global performances of the horizontal links.

Cords have to be compliant with : ISO / IEC 11801 Ed 2.2 and third part, updated Delta certified - EN50173ed.3. , EIA/TIA 568 - C.2, IEC 61935-2
Specifications Low Smoke Zero Halogen (LSZH), 4 pairs, 100 ohms, pre-wired and tested in factory, with light grey colour design (RAL7035)
Connectors with grey over-moulding, Snag-free connection to protect the plug-clip from breakage. In order to identify, a pair of COLOR clips Covering either shielded or unshielded will be provided. Each patch cord will be delivered in individual packaging.

Fiber optic jumpers :

The connection to opto-electronic equipment or the cross-connection of two fiber optic links is to be done through fiber optic jumpers fitted to each fiber optic connector on both ends.

Geometrical characteristics of fiber optic jumpers are to be the same than fiber optic links cables.

A minimum length of 2m is to be respected in order to cancel the effect of disturbing signal propagation inside the cladding.

They will be from Schneider-Electric brand or equivalent.

OPTICAL FIBER TELECOMMUNICATIONS OUTLET CONNECTOR

For optical fiber cabling, optical fiber connectors and optical fiber adapters are available in many different sizes and shapes.

Performance of Optical fiber type

STANDARD NOTES
• Horizontal optical fibers at the work area outlet shall be terminated to a duplex optical fibers outlet/connector meeting the requirements of ANSI/TIA/EIA-568B.3.
• To facilitate inter-office moves, consider the use of one style of duplex connector for the work area outlet.
• The 568SC connector/adapter has been recognized by industry standards for many years. This connector/adapter type and any additional standards-compliant connector/adapter styles, including the Small Form Factor (SFF) styles (e.g. LC), may also be considered.

OM3 and OM4 have an additional laser launch modal bandwidth as OM3 and OM4 are designed to be laser optimized. The difference between “Overfilled Launch" and “Laser Launch" is the test method. A new test method simulating a VCSEL laser launch (TIA-455-220A and IEC 60793-1-49) was deemed appropriate for these fibers which are intended for use with VCSELs at higher speeds.

Fiber Type	Max. attenuation (db/km)		Min. modal bandwidth (MHz x km)		
			Overfilled launch		*Laser launch*
	850nm	1300nm	850nm	1300nm	850nm
OM1	3,5	1,5	200	500	Not specified
OM2	3,5	1,5	500	500	Not specified
OM3	3,5	1,5	1500	500	2000
OM4	3,5	1,5	3500	500	4700

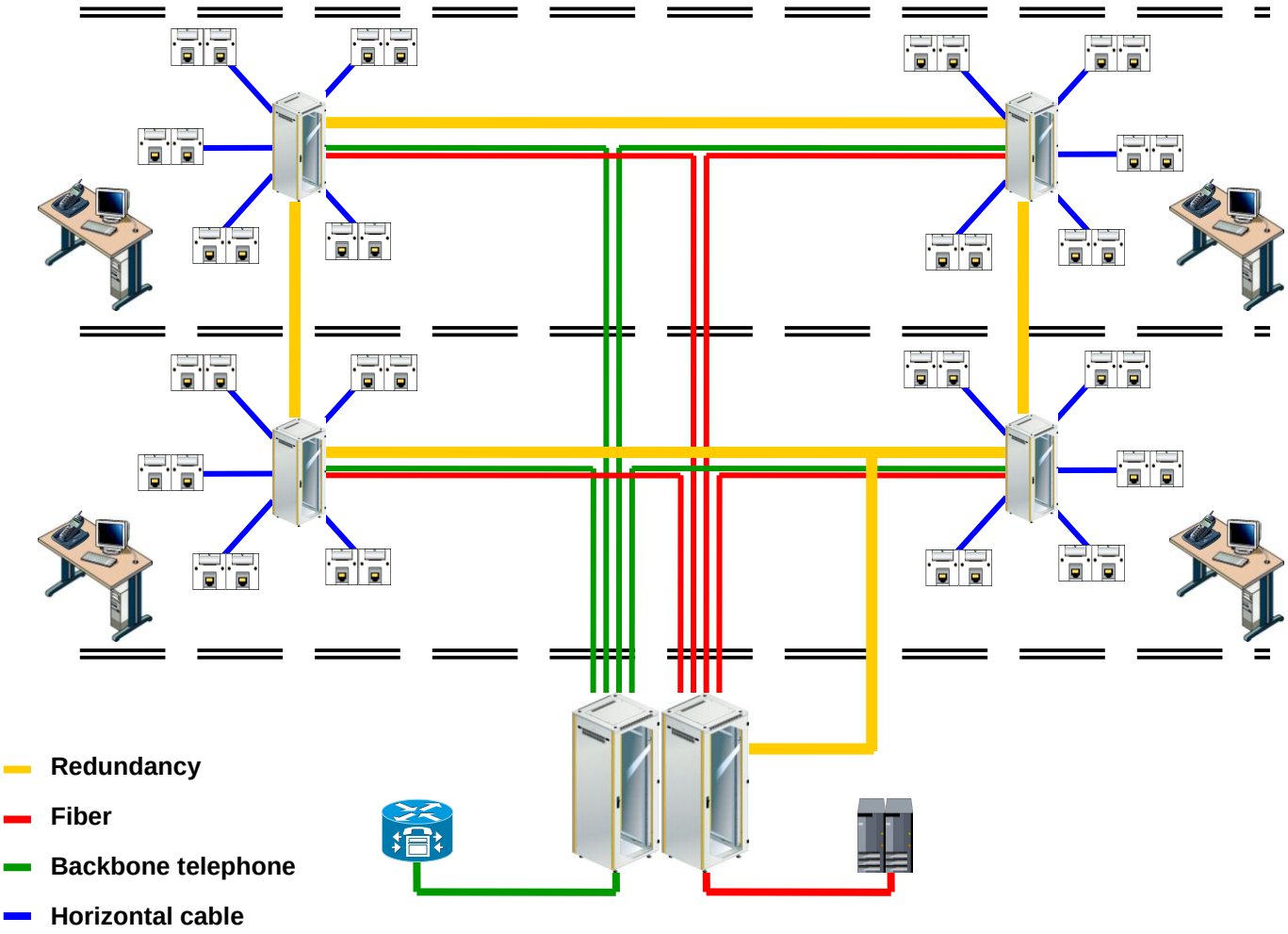
OM4 fiber is a laser-optimized, high bandwidth 50um multimode fiber. Formerly, it was called OM3-550 fiber. TIA approved EIA/TIA 492AAAD (OM4) on August 5, 2009

OM4 fiber is designed to enhance the system cost benefits enabled by 850nm VCSELs for existing 1 Gb/s and 10 Gb/s applications as well as future 40 Gb/s and 100 Gb/s systems.

OM4 fiber supports Ethernet, Fiber Channel, and OIF applications, allowing extended reach upwards of 550 meters at 10 Gb/s for ultra long building backbones and medium length campus backbones.

Star topology network with redundancy links

The basis of a cabling system organisation is shown by the following diagram. It shows a star organisation model of FD around the BD. It is to notice that the redundant backbone links shown are not compulsory but offer a higher security margin against breaks.



Category 6A UTP RJ45 connector :

- ***Terminal outlet :***

All terminal outlets are to be universal.

A workstation will include a minimum of 2 (two) outlets (e.g. one for telephone application, the other one assigned to the data network).

Terminal outlets are to be made of **cat.6A RJ45 8-pin modular jacks**, normalised by ISO 8877 (reference VDIB1772XU12 Schneider-Electric or equivalent).

RJ45 modular jacks are to be mounted on faceplate from the local standards. The faceplate have to be properly equipped to accept screw-on adapters and splitters (i.e. have a build-in nut).
Note : The outer size of the faceplate may be different if the screwing feature described above is respected (e.g. ref. 5034 Schneider-Electric Italian plate).

Bridged taps and splitters shall not be used as part of the backbone cabling. (TIA/EIA-568-B.1)

Category 6A FTP RJ45 connector :

- ***Terminal outlet :***

All terminal outlets are to be universal.

A workstation will include a minimum of 2 (two) outlets (e.g. one for telephone application, the other one assigned to the data network).

Terminal outlets are to be made of **cat.6A RJ45 9-pin modular jacks**, normalised by ISO 8877 (reference VDIB1772XB12 Schneider-Electric or equivalent).

RJ45 modular jacks are to be mounted on faceplate from the local standards. The faceplate have to be properly equipped to accept screw-on adapters and splitters (i.e. have a build-in nut).
Note : The outer size of the faceplate may be different if the screwing feature described above is respected (e.g. ref. 5034 Schneider-Electric Italian plate).

Bridged taps and splitters shall not be used as part of the backbone cabling. (TIA/EIA-568-B.1)

Entrance facility (EF)

The Entrance Facility consists of service entrance to the building including the building wall

penetration and continuing to the ER. The EF may also contain backbone paths to link other buildings as well as antenna entrances.
• All carriers and telecommunications providers involved in providing service shall be contacted to establish their requirements.
• Easements, permits and rights of way may be required.
• A service entrance pathway shall be provided (underground, aerial, buried).
• See standard for specifications defining manholes, penetrations, etc.
• Grounding and bonding to NEC or local code guidelines.

NOTES	DETIALS
Terminating space should be located where the facilities enter the building	• Limit the amount of exposed cable in the building (possibility of fire) to < 15 m (50 ft) of exposed non-fire-rated entrance cable within a building. • If more than 15m of cable is required between the entry point and the termination point, use rigid • Metallic conduit to enclose the cable. • Conduit must be grounded. Fire-rated tape wrap is not acceptable.
Ensure accessibility at all time	• Termination space should never be located within one tenant's space in a multi-dwelling building. • The termination room, telecommunications room, or space in a multi-dwelling building must be accessible through a common corridor or an outside door. • Entry to any locked termination space must be • available through: 1. 1 Maintenance personnel, or 2. 2 A common key provided to each tenant.
Safe and environmentally clean	• Safely accessible. • Free of any storage material or other obstructions. • Standard working height without the need for ladder or scaffold. • Free from moisture and severe temperature conditions.
Properly powered	An individual branch circuit is required for testing and Maintenance.
Lighting	500 lux minimum (50 foot-candles).

Telecommunications rooms :

Dedicated telecommunications room :

A telecommunications room should provide all the facilities (space, power, environmental control etc.) for passive components, active devices (HUB, Switches, routers etc.), and external network interfaces housed within it. Each telecommunications room should have direct access to the backbone cabling subsystem. It has to be of a sufficient surface (6 m² minimum) and secured (intrusion, fire, water flood). The use of raised floor is advisable. It is compulsory cool or ventilate the telecommunications room.
Among a direct access to the backbones, the telecommunications room are to be installed as close as possible to the centre of the served area to shorten the horizontal links lengths (better performances and lower costs).

TR SPECIFICATIONS

a. The telecommunications room must be dedicated to telecommunications functions.
b. Equipment not related to telecommunications shall not be installed in telecommunications
room.
c. Two walls 2.5 meters (8 ft) high covered with 20mm (3/4 inch) A-C void-free plywood
d. Minimum Floor Loading Capacity
• 2.4 kPa (50 lbf/ft2)
d. False ceilings are not permitted

LIGHTING

• Provide a minimum equivalent of 500 lux (50 foot-candles) measured 1 m (3 ft) above finished floors.
• Avoid dimmer switches.
• Coordinate closely with the rack placements.
• Light fixtures mounted min 2.6m (8.5 ft) above finished floor.
• Emergency lighting is recommended. Place emergency lighting to ensure that the loss of power to normal lights will not hamper an emergency exit from the TR.
• Power for lighting should not come from the power panel inside the TR. At least one light should be on normal power, and one light should be on emergency power, if available.

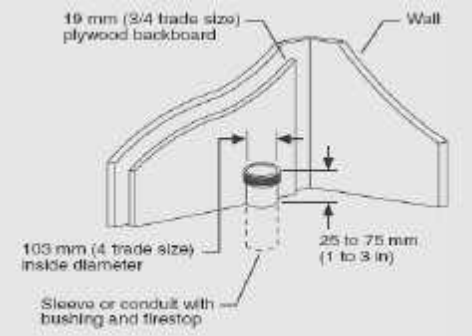
DOORS

• Fully open (180 degrees) lockable doors with minimum door size 0.9 m (36 in) wide by 2m (80 in) high.
• Door sills are not allowed because they impede the movement of equipment.
• Doors that open outward provide additional usable space and reduce constraints on TR layout.
• Door should have a lock.

POWER SUPPLY

• Branch circuits for equipment power that are protected and cabled for 20 Amp capacity (240 volts depending on the local utilities regulation)
• Minimum of two dedicated, non-switched, 3-cable, 240 volts (V) alternating current (ac) duplex electrical outlets for equipment power, each on separate branch circuits.
• Separate duplex 240 Vac convenience electrical outlets (for tools, field test instruments, located at least 150 mm (6 in) above finished floor and spaced at 1.8 m (6 ft) intervals around perimeter walls.
• Light switch locations should be easily access upon entry.
• Electrical outlets must be on non-switched circuits (electrical outlet power must not be controlled by a wall switch or other device that may lead to inadvertent loss of service).
• Consider providing emergency power or UPS backup to the TR with automatic switchover capability, to ensure continuous operation of any active equipment located in the TR.
• Distribution panels that serve telecommunications equipment should be separate from those that serve lighting fixtures.

• At least one electrical outlet should be on normal power, and one electrical outlet should be
on emergency power, if available.
• Sleeves or slots should be located adjacent to door and fire stopped except during cable installation.



Flood Prevention

Do not locate TRs in areas prone to flooding. Avoid locations that are below or adjacent to areas of potential water hazard (e.g., areas below water table, restrooms and kitchens).

Cross-Connect Field Identification

Well-organized colour coding helps to identify backbone and horizontal cables quickly and helps ensure that cable topology requirements are met. Accepted methods for colour coding cross-connect fields include coloured backboards, connections, covers or labels. The following is per ANSI/TIA/EIA 606A recommendations:

Color	Identification
Orange	Demarcation point (e.g., central office connections).
Green	Network connections (e.g., network and auxiliary equipment).
Purple	Common equipment (e.g., connections to private branch exchange [PBX], Local Area Networks [LANs], mainframe computer, multiplexer).
White	First-level backbone (e.g., termination of building backbone cable connecting MC [CD] to ICs [BDs]).
Gray	Second-level backbone (e.g., termination of building backbone cable connecting ICs [BDs] to HCs [FDs]).
Blue	Horizontal cable (e.g., horizontal connections to telecommunications outlet/ connectors).
Brown	Interbuilding backbone (campus cable terminations). NOTE: Brown takes precedence over white or gray for interbuilding runs.
Yellow	Miscellaneous (e.g., auxiliary, alarms, security).
Red	Reserved for future use (also, key telephone systems).

Clearances

• Minimum m (3 ft) of clear working space from equipment and cross-connect fields.
• 150 mm (6 in) depth off wall for wall-mounted equipment.
• Allocate a space of at least 1000 mm wide, 1000 mm deep, and 2.3 m high for each

equipment rack or cabinet.
• Provide space for an aisle of at least 1000 mm wide in the front and in the rear of the space allocated for each equipment rack or cabinet.

PATCH PANELS

Category 6A patch panels :

Empty or equipped sliding panel 1U 24 port RJ45
The patch panel will have 24 RJ45 port with a QUICKFIX function on both sides to allow a simple, quick fixing position and sliding feature. Automatic earthing for STP version will be done.
The patch panel will have individual cable management at the back and also rear position numbers to keep track on the installation. Labelling has to be integrated on each side of the QUICKFIX system.

Patch panels will be pre-equipped with RJ45 cat.6_A shielded (ref. VDIG118241BX0 ACTASSI S-ONE with a 360° shielding), or RJ45 cat.6_A unshielded (ref. VDIG118241UX0 Schneider-Electric).

One patch cord guiding panel (ref. VDIG188141 Schneider-Electric) is to be forecasted each 24 ports.

Alternatively vertical patch cord routing rings (ref. VDIM189111 FOR 600X600 or VDIM189112 for 800X800 Schneider-Electric) will be placed on the 19" uprights at each side of the cabinet (4 rings per uprights is to be forecasted).

The active equipment to be housed in cabinet will be subjected to independent technical specifications proposal.

Shielded panels should include shutters removable from the panel for dust proof. Optional coloured shutters should be supported to increase port identification.

The preferred colour of the patch panel is RAL 7016 (dark grey) in order to be homogeneous with all the RACK and other patch panels.

telecom panels

The sliding function does permit the use of the punch down tool for LSA contacts with the panel in a sliding-out position. The telecom panel must have a cable identification to avoid the need trying to figure out which cable goes where. The cable identification is very clear on the clever fixing guides. Out of this identification a clear marking with pre-printed labels and openable label holders will be part of the patch panel.
Finally, the panel has to have two earthing connection points for both shielded cables and for the rack, easily accessible at the rear.

Sliding Fiber optic panel 1U:

They will have a capacity of 4 positions equipped with 3 blank plates. Each plates will have 3 SC/ST/LC or 6 ST SIMPLEX/LC DUPLEX.
The fiber patch panel will have a 0U cable management at the front with integrated clear marking number in order to identify the cables. At the rear of the sliding fiber panel, a rear quick fixation to use with a cable gland provide with the panel.
The patch panel has to be equipped with a transparent cover protection at the front, and on the top of the panel. Finally, the panel will have one or two coiling wheels to avoid tension on the connectors, and to respect the fiber bend radius. Labelling has to be integrated on each side of the QUICKFIX system.

The preferred colour of the patch panel is RAL 7016 (dark grey) in order to be homogeneous with all the RACK and other patch panels.

Cable management:

Patchcord guiding panel :

In between each patch panel a patch cord guiding panel should be inserted. This patch cord guiding panel should have 1 U height and be fixed with ONLY 2 screws. This guiding panel must have 4 OPENABLE rings for ease of use, and as they have OPENABLE, they also have to be able to be CLOSED.

Each of these 4 rings should be removable for maintenance purpose.

Vertical rings :

In order to organise in a proper way the cabling in a rack, we recommend to use openable vertical rings. For rack 800x800mm a large capacity of up to 48 cords is recommended.
In a rack of 600X600mm a VELCRO openable vertical ring is best suitable.

Cable ties to bundle the cable are forbidden. Velcro should be used instead.

Telephone backbone wiring

Multipair backbones cables coming from the Telephone Building Distributor will either be terminated on 8-pairs modules or dedicated patch panels offering 50 RJ45 cat.3 ports on 1U (ref. VDIP141501 Schneider-Electric).
50 ports in 2 rows RJ45 patch panels will be given priority as it suits the universality feature of a cabling system. Cable organizer and label holders is mandatory.
A cross connection from the telephone backbone to the horizontal cables will allocate an extension number to the chosen telecommunication outlet.

A quickfix function on both sides to allow simple fixing and sliding feature.

3.1 CAT6 CABLING INFRASTRUCTURE

Telecommunication Outlet

All the wiring devices should be taken in the same range as infrastructure cabling system, no Mather which installation method is chosen, the wiring devices will be compliant to IEC 60364 / and HD384 series international standards.
The protection level following the IEC 60529 or l'EN 60529, should be minimum : IP 20
The shock resistance following the IEC 62262 or l'EN 62262 should be IK 02.
The wiring device should never exceed the local standard (ie : 45mm in France, Belgium)
The wiring device will be compatible with every outlet without any adaptor or dismantling.
The wiring device should be mounted next to each other without any space in between.
Every wiring device must have a clipsing mechanism without any tool. All telecommunication outlet must be trivialized.
A minimum of 2 outlets per work area is recommend in case of use of IP-TELEPHONY. Otherwise a complementary outlet should be considered.
The telecommunication outlets including or not 1 or 2 RJ45 will be ISO 8877 compliant, defined by ISO IS11801, and TIA/EIA 568 TSB40, which description is done in (29.1.2 RJ45 Connector)

RJ45 Connector

All the range of connectors have to be compliant with all the last international standards. A valid certificate must be provided by third party laboratory (type :DELTA).

Each connector of the family is available in UTP or STP one piece device compact and simple locking termination without any loose part, to avoid the installer to lose pieces , and to make it easier to handle.

The connector has to be tooless, U-Shaped cable entry, with a smart bridle with elastomer insert for cable. Easy access for all cables. Automatic 360° earthing with spring-loaded locking and earthing bridle.

The STP connector must have integrated earth-drain contact for the drain wire connection, and double earthing for the STP version at the front.
The U shape entry is the same concept, S/FTP or F/FTP cables to enable them to keep their structure intact (screens and foils are not damaged) transmission performance is safe. No risk to tear and roll up the screen.

The connector must have at least a 750 connection/disconnection. It has to be manufactured in EUROPE.

Figure 3 : U-shaped cable entry

SMART BRIDLE

The U-shaped cable entry should be considered for reducing risk of damaging connections. For the S/FTP et F/FTP (easy access for all cable)

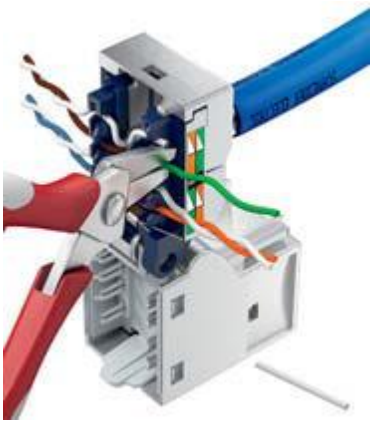


Figure 4 : Protected IDC contacts

DONE

Insulated plastic IDC housing eliminates short-circuit between conductors and metal body.
The crossing of pairs is implemented before the cable's introduction into the connector for easy, secured and efficient wiring. The pair foil can be as near as possible to the IDC.

The earth drain wire is inserted in an horizontal groove with entire security and is terminated vertically down on the side of the connector. Secured integrated guiding parts to enable reproductive position.

The connector has to be labelled on each side the colour coding from the standard EIA 568 A & B.
The connector has to be smooth design with rounded edges, and touch –friendly materials to avoid injuries.

The connector has to be able to Re-open in two clicks, and audible in opening and closing.

Performances :

The level of performance has been certified by an independent laboratory Delta with the EIA/TIA and ISO 11801:2011 Ed2.2 Class E permanent link and channel. All the parameters required have been surpassed by far during the test.

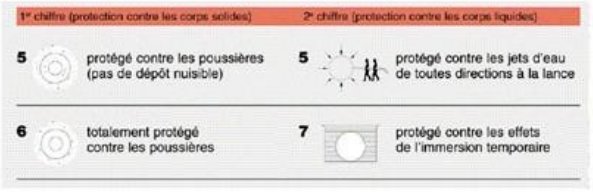
The test method « Direct Probing » will warranty the interoperability of the connector at 500Mhz, and met the requirement of the international IEC60512-99-001 ed 1 POEP standard.

RJ45 WATERPROOF

The RJ Protek faceplate are specially design for industrial or laboraty environment, surgery rooms where chemical, dust, humidity constraints are usual).

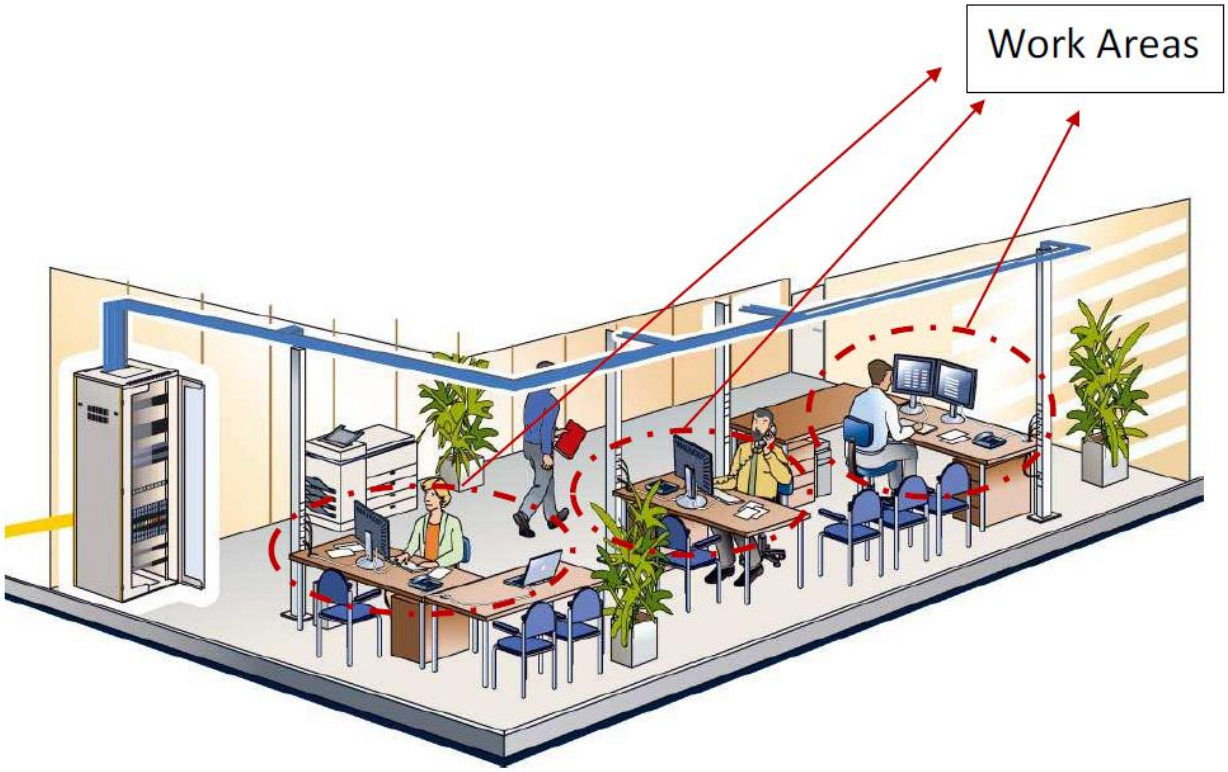
For Heavy steel industry vibration plants this RJ45 has improved resistance against unplanned disconnexion due to high vibrations.

The Waterproof of the RJ45 is secured by the turn&lock, and this gives a IP55 in surface mount and up to IP67 in flush mount.



3.1.1 WORK AREA

In this chapter, we shall learn about cabling components located in work areas, with references to the second edition of ISO/IEC 11801 Ed.2:2002 (equivalent to AS/NZS 3080 for Australia and New Zealand) and the ANSI/TIA/EIA-568-B series of standards.



Design considerations

Guidelines for planning the location of telecommunications outlet boxes in the Work Area:

1. Each work area shall have a minimum of ONE telecommunications outlet box location. TWO telecommunications outlet box locations should be provided and located for future additional telecommunications outlets.

2. Work area telecommunications outlet box size.

ANSI/TIA/EIA-569-B, specifies the *following*:

3. Telecommunications outlet boxes may require supports for attaching the box and a suitable faceplate to support the telecommunications outlet/connectors that are housed by the work area telecommunications outlet box.

• Outlet boxes shall be no smaller than

Width: W	Height: H	Depth: D
50 mm, (2 in)	75 mm (3 in)	64 mm (2 1/2 in)

The work area telecommunications outlet box should be located near an electrical outlet (e.g., within 1 m [3 ft]) and installed at the same height if appropriate.

5. Floor-mounted telecommunications outlet boxes and monuments (pedestals), and the cables extending from them, can present a tripping hazard. The location of these telecommunications outlet boxes should be coordinated with furniture to minimize such hazards.
6. Cabling system performance may be sensitive to the arrangement and organization of cable slack located behind the telecommunications outlet/connector. Sufficient space must be provided in the telecommunications outlet box or equivalent space so that minimum cable bend radius requirements are not exceeded.
7. The location, mounting, or strain relief of the telecommunications outlet/connector should allow pathway covers and trim to be removed without disturbing the cable termination. Care should be exercised to ensure that telecommunications outlet/ connectors are mounted in such a way that they do not significantly reduce the required pathway cabling capacity.
8. Open office furniture openings provide for mounting faceplates containing one or more telecommunications outlet/connectors. Two standard sizes of openings are specified:

Work area subsystem

The work area refers to spaces where occupants normally work and interact with their telecommunications equipment. The work area subsystem refers to the components that extend from the telecommunications outlet/connector at the end of the horizontal cabling system to the work station equipment. This equipment requires a patch cord plugged into the telecommunications outlet/connector.

All four pairs in the cable shall be terminated in an 8-position modular outlet/connector at the work area. These connectors may be x/xTP, as described in the above section.

Two wiring schemes are specified in the ANSI/TIA/EIA 568-B.1 Clause 6.2.1. The pin/pair assignments for T568A and T568B are shown in Figure 1.19b depicting the front view of each telecommunications outlet/connector.
T568A is the preferred wiring scheme, and T568B optional if necessary to accommodate certain pre-existing 8-pin cabling systems.

When selecting a connector, make sure it is specified and tested to meet ANSI/TIA/EIA-568-B.2.
Connecting hardware should be marked to designate transmission performance at the discretion of the manufacturer or approval agency. The markings, if any, shall be visible during installation. It is suggested that such markings consist of:

Category 6 components: “Cat 6”

Work area cables

Work area cables (known also as “Patch cords”, “equipment cords” or “station cords”) extend from the TO or MUTOA to the work area equipment. To assure adequate flex-

life, cables used for UTP patch cords shall have stranded/solid conductors. Depending on the application, a cord with identical connectors on both ends is commonly used.
Note that a maximum length of 5 m (16 ft) of work area cord is allowed for the horizontal link.
Patch cords used in the work area shall meet or exceed the performance requirements in ANSI/TIA/EIA-568-B.2 and ANSI/TIA/EIA-568-B.3.
When application specific adaptors (eg. Baluns) are needed at the work area, they shall be external to the telecommunications outlet/connector (EIA/TIA 568-B.1 clause 4.2).
Due to insertion lost and impedance mismatch, work area cabling often becomes the bottleneck or the “weakest link” in the channel. The transmission performance of the entire channel will be reduced to that of the work area cable. ANSI TIA/EIA 568-B recommends the use of factory assembled work area cables.
Work area cables and other equipment cables connecting to the horizontal cabling shall meet or exceed the performance requirements described in ANSI/TIA/EIA568-B and ISO/IEC 11801 Ed.2:2002 cabling standards.

3.1.2 CONSOLIDATION POINT

One consolidation point is permitted between a FD and any TO.
The installation of a consolidation point in the horizontal cabling between the floor distributor and the telecommunication outlet may be useful in an open office environment where the flexibility of relocating TOs in the work area is required.
The consolidation point shall only contain passive connecting hardware and shall not be used for cross-connections. In addition, where a consolidation point is used :

f) the consolidation point shall be located so that each work area group is served by at least one consolidation point;
g) the consolidation point should be limited to serving a maximum of twelve work areas ;
h) a consolidation point should be located in accessible locations ;
i) the consolidation point should be located so that there is at least 15m from it to the floor distributor ;
j) CP cables are to be of the same type than capillary cable and are to be equipped with RJ45 plugs recommended by the manufacturer.

• Category 6 , (see 3.3 Chapter)
• Optical fiber ……..(see 3.3 Chapter)

When using adapters (e.g., installing a balun), the adaptors must be external to the telecommunications outlet/connector or MUTOA. For further information, see Cabling Adapters in CORE-2: Horizontal Distribution Systems. The cabling infrastructure designer needs to be aware that these work area equipment-specific adaptors may or may not offer the same level of transmission performance as the cabling systems to which they connect.

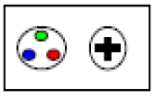
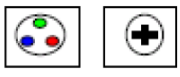
• Active adapters (e.g. Fiber Optic transceivers) that may be needed when connecting devices that use different signalling schemes.

• A special cable or adapter is required when the equipment connector is different from the telecommunications outlet/connector.

The maximum horizontal cable length of 90 m (295 ft) is based on a maximum length of 5 m (16 ft) of work area cable. The combined length of equipment cables, work area cords, and patch cords in the telecommunications room (TR) or equipment room (ER) shall not exceed 10 m (33 ft), with the exception of MUTOA where longer work area cables are used. In the case of MUTOA's, the horizontal cable length is reduced when the work area cords exceed 5m.

3.1.3 OPEN OFFICE CABLING

Modern offices today adopt flexible layouts for supporting collaborative work by small teams. From time to time, changes in individual work or group work results in re-arrangements to office settings in which much of the available work area space is divided by modular furniture and partitions rather than by fixed walls.
To accommodate such changes without disturbing horizontal cable runs, EIA/TIA 568-B recommends that these partitions and furniture typically provide for the use of:
• Multi-user telecommunications outlet assembly (MUTOA).
• Consolidation point (CP).
• Cable pathways.
• Telecommunications outlet/connector.
Each of these open office distribution system components will be covered in some detail throughout this chapter.

Minimum Distance between Data Cabling and Power Lines of up to 5 kVA Power Lines		**UTP**	**FTP**
Unshielded Power Lines with No Separation from Data Cable		127 mm (5.08")	50 mm (2")
Unshielded power Lines Separated from Data Cable with Grounded Metallic Elements		64 mm (2.56")	30 mm (1.2")
Power Lines and Data Cables Enclosed in Separate Grounded Metallic Conduits		0mm	0mm

Bending Radius and Max. Pulling Force for various cables:

TYPE Of CABLE	BENDING RADIUS (mm)	MAX PULLING FORCE (N)
2 core Fiber Zip Cord	35	100
8/12/24/36-core indoor Fiber	30	500
8/12 Loose Fiber	225	1250
8/12/24/36-core Armoured Loose Tube Fiber	225	2500
4-pair UTP (Cat5e/Cat6)	4 X OD	100
4-pair FTP (Cat5e/Cat6)	8 X OD	200
4 pair UTP (Cat6A)	4 X OD	110

Cable Pulling

The maximum pulling tension for a 4-pair balanced twisted pair cable must not exceed 25 lbf (110N). Exceeding this tension will result in transmission degradation and may affect the system's ability to pass certification testing.

		5e	6	$6A_1$
Average OD		.185"	.230"	.330"
Cable Tray*	2" x 6"	111	72	35
	4" x 8"	298	192	93
	6" x 20"	1116	722	350
Conduit**	3/4	6	5	1
	1	11	8	4
	1 1/4	19	14	6
	1 1/2	25	19	9

Typical tray and conduit capacity (number of cables)

Conduit Fill

A maximum conduit fill ratio of 40% is recommended by TIA-569 standards to accommodate cable bundle bend radius requirements and allow for future expansion.

Cable Tray Fill

TIA-569 recommends 25% fill at initial installation and up to 50% with unplanned additions. If a single cable tray will also carry power cables, a physical barrier is required to comply with the NEC. Finally, ensure tray support spacing is sufficient to prevent excessive sagging. Consider solid bottom tray for higher density applications.

Cable Tray Sizing

Step	Instructions	Example
1	Determine cable diameter and total number of cables	.30" diameter each, 100 cables total
2	Square the cable diameter	.30 x .30 = .09
3	Multiply result by number of cables	.09 x 100 = 9
4	Multiply result by .785 to factor for cable roundness (This result is the total cross-sectional area of your cables)	9 x .785 = 7.065 sq in
5	Multiply result by 4 to obtain pathway size at 25% fill	7.065 x 4 = 28.26 sq in

Consolidation Points & Zone Enclosures

TIA standards allow an optional consolidation point (CP) within a permanent link. Consolidation points may be mounted into a zone enclosure, which are available in several styles:

- Ceiling- or floor-mount
- Plenum-rated
- Active or passive equipment rated

Zone enclosures also accept patch panels and/or active equipment, and are then considered telecom enclosures (TEs).

STRAIN RELIEF

Cables shall be free of physical stress over the entire length of the run. Use of cable supports, Velcro ties are recommended for strain relieving. Do not over tighten straps or tie-wraps to avoid damage to the cable.
Velcro ties shall always be used for bundling cables properly in channels and raceways.
Cables distributed to the same work area zone may be bundled together.
The maximum number of cables per bundle shall not exceed 50 cables.

DEFINITIONS

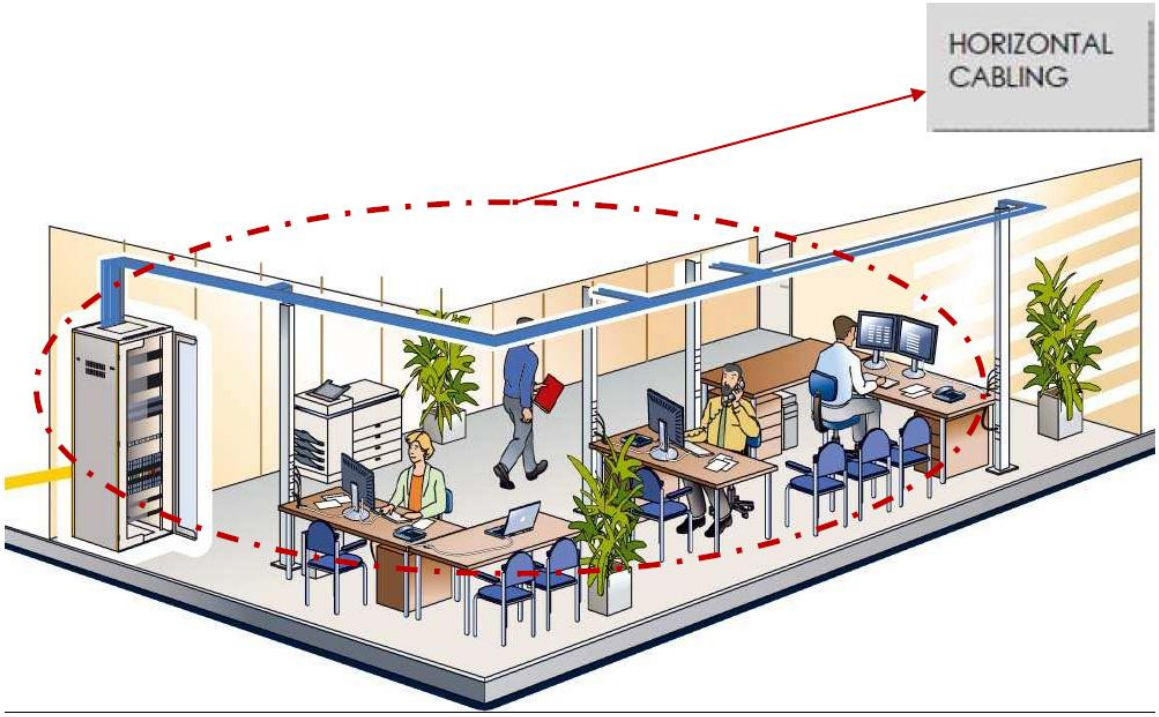
CP: Consolidation Point - a location for the interconnection between horizontal cables that extend from building pathways and horizontal cables that extend into work areas.
MUTOA: Multi-user Telecommunications Outlet Assembly - a grouping in one housing of several telecommunications outlets/connectors.
Open Office - a floor space division provided by furniture, movable partitions, or other means, instead of building walls.

3.1.4 HORIZONTAL CABLING SYSTEM

The specifications in this section make specific reference to the horizontal cabling requirements stated in ANSI/TIA/EIA-568-B.l, Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements.
The internationally recognized standard for premises cabling is ISO/IEC 11801 Ed.2:2002.
In this section, the Students will learn
1) The definition and Scope of the Horizontal Cabling System.
2) Primary design objective of the Horizontal Cabling Design.
3) Key Design Considerations of the Horizontal Cabling System.

Definition and Scope of the Horizontal Cabling System

The horizontal cabling is the portion of the telecommunications cabling system that extends from the work area telecommunications outlet/connector to the horizontal cross-connect in the telecommunication's closet. It includes
a) Horizontal cables;
b) Telecommunications outlet/connector in the work area,
c) The mechanical terminations,
d) Patch cords or jumpers located in the telecommunications closet and
e) May include multi-user telecommunications outlet assemblies (MUTOA's) and consolidation points (CP's).



Design goals

A good cabling plant design always considers possible changes in user requirements in the future. The horizontal cabling is often very inaccessible after the building is completed and can incur high cost of changes and result in disruption to occupants and their work.

Electromagnetic Interference (EMI)

Sources of EMI should be considered when selecting types of horizontal cabling and designing the layout of horizontal pathways.

Potential sources of EMI include:
• Electric motors and transformers that reside in close proximity to telecommunications cabling.
• Copiers that share space with telecommunications cables and equipment.
• Electrical power cables that support such equipment.

Avoiding EMI

1. Maintain physical separation between possible sources and the telecommunications cabling.

Types of Power Line/Equipment	<2 kVA	2 to 5 kVA	> 5 kVA
Unshielded	127mm	305mm	610mm
Unshielded with cable enclosed in a grounded metallic conduit	64mm	152mm	305mm
Lead sheathed power lines with cable enclosed in a separate grounded metallic conduit.	38mm	76mm	152mm

1. Optical fiber and shielded cable should be used for buildings with high levels of ambient EMI.
2. Balanced twisted-pair cabling, such as Category 5e or better (Category 6 recommended), can offer a certain degree of noise immunity that ensures reliable transmission in most environments (e.g., electrical field intensity less than 3 volts per meter [V/m]).

Grounding and Bonding Considerations

For FTP or STP cable used in the horizontal cabling system, Schneider-Electric recommends that the telecommunications grounding/bonding installation shall conform with ANSI J-STD-607-A and ANSI/TIA/EIA-568-B.1-2, Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements, Addendum 2, Grounding and Bonding Specifications for Screened Horizontal Cabling.
Note: ANSI/TIA/EIA-607-A: Commercial Building Grounding and Bonding Requirements for Telecommunications are
superseded by J-STD-607-A.

In General, the following guidelines shall be followed,
a) An approved ground shall be made available at the TC for
– Patch Panel frames.
– Equipment Racks and Cabinets.
– All Active Equipment.

b) The shield of FTP cables shall be bonded through a conducting path to the telecommunications grounding bus-bar (TGB) in the telecommunications room.
c) Shielded connections at the work area are accomplished through a FTP patch cord.
d) Grounding at the work area is usually accomplished through the equipment power connection.
e) At the work area end of the horizontal cabling, the voltage measured between the shield and the ground wire of the electrical outlet used to supply power to the work station shall not exceed Vrms.
f) All patch panel and RJ45 connector have to be direct earthing.

Administration

Schneider Electric Network Connectivity requires proper and systematic methods and procedures for labelling and management of horizontal cabling. The guidelines and requirements for the administration of horizontal cabling systems comply to and make references to ANSI/TIE/EIA-606-A.
1) All cabling must be identified at both ends of the run.
2) Markings on the cable must be:
a) Clearly visible after installation.
b) Easily distinguishable from any manufacturers marking on the cable.
c) Can last the full duration of the warranty

Standard Horizontal Cabling Configuration

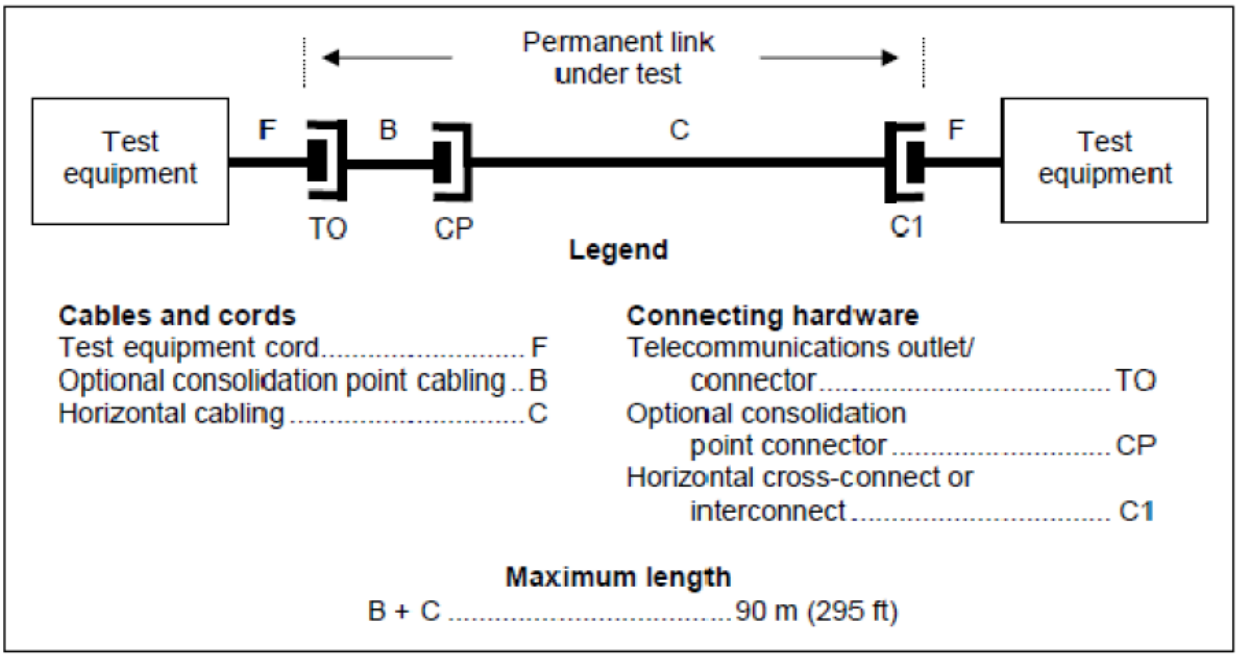


Figure 1.8a: Permanent Link
(Extract from ANSI/EIA/TIA 568-B.2-10)

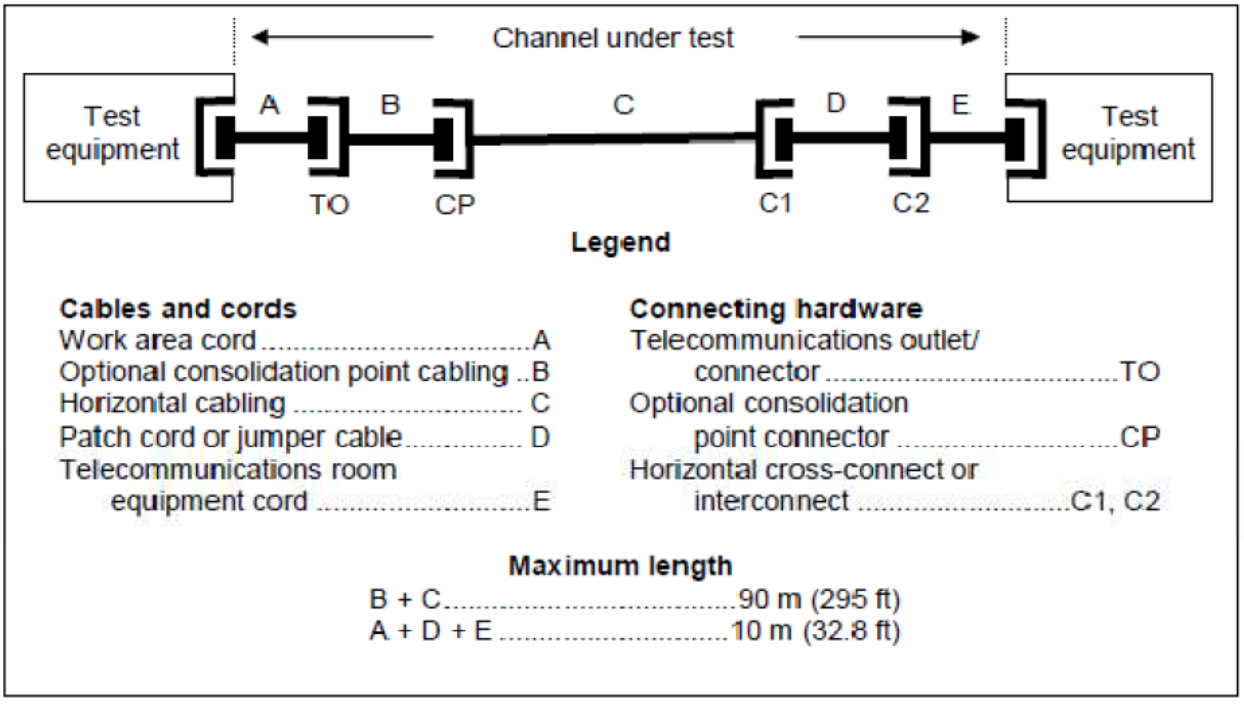


Figure 1.8b: Channel
(Extract from ANSI/EIA/TIA 568-B.2-10)

Connection Schemes

For horizontal cabling, there are 2 recognized schemes for making connections:
1. Cross-connection — A connection scheme that uses patch cords or jumpers that attach to connecting hardware on each end.
2. Interconnection — A connection scheme that facilitates the direct connection of individual cables to another cable or to equipment without a patch cord. The two connection schemes are as follows:

Recognised horizontal cable types

For the link and channel configuration, the recognized horizontal cable type varies depending on standards. The following table summarizes the difference between the various standards.

Horizontal Cable Types	ANSI/TIA/EIA-568-B	ISO/IEC 11801 Ed.2:2002	CENELEC EN 50173 .1:2002
COPPER	100 ohm	100 ohm Class D, E, E_A, F	100 ohm Class D, E, E_A, F
FIBER	50 or 62.5 µm MM Optical Fiber 8 -10 µm SM Optical Fiber	50 or 62.5 µm MM Optical Fiber OM1, OM2, OM3, SM fiber OS1	50 or 62.5 µm MM Optical Fiber OM1, OM2, OM3 SM fiber, OS1

- OM1 62,5µm is not anymore used on the market.

Copper performance categories

There are several performance categories for 100 ohm balanced twisted-pair cable and connecting hardware categories specified in the ANSI/TIA/EIA-568-B series and addenda or ISO/I EC 11801 Ed.2:2002.
The connecting hardware and patch cords used for a horizontal run must be rated in the same category as the cable, or higher. The various category definitions are found in the following table:

Category	Definition
Category 3	Cables and connecting hardware are specified up to 16Mhz Cat3 performance correspond to application CLASS C as specified in ISO/IEC 11801 Ed2:2002
Category 5e	Cables and connecting hardware are specified up to 100Mhz Cat5e performance correspond to application CLASS D as specified in ISO/IEC 11801 Ed2:2002 and ANSI/TIA/EIA-568-B series
Category 6	Cables and connecting hardware are specified up to 250Mhz Cat6 performance correspond to application CLASS E as specified in ISO/IEC 11801 Ed2:2002 and CENELEC EN50173-1
Category 6_A	Cables and connecting hardware are specified up to 500Mhz $Cat6_A$ performance correspond to application CLASS E_A as specified in

	ISO/IEC 11801 Ed2:2002 and CENELEC EN50173-1:Ed2/A1
Category 7	Cables and connecting hardware are specified up to 600Mhz Cat7 performance correspond to application CLASS F as specified in ISO/IEC 11801 Ed2:2002 and CENELEC EN50173-1
Category 7_A	Cables and connecting hardware are specified up to 1000Mhz $Cat7_A$ performance correspond to application CLASS F_A as specified in ISO/IEC 11801 Ed2:2002 and CENELEC EN50173-1 Am2

NOTE: Categories 2, 4, and 5 cables are not recognized

Category Mixture

Multiple-category balanced twisted-pair system can be confusing and costly to maintain. Schneider Electric endorses the use of single category of cabling components, selected for use in a cabling system. Schneider Electric system warranty does not recognize the use of mix and match categories in a installed cabling system.

Crossovers/Polarity

When there is a need to connect a transmitter on one end and a receiver on the other, a cross over cable is required of the copper pair or fiber cores.

Copper

– If crossover cables are required for copper based cable application, they may be used only outside of the horizontal cabling system. Active equipment will provide the right polarity if need (MDI/MDI-X).

Optical Fiber

– The optical fiber cabling link shall be installed in a pair-wise crossover orientation in which the optical fibers of a pair identified as Position A and Position B at one end are reversed and identified as Position B and Position A (respectively) at the other end.

– This pair-wise crossover for optical fibers is achieved by using connector polarity and labelling methodologies that apply to horizontal cables, patch cords, equipment cords, and duplex optical fiber adapters.

Horizontal Connecting Hardware

General

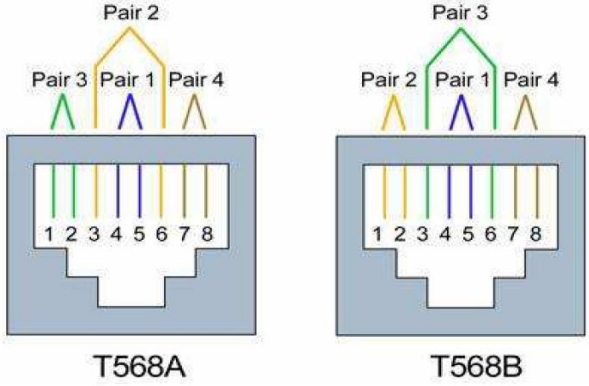
Connecting hardware for horizontal cabling includes:

• Telecommunications outlet/connectors.
• Connectors used in the HCs (FDs).
• CP connectors (optional).

All connecting hardware used for horizontal cable connections must meet the requirements for reliability, safety, and transmission performance specified in the:

• ANSI/TIA/EIA-568-B series or ISO/I EC 11801 Ed.2:2002.
• NEC in the United States.

Figure 1.19b: Eight-position jack pin/pair assignments (front view of connectors)



NOTE: The colours indicated are associated with horizontal balanced twisted-pair cable. Colour coding for equipment cables, work area cords, patch cords, and jumpers may vary.

Centralized Fiber Cabling

Centralized optical fiber cabling is designed to support centralized communications equipment.

Centralized cabling connects the work areas to the centralized cross-connect by allowing the use of interconnect, pull-through cables, or a splice in the TR.

Length limitation

1) The installation length limit of 300m applies to the interconnection and splice methods. It is based on the combined length of horizontal cable, backbone cable, equipment cables, cross-connections, and patch cords.

Within the 300 m limit, multimode cabling system will support gigabit services using centralized networking devices with appropriate optical fiber cable.

2) The cabling length limitation of 90m is associated with the pull-through method. It is based on the length of horizontal cable from the MC (CD) to the TO/WA.

The total allowable length of additional equipment cables at the MC (CD) and equipment cables in the work area is 10m with the pull-through method.

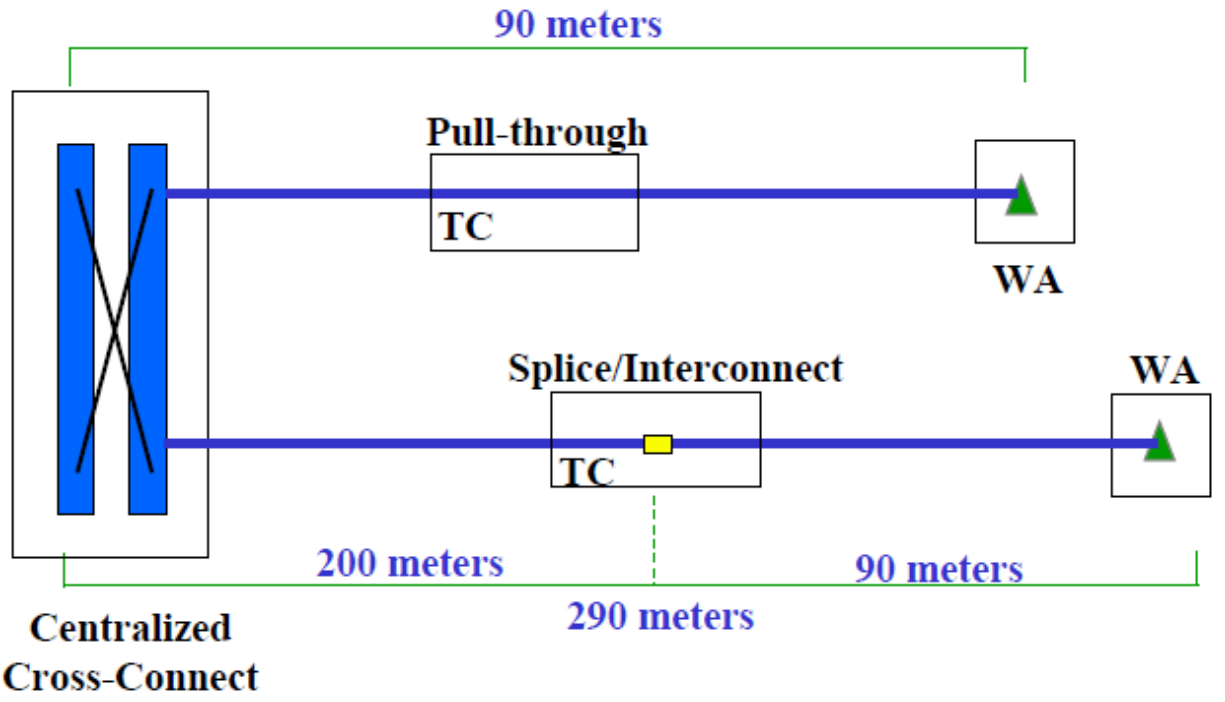


Figure 1.6.1a: Example of centralized optical fiber cabling.

3.1.5 FLOOR DISTRIBUTOR (FD)

They are used to connect between the horizontal cable and other cabling subsystems or equipment. A minimum of one floor distributor should be provided for every floor ; for floor spaces exceeding 1 000 m², a minimum of one floor distributor should be provided for every 1 000 m² of floor space reserved for offices. If a floor space is sparsely populated (for example a lobby), it is permissible to serve this floor from the floor distributor located on an adjacent floor.

A floor distributor combines :
• Identification and management of the horizontal links (through a clear labelling)
• The cross-connection for data networks by mean of copper patch cords and/or fiber optic jumpers. Horizontal (19" panels) and vertical (rings) patch cords routing accessories are compulsory to facilitate a clear organisation of the cross-connections inside a single cabinet.
• The housing of active equipment intended for concentrating, switching or supervising, Data, Video and access control networks.

3.1.6 19" FLOOR STANDING CABINETS :

COMPLIANCE WITH THE STANDARDS

Standard	Title	Use
IEC 60297-3-100	Mechanical Structure for Electronic Equipment	- Dimension of Mechanical structures of the 19”
EIA-310-E	Cabinets Racks Panels and associated Equipments	- US cabinets and racks standard
IEC60529	Degrees of protection provided by enclosures (IP code)	Degree of protection against liquids and dust to enter the enclosure. - IP 20
IEC62262	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)	Degree of protection from solid bodies to enter the enclosure. - IK10 For plain door - IK08 for glass door

SPECIFIC REQUIREMENTS

3.1.7 ENCLOSURE :

Floor-standing cabinet made of galvanized steel symmetric uprights and following dimension Height:1200, 1400, 1600, 1800, 2000, 2200, Width: 600/750, 800, Depth: 600/800,1000, 1060,1200. Cabinet should be coated with epoxy-polyester powder hot polymerized in textured RAL 7035 for better corrosion resistance.

All the side panels must be flush with the framework to avoid surprises during the installation process. For joined enclosures the total length of the set must be the sum of the individual enclosures that form it to avoid surprises during the installation.

For easier installation and maintenance the cabinet must allow installation of doors on front and back sides (without special accessories) and installation of 2 doors in the same upright.

In case that two or more enclosures are installed together the doors should be able to open without interfering with the adjacent enclosures.

Doors:
Sheet steel plain / transparent door , provided with foamed-in polyurethane gasket and front door opening. Door shall be provided of adjustable reinforcement frame for increased ruggedness and assembly of accessories.

Door shall be supplied with an opening handle to allow easy door managing when equipped,
and shall be provided with a closing system locked by a key number 333.

The impact strength as per IEC 62262 shall be IK10. For enclosures with transparent door must not have any effect on IP degree however, IK08 is acceptable.

Enclosure should allow door opening change. For safety reasons the door must not fall off when totally open and the pins are off the axis of the hinge. Door opening of 180º for easy maintenance.

Accessories:
Enclosure shall be supplied with 19" uprights, 100mm / 200mm / no mm base/plinth, with/without document pocket, earthing straps, with/without 19" profiles, eyebolts / lifting brackets / lifting bars, with/without door switch & lamp.

3.1.8 THERMAL STUDY:

For ED switchboards and Industrial Control boards the supplier must present a thermal study clearly indicating if thermal management measures are needed, and:
> Highest temperature of the board without temperature management
> Necessary cooling power
> Cooling power offered by the solution
> & the calculations made

Operation & Maintenance

3.1.9 QUALITY ASSURANCE

All materials and products shall be new, sound and uniform in quality, size, shape, color and texture.
The assembler shall be responsible for ensuring that the required standards of quality control as mentioned in relative sections are maintained for the proposed enclosures.
If requested by the client, the supplier shall provide proof of application of a quality procedure complying with standards. This means:

- Use of a quality manual approved and signed by a management representative.
- regular updating of this manual so that it reflects the most recent applicable quality control procedures,
- ISO 9001 or ISO 14001 certification

3.1.10 PRODUCT DELIVERY, STORAGE and HANDLING

- Deliver, store, protect and handle products to site as per manufacturer's instructions.

- Store enclosures in clean and dry space. Inspect for exterior damage. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris and traffic.
- Lift only with lugs provided for the purpose. Handle carefully to avoid damage to enclosure and finish.

3.1.11 SUSTAINABLE DEVELOPMENT

- Production site organisation shall be non polluting and certified to comply with ISO 9001 and ISO 14001 standards.
- Enclosures shall be designed according to Eco-design and the materials shall be of halogen free type.
- Enclosure painting process shall be complying with environmental directives RoHS and REACH.
- Packaging ecological and re-usable as a must.

3.1.12 EQUIPMENT ROOM (ER) SPECIFICATIONS

The Equipment Room houses electronic equipment (PBX, video, computing equipment, etc.) serving building occupants. Many of the TR's installed today can be classed as ER's because they may contain active electronic equipment and need to provide space and maintain a suitable operating environment for large telecommunications and/or computer equipment.
ER's are different and are generally considered to serve a building, a campus, a tenant, or a service provider (SP), and are connected to backbone pathways that run both within and between buildings.
ER's typically contain active equipment, terminations, interconnections, and cross-connections for telecommunications distribution cables.

LOCATION OF THE ER

Consider the following when choosing a location for the ER,
- Distance from telecommunications cable pathways
- Space required for the equipment.
- Expandability
- Cater for access for large equipment and cables.
- Facilities that serve and are served by the ER.
- Service Provider (SP) equipment requirements.
- Distance from electrical service and mechanical equipment.
- Sources of electromagnetic interference (EMI).

Ceiling Requirements

The recommended height of the ceiling in an ER is at least 3 m (10 ft). Ceiling protrusions (e.g., sprinkler heads) must be placed to assure a minimum clear height of 2.4 m (8 ft) that

is clear of obstructions, to provide space over the equipment frames for cables and suspended cable trays.
Some equipment may require additional ceiling clearance, depending upon the manufacturer's specifications.
The ceiling finish must:
• Minimize dust.
• Be light coloured to enhance the room lighting.

For fewer than 200 work areas, the minimum ER size shall be no less than 14 m2.

Number of Workstations	Estimated Equipment-Room Floor Space
1 to 100	15 m^2
101 to 400	40 m^2
401 to 800	80 m^2
801 to 1,200	120 m^2

ER shall have access to the main HVAC 24 hours per day, 365 days per year.
• Temperature will be controlled to 18°-24°C (64°-7 5°F).
• Humidity shall be in the range of 30 to 50%. Both humidity and temperature will be measured 1.5m off the floor.

LIGHTING

• Provide a minimum equivalent of 500 lux (50 foot-candles) measured 1 m above finished floors.
• Avoid dimmer switches.
• Coordinate closely with the rack placements.
• Light fixtures mounted min 2.6m above finished floor.
• Emergency lighting is recommended. Place emergency lighting to ensure that the loss of power to normal lights will not hamper an emergency exit from the ER.
• Power for lighting should not come from the power panel inside the ER. At least one light should be on normal power, and one light should be on emergency power, if available.

FIRE SAFETY

Appropriate portable fire extinguishers shall be kept in ER near the entry or exit.

Electrical Power Requirements

Active equipment and systems have strict electrical power requirements. To ensure adequate electrical power closely follow the following:
• Dedicated, non-switched, 3-cable, 240 volt (V) alternating current (ac) duplex electrical outlets for equipment power to prevent interference and accidental power-off for critical equipment.
• Electrical outlets must be on non-switched circuits (electrical outlet power must not be controlled by a wall switch or other device that may lead to inadvertent loss of service).
• Comply with equipment manufacturer's requirements and guidelines.
• Comply with local electrical code requirements.
• Branch circuits for equipment power that are protected and cabled for 20 A (240V)

capacity.
• Separate duplex 240 Vac convenience electrical outlets (for tools, field test instruments, located at least 150 mm (6 in) above finished floor and spaced at 1.8 m (6 ft) intervals around perimeter walls.
• Light switch locations should be easily access upon entry.
• Consider providing emergency power to the ER with automatic switchover capability. Consider UPS backup for essential active equipment.
• Distribution panels that serve telecommunications equipment should be separate from those that serve lighting fixtures.
• At least one electrical outlet should be on normal power, and one electrical outlet should be on emergency power, if available.

Power Conditioning

The sensitivity of telecommunications equipment to electrical power fluctuations is a significant issue in assuring system reliability and longevity. Assess the need for power conditioner before telecommunications equipment is installed. Many UPS devices will provide the required power conditioning.

3.1.13 BACKBONES :

Telephone building distributor (TBD)

It is the link between the Private Block Exchange (PBX) and the telephone network, it permit the allocation of telephone extensions to any floor distributor by the only mean of cross connections.
Telephone lines within building distributor can be either terminated on 8 pairs modules or dedicated RJ45 patch panel (ref. VDIG141501 Schneider-Electric). The TBD is to be located next to the PBX in an area with no electromagnetic disturbances.

Telephone backbones :

As these cables are designed to carry only telephone signals at 64 Kbits cat.3 performance level is sufficient. They will consist of VDIC235212 (Schneider-Electric) Multi-pair cable (128 pairs).
Note : To comply with the principle of standardisation of horizontal links, capillary cables will address the general performance requirements of the cabling system (cat.5^{e} of above).

Data backbones :

Data backbone cat.6 U/UTP :

These cable will reach category 6 performance level minimum. It is compulsory to build cat.6 backbones using 4 pairs shielded cables (VDIC116118 or VDIC136218). Multi-pair cables are to be proscribed.

copper cable colour: should be either green or blue. A white colour is allowed for LSFROH (IEC60332-3C) cable only.

Fiber optic backbone :

Several type of fiber may be used depending on the site specificity :

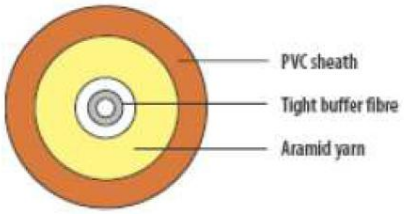
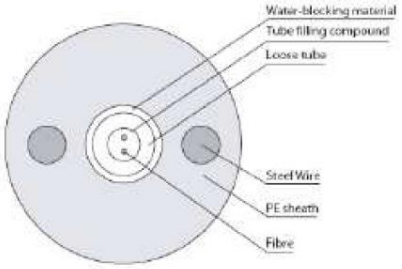
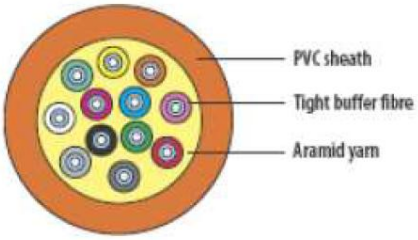
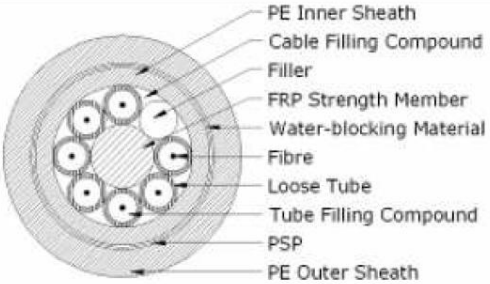
- For indoor use, the fiber cable will be non-armoured. An anti-rodent protection may be included. It should have a tight buffered structure.
- For outdoor use, the fiber cable will be armoured and provide an anti-rodent protection. It should either have a tight buffered or loose tube structure.

Further fiber optic specificity :

LAN fiber optic cables are multimode 50/125 µm type OM3 or OM 4 in a tight buffer structure, connected to SC, ST or LC connectors. For greater sites, the use of dedicated fiber cables (12 or 24 cores) is advisable (ref. VDIC52412T or VDIC52424T)

Cable types

CHARACTERISTICS	
Tight Buffer	**Loose Buffer (Tube)**
More sensitive than loose-buffered cables to: • Adverse temperatures. • Mechanical stresses.	Can operate in wider range of temperature and mechanical stress.
Increased physical flexibility.	Less flexibility due to higher fiber count.
Smaller bend radius for low fiber count cables.	Bigger bend radius
Distribution design: Single jacket protecting all the tight-buffered optical fibers.	
Breakout design: Individual jacket for each tight-buffered optical fiber.	

TIGHT BUFFER	LOOSE BUFFER(TUBE)
CABLE STRUCTURE 	
CABLE STRUCTURE 	
Constructed of materials that meet building fire code requirements.	Constructed of materials that meet outside plant requirements.
Unfilled	Filled
Used as intra-building backbone.	Have a 900 µm plastic coating applied directly to the fiber.
Used in horizontal distribution.	Used for interbuilding backbone distribution.
Used for making patch cords and equipment cables.	

Classifications of copper by functions

Standard copper LAN cables for your day-to-day installations, based on U/UTP and F/UTP cables, from category 5 to category 6_A. The CL-C cables are reliable and well-known, with good performance.

High-end copper LAN cables for performances from category 6 to category 6_A 500 Mhz. While exceeding international standards by 3 dB minimum on NEXT & RL, the cable should have better resistance to the mechanical constraints.

LAN copper cables for category 6_A with a single-foil metallic cross-filler, providing high performance and reliable shielded installations. While exceeding international standards by 3 dB minimum on NEXT & RL, the cable must provide superior shielding, faster installations and increased efficiency.

Also, in order to facilitate cable laying, the cables should be available in dual version. This will allow only one operation to install two cables.

Classifications of fiber by Buffering mechanism.

The two types of buffering mechanisms for optical fiber cable are:
• Tight buffer (inside plant and underground OSP cables).
• Loose buffer (OSP and some inside plant cables).

Certificates

All LAN cables from Category 6 have to be certified at a component level by the independent third-party laboratory Delta. Certificates are regularly updated to be compliant to the latest and highest international standards.

Category 6 U/UTP 300Mhz cabling :

Horizontal cables will be made of 4 twisted copper pairs cable cat.6 UTP. They will consist of CL-MNC cable (100 ohms) from Schneider-Electric or equivalent.
These cables will be made of halogen free compound. A central cross has to be included in the cable. Among other features, this cross has to be asymmetric and should have an integrated pair blocking system (DCBS technology).
The total length of a single link should not exceed 90 meters.
Cable sheath should be blue or green, and the NVP should be printed.

Category 6 U/FTP 300Mhz cabling :

Horizontal cables will be made of 4 or 2x4 twisted copper pairs cable cat.6 FTP. The screens will provide a perfect protection against electromagnetical disturbances. They will consist of CL-MNC cable (100 ohms) from Schneider-Electric or equivalent.
These cables will be made of halogen free compound and should offer a shielding made of an Aluminium foil laid longitudinally throughout the cable. The foil (or the foils) should respect the Snail technology features to improve EMC.
A central cross has to be included in the cable. Among other features, this cross has to be asymmetric and should have an integrated pair blocking system (DCBS technology).
The total length of a single link should not exceed 90 meters.
Cable sheath should be blue or green, and the NVP should be printed.

LSZH

LSZH (Low Smoke Zero Halogen) sheath according to test methods IEC 61034 (smoke density), IEC 60754-1 (gas toxicity), IEC 60754-2 (gas corrosiveness) for Tight buffered and Loose tube cables.

Flame retardant

Flame retardant (self extinguishing) according to IEC 60332-1 for Tight buffered and Loose tube cables.

Fire retardant
Fire retardant (no fire propagation along the cable) according to IEC 60332-3C for Tight buffered cables.

The CL-MX cable is wrapped in one single foil, this means less cutting and improved quality of cable preparation.

The total length of a single link should not exceed 90 meters.

High-speed transmission protocols beyond 10Gbit/s highlight ANEXT sensitivity and noise immunity as key performance factors for efficient, secure and robust installations. The single-foil structure of the metallic cross filler acts like a triple screen protection around the copper twisted pairs. This specific design enhances EMC performances to reach grade 1 on the transfer impedance parameter, which is better than a shielded design with braid.

Cable sheath should be blue, and the NVP should be printed

The total length of a single link should not exceed 90 meters.
Cable sheath should be blue or white, and the NVP should be printed.
The outer-sheath of the CL-MX should be available in LSFRZH to comply with IEC 60332-1 and 60332-3c standards. This means reduction of the emissions of opaque smoke and acid gases. Thus helps reducing damages to equipment and allows people to escape from the building more easily.
LSZH
LSZH (Low Smoke Zero Halogen) sheath according to test methods IEC 61034 (smoke density), IEC 60754-1 (gas toxicity), IEC 60754-2 (gas corrosiveness) for Tight buffered and Loose tube cables.
Flame retardant
Flame retardant (self extinguishing) according to IEC 60332-1 for Tight buffered and Loose tube cables.
Fire retardant
Fire retardant (no fire propagation along the cable) according to IEC 60332-3C for Tight buffered cables.

3.1.14 CLASSIFICATIONS OF FIBER BY FUNCTIONS

Intra-building Backbone

The Actassi Indoor and Indoor//Outdoor LSZH Cable is a low smoke zero halogen (LSZH) cable that provides excellent anti flame performance. The need for splicing between indoor and outdoor cables can be eliminated. The buffered tubes are surrounded by Aramid yarns and covered by a low smoke, flame-retardant jacket for protection. A direct outdoor to indoor transition can be completed with this single cable.

The Actassi Indoor LSZH Tight buffered Cables pass most of the following tests:
1) IEC 60754 part 3, Acidity/Corrosively based on pH and Conductivity Measurements
2) IEC 60332-3C, Fire Retardant
3) NES 713, Toxicity Index
4) IEC 61034, Smoke Emissions

The Actassi Indoor/Outdoor Loose tube LSZH Cables pass most of the following tests:
1) IEC 60754 part 3, Acidity/Corrosively based on pH and Conductivity Measurements
2) IEC 60332-1, Flame Retardant
3) NES 713, Toxicity Index
4) IEC 61034, Smoke Emissions

I. Eight fiber-type performances:
a. Normal offer: Multimode OM1, OM2, OM3, OM4; Single-mode OS1,OS2 (G.652D).

The Fiber indoor/outdoor must have a green sheath colour.

3.1.15 BACKBONE CABLING – MULTI MODE FIBER

Fiber

All fiber shall be complete with graded index optical fiber waveguide with mode field diameter of 50um ± 0.5um and cladding diameter of 125um ± 2 um;
Optical fiber shall conform to the OM3 standard defined in ISO-11801 2nd Edition, to support 10Gb Ethernet over increased distances;
Optical fiber shall be in compliance with IEC 60793 and TIA/EIA 492 specifications;
Each fiber shall be contained in a colour-coded nylon jacket for easy identification;
The jacket of each fiber shall ensure colour retention, minimize micro-bending losses, improve handling and be mechanically strippable;
The non-circularity of the core and cladding of each fiber shall be less than 6% and 2% respectively;
The core/cladding concentricity error of each fiber shall be less than 3 um;
All fibers shall operate in both 850nm and 1300nm optical windows with maximum attenuation of 3.1dB/km and 1.3dB/km respectively;
All fibers shall have its minimum information transmission capacity for 850nm and 1300nm optical windows as 200 MHz-km and 500 MHz-km respectively;
Each overall cable diameter shall not exceed 16mm;
All fiber cables shall be of a dry and dielectric construction. No gel or metallic content shall be allowed;
The cable shall have water swell able yarn located with the fibers to prevent the migration of water should the sheath material become punctured;
The minimum allowable bending radius of the cable shall be 10D and 20D during and after installation respectively where D stands for the overall cable diameter;
The cable marking shall include traceable part numbers from the manufacturer packaging to assist in quality validation of the installed cable;

The cable should be a 4 pair or 2x4 pairs categorie 5e , U/UTP.

The screen will be made of aluminium in order to maintain the Electromagnetic Immunity robustness and to meet the quality and performance criteria for high frequencies during all the warranty time of the system.
In case of fire, the sheath of the cable shouldn't produce toxic fumes (HALOGEN FREE) and flame retardant.

All cables shall be 4-pair unshielded Twisted Pair (UTP) cables meeting or exceeding the quality and performance requirements for Category 6 UTP cables stipulated in EIA/TIA-568-B.2-1 standard. Each Category 6 UTP cable shall be terminated on an 8-conductor Category 6 jack in accordance with the EIA/TIA-568B wiring code;
The cable shall be solid or stranded copper conductors of 23 AWG insulated with high density, PVC or LSZH sheath. **Cross filler with optimized design and micro-blades, is preferred**
The cable shall be accompanied with traceable serial numbers from the manufacturer indicated on the packaging to assist in quality validation of the installed cables;
The cable shall provide the guaranteed channel performance specifications of the Category 6 Channel complies to EIA/TIA-568-B.2-1 standard.
Each pair should have an impedance of 100 Ohms, with+/- 15 Ohms, tolerance.

A valid certificate should be delivered by the manufacturer in order to demonstrate the ISO/IEC 11801: 2002 or au standard TIA/EIA 568 B2-10 standard compliance.

Cords (Copper – Fiber):

All patch cord should be RAL 7035 colour coded, pre-wired and tested in factory. These patch cords have to be delivered with colour clip identifier. The connector of these patch cords have to be snag-free to protect the plug-clip from breakage.
For performance purpose, all the patch cords must comply to :
ISO/IEC 11801 Ed 2.2
DELTA Certified
EN 50173 Ed.3.
EIA/TIA 568-C.2
IEC61935-2
For security purpose, all patch cord must be LSZH compliant

Copper :

Patch cords or work area cords, category 6U/ UTP 250Mhz :

Cords are to be of the same manufacturer than cables and connectors used in horizontal links to obtain optimal performances and prevent crosstalk incompatibilities in category 6. They will be unshielded and have an impedance of 100 Ohms (ref. VDIP181646020 Schneider-Electric for a 2m length).
Cords must always be as short as possible to ease their management inside cabinets and higher the global performances of the horizontal links.
Cords have to be compliant with : ISO / IEC 11801 Ed 2.2 and third part, updated Delta certified - EN50173ed.3. , EIA/TIA 568 - C.2, IEC 61935-2
Specifications Low Smoke Zero Halogen (LSZH), 4 pairs, 100 ohms, pre-wired and tested in factory, with light grey colour design (RAL7035)
Connectors with grey over-moulding, Snag-free connection to protect the plug-clip from breakage. In order to identify, a pair of COLOR clips Covering either shielded or unshielded will be provided. Each patch cord will be delivered in individual packaging.

Patch cords or work area cords, category 6 F/UTP 250 Mhz :

Cords are to be of the same manufacturer than cables and connectors used in horizontal links to obtain optimal performances and prevent crosstalk incompatibilities in category 6. They will have an individual shield on each pair and have an impedance of 100 Ohms (ref. VDIP184646020 Schneider-Electric for a 2m length).
Cords must always be as short as possible to ease their management inside cabinets and higher the global performances of the horizontal links.
Cords have to be compliant with : ISO / IEC 11801 Ed 2.2 and third part, updated Delta certified - EN50173ed.3. , EIA/TIA 568 - C.2, IEC 61935-2
Specifications Low Smoke Zero Halogen (LSZH), 4 pairs, 100 ohms, pre-wired and tested in factory, with light grey colour design (RAL7035)
Connectors with grey over-moulding, Snag-free connection to protect the plug-clip from breakage. In order to identify, a pair of COLOR clips Covering either shielded or unshielded will be provided. Each patch cord will be delivered in individual packaging.

Fiber optic jumpers :

The connection to opto-electronic equipment or the cross-connection of two fiber optic links is to be done through fiber optic jumpers fitted to each fiber optic connector on both ends.

Geometrical characteristics of fiber optic jumpers are to be the same than fiber optic links cables.

A minimum length of 2m is to be respected in order to cancel the effect of disturbing signal propagation inside the cladding.

They will be from Schneider-Electric brand or equivalent.

OPTICAL FIBER TELECOMMUNICATIONS OUTLET CONNECTOR

For optical fiber cabling, optical fiber connectors and optical fiber adapters are available in many different sizes and shapes.

Performance of Optical fiber type

STANDARD NOTES

• Horizontal optical fibers at the work area outlet shall be terminated to a duplex optical fibers outlet/connector meeting the requirements of ANSI/TIA/EIA-568B.3.

• To facilitate inter-office moves, consider the use of one style of duplex connector for the work area outlet.

• The 568SC connector/adapter has been recognized by industry standards for many years. This connector/adapter type and any additional standards-compliant connector/adapter styles, including the Small Form Factor (SFF) styles (e.g. LC), may also be considered.

OM3 and OM4 have an additional laser launch modal bandwidth as OM3 and OM4 are designed to be laser optimized. The difference between “Overfilled Launch" and “Laser Launch" is the test method. A new test method simulating a VCSEL laser launch (TIA-455-220A and IEC 60793-1-49) was deemed appropriate for these fibers which are intended for use with VCSELs at higher speeds.

Fiber Type	Max. attenuation (db/km)		Min. modal bandwidth (MHz x km)		
			Overfilled launch		*Laser launch*
	850nm	1300nm	850nm	1300nm	850nm
OM1	3,5	1,5	200	500	Not specified
OM2	3,5	1,5	500	500	Not specified
OM3	3,5	1,5	1500	500	2000
OM4	3,5	1,5	3500	500	4700

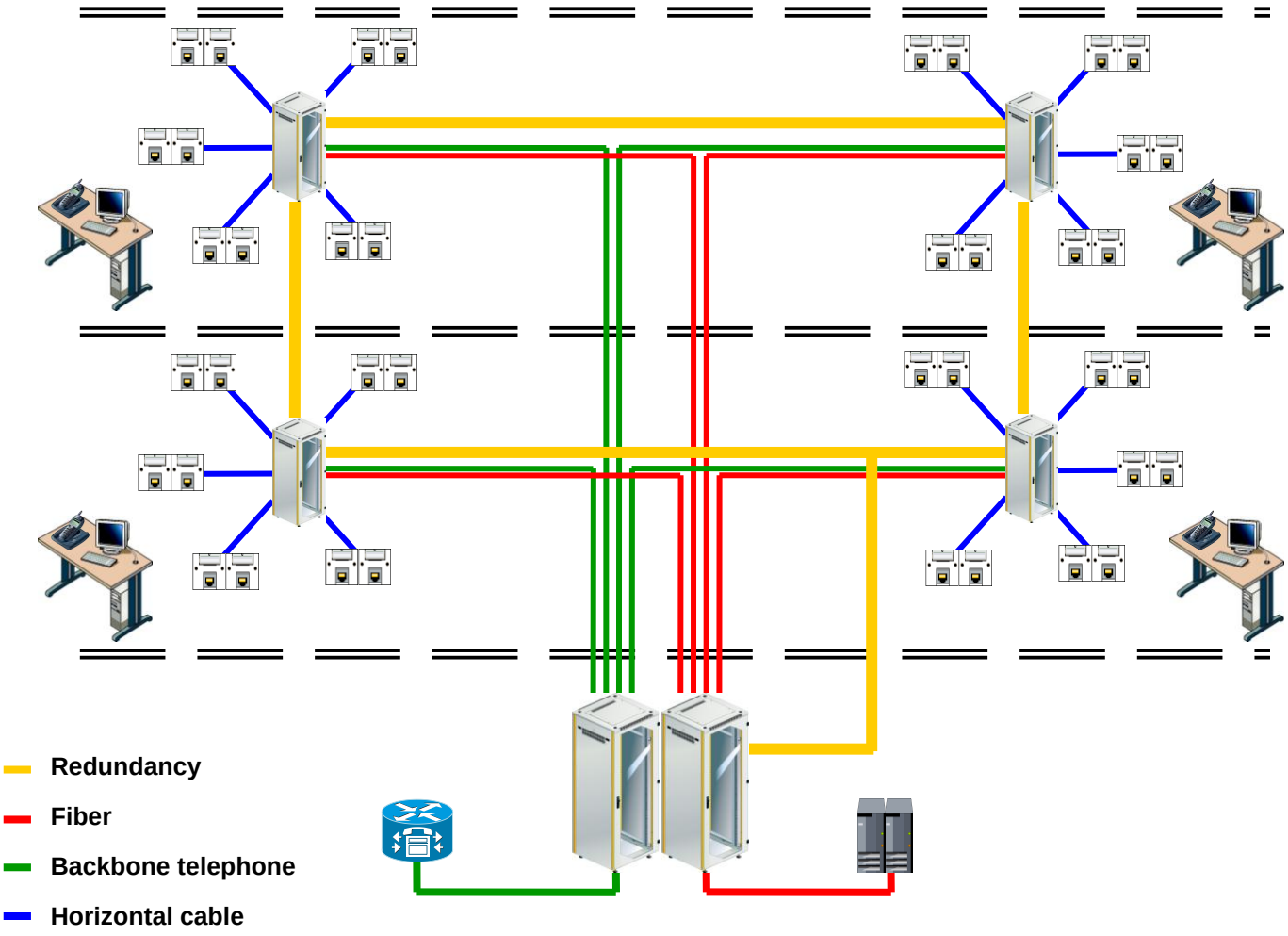
OM4 fiber is a laser-optimized, high bandwidth 50um multimode fiber. Formerly, it was called OM3-550 fiber. TIA approved EIA/TIA 492AAAD (OM4) on August 5, 2009

OM4 fiber is designed to enhance the system cost benefits enabled by 850nm VCSELs for existing 1 Gb/s and 10 Gb/s applications as well as future 40 Gb/s and 100 Gb/s systems.

OM4 fiber supports Ethernet, Fiber Channel, and OIF applications, allowing extended reach upwards of 550 meters at 10 Gb/s for ultra long building backbones and medium length campus backbones.

Star topology network with redundancy links

The basis of a cabling system organisation is shown by the following diagram. It shows a star organisation model of FD around the BD. It is to notice that the redundant backbone links shown are not compulsory but offer a higher security margin against breaks.



Universal components used for telephone and data networks :

Category 6 UTP RJ45 connector :

- ***Terminal outlet :***

All terminal outlets are to be universal.

A workstation will include a minimum of 2 (two) outlets (e.g. one for telephone application, the other one assigned to the data network).

Terminal outlets are to be made of **cat.6 RJ45 8-pin modular jacks**, normalised by ISO 8877 (reference VDIB17726U12 Schneider-Electric or equivalent).

RJ45 modular jacks are to be mounted on faceplate from the local standards. The faceplate have to be properly equipped to accept screw-on adapters and splitters (i.e. have a build-in nut).
Note : The outer size of the faceplate may be different if the screwing feature described above is respected (e.g. ref. 5034 Schneider-Electric Italian plate).

Bridged taps and splitters shall not be used as part of the backbone cabling. (TIA/EIA-568-B.1)

Category 6 FTP RJ45 connector :

- ***Terminal outlet :***

All terminal outlets are to be universal.

A workstation will include a minimum of 2 (two) outlets (e.g. one for telephone application, the other one assigned to the data network).

Terminal outlets are to be made of **cat.6 RJ45 9-pin modular jacks**, normalised by ISO 8877 (reference VDIB17726U12 Schneider-Electric or equivalent).

RJ45 modular jacks are to be mounted on faceplate from the local standards. The faceplate have to be properly equipped to accept screw-on adapters and splitters (i.e. have a build-in nut).
Note : The outer size of the faceplate may be different if the screwing feature described above is respected (e.g. ref. 5034 Schneider-Electric Italian plate).

Bridged taps and splitters shall not be used as part of the backbone cabling. (TIA/EIA-568-B.1)

Entrance facility (EF)

The Entrance Facility consists of service entrance to the building including the building wall penetration and continuing to the ER. The EF may also contain backbone paths to link other buildings as well as antenna entrances.

• All carriers and telecommunications providers involved in providing service shall be contacted to establish their requirements.
• Easements, permits and rights of way may be required.
• A service entrance pathway shall be provided (underground, aerial, buried).
• See standard for specifications defining manholes, penetrations, etc.
• Grounding and bonding to NEC or local code guidelines.

NOTES	DETIALS
Terminating space should be located where the facilities enter the building	• Limit the amount of exposed cable in the building (possibility of fire) to < 15 m (50 ft) of exposed non-fire-rated entrance cable within a building. • If more than 15m of cable is required between the entry point and the termination point, use rigid • Metallic conduit to enclose the cable. • Conduit must be grounded. Fire-rated tape wrap is not acceptable.
Ensure accessibility at all time	• Termination space should never be located within one tenant's space in a multi-dwelling building. • The termination room, telecommunications room, or space in a multi-dwelling building must be accessible through a common corridor or an outside door. • Entry to any locked termination space must be • available through: 1. 1 Maintenance personnel, or 2. 2 A common key provided to each tenant.
Safe and environmentally clean	• Safely accessible. • Free of any storage material or other obstructions. • Standard working height without the need for ladder or scaffold. • Free from moisture and severe temperature conditions.
Properly powered	An individual branch circuit is required for testing and Maintenance.
Lighting	500 lux minimum (50 foot-candles).

Telecommunications rooms :

Dedicated telecommunications room :

A telecommunications room should provide all the facilities (space, power, environmental control etc.) for passive components, active devices (HUB, Switches, routers etc.), and external network interfaces housed within it. Each telecommunications room should have direct access to the backbone cabling subsystem. It has to be of a sufficient surface (6 m² minimum) and secured (intrusion, fire, water flood). The use of raised floor is advisable. It is compulsory cool or ventilate the telecommunications room. Among a direct access to the backbones, the telecommunications room are to be installed as close as possible to the centre of the served area to shorten the horizontal links lengths (better performances and lower costs).

TR SPECIFICATIONS

a. The telecommunications room must be dedicated to telecommunications functions.
b. Equipment not related to telecommunications shall not be installed in telecommunications
room.
c. Two walls 2.5 meters (8 ft) high covered with 20mm (3/4 inch) A-C void-free plywood
d. Minimum Floor Loading Capacity
• 2.4 kPa (50 lbf/ft2)
d. False ceilings are not permitted

LIGHTING

• Provide a minimum equivalent of 500 lux (50 foot-candles) measured 1 m (3 ft) above finished floors.
• Avoid dimmer switches.
• Coordinate closely with the rack placements.
• Light fixtures mounted min 2.6m (8.5 ft) above finished floor.
• Emergency lighting is recommended. Place emergency lighting to ensure that the loss of power to normal lights will not hamper an emergency exit from the TR.
• Power for lighting should not come from the power panel inside the TR. At least one light should be on normal power, and one light should be on emergency power, if available.

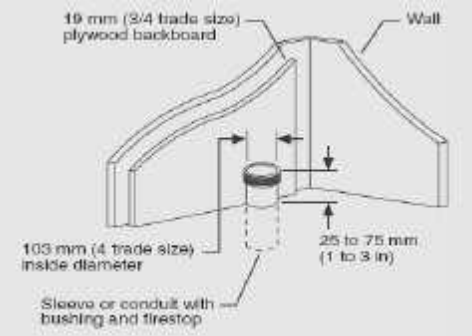
DOORS

• Fully open (180 degrees) lockable doors with minimum door size 0.9 m (36 in) wide by 2m (80 in) high.
• Door sills are not allowed because they impede the movement of equipment.
• Doors that open outward provide additional usable space and reduce constraints on TR layout.
• Door should have a lock.

POWER SUPPLY

• Branch circuits for equipment power that are protected and cabled for 20 Amp capacity (240 volts depending on the local utilities regulation)
• Minimum of two dedicated, non-switched, 3-cable, 240 volts (V) alternating current (ac) duplex electrical outlets for equipment power, each on separate branch circuits.
• Separate duplex 240 Vac convenience electrical outlets (for tools, field test instruments, located at least 150 mm (6 in) above finished floor and spaced at 1.8 m (6 ft) intervals around perimeter walls.
• Light switch locations should be easily access upon entry.
• Electrical outlets must be on non-switched circuits (electrical outlet power must not be controlled by a wall switch or other device that may lead to inadvertent loss of service).
• Consider providing emergency power or UPS backup to the TR with automatic switchover capability, to ensure continuous operation of any active equipment located in the TR.
• Distribution panels that serve telecommunications equipment should be separate from those that serve lighting fixtures.

• At least one electrical outlet should be on normal power, and one electrical outlet should be
on emergency power, if available.
• Sleeves or slots should be located adjacent to door and fire stopped except during cable installation.



Flood Prevention

Do not locate TRs in areas prone to flooding. Avoid locations that are below or adjacent to areas of potential water hazard (e.g., areas below water table, restrooms and kitchens).

Cross-Connect Field Identification

Well-organized colour coding helps to identify backbone and horizontal cables quickly and helps ensure that cable topology requirements are met. Accepted methods for colour coding cross-connect fields include coloured backboards, connections, covers or labels. The following is per ANSI/TIA/EIA 606A recommendations:

Color	Identification
Orange	Demarcation point (e.g., central office connections).
Green	Network connections (e.g., network and auxiliary equipment).
Purple	Common equipment (e.g., connections to private branch exchange [PBX], Local Area Networks [LANs], mainframe computer, multiplexer).
White	First-level backbone (e.g., termination of building backbone cable connecting MC [CD] to ICs [BDs]).
Gray	Second-level backbone (e.g., termination of building backbone cable connecting ICs [BDs] to HCs [FDs]).
Blue	Horizontal cable (e.g., horizontal connections to telecommunications outlet/ connectors).
Brown	Interbuilding backbone (campus cable terminations). NOTE: Brown takes precedence over white or gray for interbuilding runs.
Yellow	Miscellaneous (e.g., auxiliary, alarms, security).
Red	Reserved for future use (also, key telephone systems).

Clearances

• Minimum m (3 ft) of clear working space from equipment and cross-connect fields.
• 150 mm (6 in) depth off wall for wall-mounted equipment.
• Allocate a space of at least 1000 mm wide, 1000 mm deep, and 2.3 m high for each

equipment rack or cabinet.
• Provide space for an aisle of at least 1000 mm wide in the front and in the rear of the space allocated for each equipment rack or cabinet.

PATCH PANELS

Category 6 patch panels :

Empty or equipped sliding panel 1U 24 port RJ45
The patch panel will have 24 rj45 port with a QUICKFIX function on both sides to allow a simple, quick fixing position and sliding feature. Automatic earthing for STP version will be done.
The patch panel will have individual cable management at the back and also rear position numbers to keep track on the installation. Labelling has to be integrated on each side of the QUICKFIX system.

Patch panels will be pre-equipped with RJ45 cat.6 shielded (ref. VDIG118241B60 ACTASSI S-ONE with a 360° shielding), or RJ45 cat.6 unshielded (ref. VDIG118241U60 Schneider-Electric).

One patch cord guiding panel (ref. VDIG188141 Schneider-Electric) is to be forecasted each 24 ports.

Alternatively vertical patch cord routing rings (ref. VDIM189111 for 600X600 or VDIM189112 for 800X800 Schneider-Electric) will be placed on the 19" uprights at each side of the cabinet (4 rings per uprights is to be forecasted).

The active equipment to be housed in cabinet will be subjected to independent technical specifications proposal.

Shielded panels should include shutters removable from the panel for dust proof. Optional coloured shutters should be supported to increase port identification.

The preferred colour of the patch panel is RAL 7016 (dark grey) in order to be homogeneous with all the RACK and other patch panels.

telecom panels

The sliding function does permit the use of the punch down tool for LSA contacts with the panel in a sliding-out position. The telecom panel must have a cable identification to avoid the need trying to figure out which cable goes where. The cable identification is very clear on the clever fixing guides. Out of this identification a clear marking with pre-printed labels and openable label holders will be part of the patch panel.

Finally, the panel has to have two earthing connection points for both shielded cables and for the rack, easily accessible at the rear.

Sliding Fiber optic panel 1U:

They will have a capacity of 4 positions equipped with 3 blank plates. Each plates will have 3 SC/ST/LC or 6 ST SIMPLEX/LC DUPLEX.
The fiber patch panel will have a 0U cable management at the front with integrated clear marking number in order to identify the cables. At the rear of the sliding fiber panel, a rear quick fixation to use with a cable gland provide with the panel.
The patch panel has to be equipped with a transparent cover protection at the front, and on the top of the panel. Finally, the panel will have one or two coiling wheels to avoid tension on the connectors, and to respect the fiber bend radius. Labelling has to be integrated on each side of the QUICKFIX system.

The preferred colour of the patch panel is RAL 7016 (dark grey) in order to be homogeneous with all the RACK and other patch panels.

Cable management:

Patchcord guiding panel :

In between each patch panel a patch cord guiding panel should be inserted. This patch cord guiding panel should have 1 U height and be fixed with ONLY 2 screws. This guiding panel must have 4 OPENABLE rings for ease of use, and as they have OPENABLE, they also have to be able to be CLOSED.

Each of these 4 rings should be removable for maintenance purpose.

Vertical rings :

In order to organise in a proper way the cabling in a rack, we recommend to use openable vertical rings. For rack 800x800mm a large capacity of up to 48 cords is recommended.
In a rack of 600X600mm a VELCRO openable vertical ring is best suitable.

Cable ties to bundle the cable are forbidden. Velcro should be used instead.

Telephone backbone wiring

Multipair backbones cables coming from the Telephone Building Distributor will either be terminated on 8-pairs modules or dedicated patch panels offering 50 RJ45 cat.3 ports on 1U (ref. VDIP141501 Schneider-Electric).
50 ports in 2 rows RJ45 patch panels will be given priority as it suits the universality feature of a cabling system. Cable organizer and label holders is mandatory.

A cross connection from the telephone backbone to the horizontal cables will allocate an extension number to the chosen telecommunication outlet.
A quickfix function on both sides to allow simple fixing and sliding feature.

4.1 CAT5e CABLING INFRASTRUCTURE

Telecommunication Outlet

All the wiring devices should be taken in the same range as infrastructure cabling system, no Mather which installation method is chosen, the wiring devices will be compliant to IEC 60364 / and HD384 series international standards.
The protection level following the IEC 60529 or l'EN 60529, should be minimum : IP 20
The shock resistance following the IEC 62262 or l'EN 62262 should be IK 02.
The wiring device should never exceed the local standard (ie : 45mm in France, Belgium)
The wiring device will be compatible with every outlet without any adaptor or dismantling.
The wiring device should be mounted next to each other without any space in between.
Every wiring device must have a clipsing mechanism without any tool. All telecommunication outlet must be trivialized.
A minimum of 2 outlets per work area is recommend in case of use of IP-TELEPHONY. Otherwise a complementary outlet should be considered.
The telecommunication outlets including or not 1 or 2 RJ45 will be ISO 8877 compliant, defined by ISO IS11801, and TIA/EIA 568 TSB40, which description is done in (29.1.2 RJ45 Connector)

RJ45 Connector

All the range of connectors have to be compliant with all the last international standards. A valid certificate must be provided by third party laboratory (type :DELTA).

Each connector of the family is available in UTP or STP one piece device compact and simple locking termination without any loose part, to avoid the installer to lose pieces , and to make it easier to handle.

The connector has to be tooless, U-Shaped cable entry, with a smart bridle with elastomer insert for cable. Easy access for all cables. Automatic 360° earthing with spring-loaded locking and earthing bridle.

The STP connector must have integrated earth-drain contact for the drain wire connection, and double earthing for the STP version at the front.
The U shape entry is the same concept, S/FTP or F/FTP cables to enable them to keep their structure intact (screens and foils are not damaged) transmission performance is safe. No risk to tear and roll up the screen.

The connector must have at least a 750 connection/disconnection. It has to be manufactured in EUROPE.

Figure 5 : U-shaped cable entry

SMART BRIDLE

The U-shaped cable entry should be considered for reducing risk of damaging connections. For the S/FTP et F/FTP (easy access for all cable)

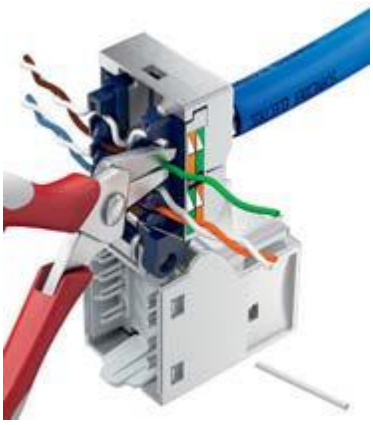


Figure 6 : Protected IDC contacts

DONE

Insulated plastic IDC housing eliminates short-circuit between conductors and metal body.
The crossing of pairs is implemented before the cable's introduction into the connector for easy, secured and efficient wiring. The pair foil can be as near as possible to the IDC.

The earth drain wire is inserted in an horizontal groove with entire security and is terminated vertically down on the side of the connector. Secured integrated guiding parts to enable reproductive position.

The connector has to be labelled on each side the colour coding from the standard EIA 568 A & B.
The connector has to be smooth design with rounded edges, and touch –friendly materials to avoid injuries.

The connector has to be able to Re-open in two clicks, and audible in opening and closing.

Performances :

The level of performance has been certified by an independent laboratory Delta with the EIA/TIA and ISO 11801:2011 Ed2.2 Class E permanent link and channel. All the parameters required have been surpassed by far during the test.

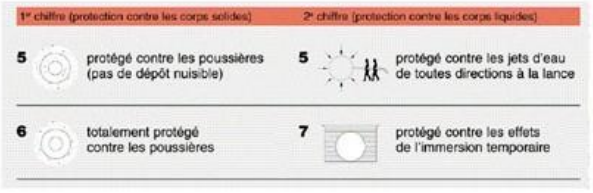
The test method « Direct Probing » will warranty the interoperability of the connector at 500Mhz, and met the requirement of the international IEC60512-99-001 ed 1 POEP standard.

RJ45 WATERPROOF

The RJ Protek faceplate are specially design for industrial or laboraty environment, surgery rooms where chemical, dust, humidity constraints are usual).

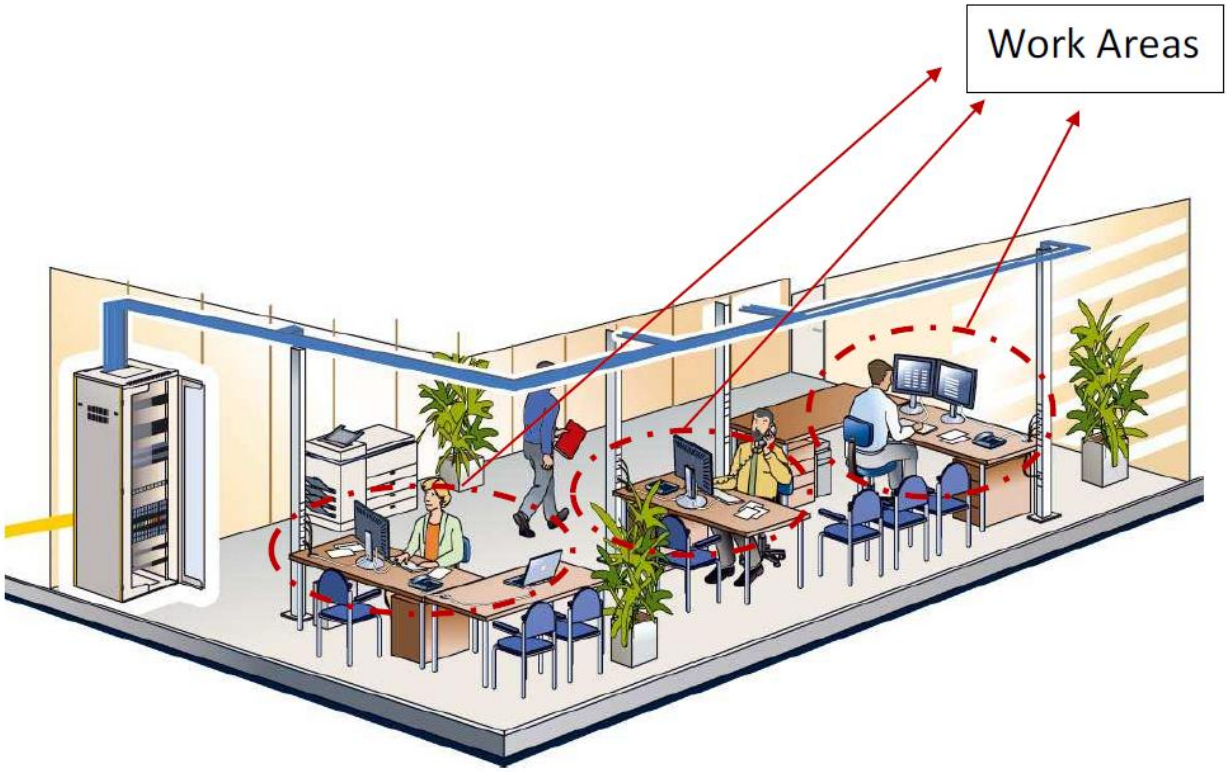
For Heavy steel industry vibration plants this RJ45 has improved resistance against unplanned disconnexion due to high vibrations.

The Waterproof of the RJ45 is secured by the turn&lock, and this gives a IP55 in surface mount and up to IP67 in flush mount.



4.1.1 WORK AREA

In this chapter, we shall learn about cabling components located in work areas, with references to the second edition of ISO/IEC 11801 Ed.2:2002 (equivalent to AS/NZS 3080 for Australia and New Zealand) and the ANSI/TIA/EIA-568-B series of standards.



Design considerations

Guidelines for planning the location of telecommunications outlet boxes in the Work Area:

1. Each work area shall have a minimum of ONE telecommunications outlet box location. TWO telecommunications outlet box locations should be provided and located for future additional telecommunications outlets.

2. Work area telecommunications outlet box size.

ANSI/TIA/EIA-569-B, specifies the *following*:

3. Telecommunications outlet boxes may require supports for attaching the box and a suitable faceplate to support the telecommunications outlet/connectors that are housed by the work area telecommunications outlet box.

• Outlet boxes shall be no smaller than

Width: W	Height: H	Depth: D
50 mm, (2 in)	75 mm (3 in)	64 mm (2 1/2 in)

The work area telecommunications outlet box should be located near an electrical outlet (e.g., within 1 m [3 ft]) and installed at the same height if appropriate.

5. Floor-mounted telecommunications outlet boxes and monuments (pedestals), and the cables extending from them, can present a tripping hazard. The location of these telecommunications outlet boxes should be coordinated with furniture to minimize such hazards.
6. Cabling system performance may be sensitive to the arrangement and organization of cable slack located behind the telecommunications outlet/connector. Sufficient space must be provided in the telecommunications outlet box or equivalent space so that minimum cable bend radius requirements are not exceeded.
7. The location, mounting, or strain relief of the telecommunications outlet/connector should allow pathway covers and trim to be removed without disturbing the cable termination. Care should be exercised to ensure that telecommunications outlet/ connectors are mounted in such a way that they do not significantly reduce the required pathway cabling capacity.
8. Open office furniture openings provide for mounting faceplates containing one or more telecommunications outlet/connectors. Two standard sizes of openings are specified:

Work area subsystem

The work area refers to spaces where occupants normally work and interact with their telecommunications equipment. The work area subsystem refers to the components that extend from the telecommunications outlet/connector at the end of the horizontal cabling system to the work station equipment. This equipment requires a patch cord plugged into the telecommunications outlet/connector.

All four pairs in the cable shall be terminated in an 8-position modular outlet/connector at the work area. These connectors may be x/xTP, as described in the above section.

Two wiring schemes are specified in the ANSI/TIA/EIA 568-B.1 Clause 6.2.1. The pin/pair assignments for T568A and T568B are shown in Figure 1.19b depicting the front view of each telecommunications outlet/connector.
T568A is the preferred wiring scheme, and T568B optional if necessary to accommodate certain pre-existing 8-pin cabling systems.

When selecting a connector, make sure it is specified and tested to meet ANSI/TIA/EIA-568-B.2.
Connecting hardware should be marked to designate transmission performance at the discretion of the manufacturer or approval agency. The markings, if any, shall be visible during installation. It is suggested that such markings consist of:

Category 5e components: “Cat 5e”

Work area cables

Work area cables (known also as “Patch cords”, “equipment cords” or “station cords”) extend from the TO or MUTOA to the work area equipment. To assure adequate flex-life, cables used for UTP patch cords shall have stranded/solid conductors. Depending on the application, a cord with identical connectors on both ends is commonly used.
Note that a maximum length of 5 m (16 ft) of work area cord is allowed for the horizontal link.
Patch cords used in the work area shall meet or exceed the performance requirements in ANSI/TIA/EIA-568-B.2 and ANSI/TIA/EIA-568-B.3.
When application specific adaptors (eg. Baluns) are needed at the work area, they shall be external to the telecommunications outlet/connector (EIA/TIA 568-B.1 clause 4.2).
Due to insertion lost and impedance mismatch, work area cabling often becomes the bottleneck or the “weakest link” in the channel. The transmission performance of the entire channel will be reduced to that of the work area cable. ANSI TIA/EIA 568-B recommends the use of factory assembled work area cables.
Work area cables and other equipment cables connecting to the horizontal cabling shall meet or exceed the performance requirements described in ANSI/TIA/EIA568-B and ISO/IEC 11801 Ed.2:2002 cabling standards.

4.1.2 CONSOLIDATION POINT :

One consolidation point is permitted between a FD and any TO.
The installation of a consolidation point in the horizontal cabling between the floor distributor and the telecommunication outlet may be useful in an open office environment where the flexibility of relocating TOs in the work area is required.
The consolidation point shall only contain passive connecting hardware and shall not be used for cross-connections. In addition, where a consolidation point is used :

k) the consolidation point shall be located so that each work area group is served by at least one consolidation point;
l) the consolidation point should be limited to serving a maximum of twelve work areas ;
m) a consolidation point should be located in accessible locations ;
n) the consolidation point should be located so that there is at least 15m from it to the floor distributor ;
o) CP cables are to be of the same type than capillary cable and are to be equipped with RJ45 plugs recommended by the manufacturer.

• Category 5e ……...(see 3.3 Chapter)
• Optical fiber ……..(see 3.3 Chapter)

When using adapters (e.g., installing a balun), the adaptors must be external to the telecommunications outlet/connector or MUTOA. For further information, see Cabling Adapters in CORE-2: Horizontal Distribution Systems. The cabling infrastructure designer needs to be aware that these work area equipment-specific adaptors may or

may not offer the same level of transmission performance as the cabling systems to which they connect.

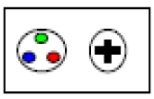
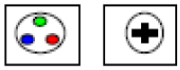
• Active adapters (e.g. Fiber Optic transceivers) that may be needed when connecting devices that use different signalling schemes.

• A special cable or adapter is required when the equipment connector is different from the telecommunications outlet/connector.

The maximum horizontal cable length of 90 m (295 ft) is based on a maximum length of 5 m (16 ft) of work area cable. The combined length of equipment cables, work area cords, and patch cords in the telecommunications room (TR) or equipment room (ER) shall not exceed 10 m (33 ft), with the exception of MUTOA where longer work area cables are used. In the case of MUTOA's, the horizontal cable length is reduced when the work area cords exceed 5m.

4.1.3 OPEN OFFICE CABLING

Modern offices today adopt flexible layouts for supporting collaborative work by small teams. From time to time, changes in individual work or group work results in re-arrangements to office settings in which much of the available work area space is divided by modular furniture and partitions rather than by fixed walls.
To accommodate such changes without disturbing horizontal cable runs, EIA/TIA 568-B recommends that these partitions and furniture typically provide for the use of:
• Multi-user telecommunications outlet assembly (MUTOA).
• Consolidation point (CP).
• Cable pathways.
• Telecommunications outlet/connector.
Each of these open office distribution system components will be covered in some detail throughout this chapter.

Minimum Distance between Data Cabling and Power Lines of up to 5 kVA Power Lines		**UTP**	**FTP**
Unshielded Power Lines with No Separation from Data Cable		127 mm (5.08")	50 mm (2")
Unshielded power Lines Separated from Data Cable with Grounded Metallic Elements		64 mm (2.56")	30 mm (1.2")
Power Lines and Data Cables Enclosed in Separate Grounded Metallic Conduits		0mm	0mm

Bending Radius and Max. Pulling Force for various cables:

TYPE Of CABLE	BENDING RADIUS (mm)	MAX PULLING FORCE (N)
2 core Fiber Zip Cord	35	100
8/12/24/36-core indoor Fiber	30	500
8/12 Loose Fiber	225	1250
8/12/24/36-core Armoured Loose Tube Fiber	225	2500
4-pair UTP (Cat5e/Cat6)	4 X OD	100
4-pair FTP (Cat5e/Cat6)	8 X OD	200
4 pair UTP (Cat6A)	4 X OD	110

Cable Pulling

The maximum pulling tension for a 4-pair balanced twisted pair cable must not exceed 25 lbf (110N). Exceeding this tension will result in transmission degradation and may affect the system's ability to pass certification testing.

		5e	6	$6A_1$
Average OD		.185"	.230"	.330"
Cable Tray*	2" x 6"	111	72	35
	4" x 8"	298	192	93
	6" x 20"	1116	722	350
Conduit**	3/4	6	5	1
	1	11	8	4
	1 1/4	19	14	6
	1 1/2	25	19	9

Typical tray and conduit capacity (number of cables)

Conduit Fill

A maximum conduit fill ratio of 40% is recommended by TIA-569 standards to accommodate cable bundle bend radius requirements and allow for future expansion.

Cable Tray Fill

TIA-569 recommends 25% fill at initial installation and up to 50% with unplanned additions. If a single cable tray will also carry power cables, a physical barrier is required to comply with the NEC. Finally, ensure tray support spacing is sufficient to prevent excessive sagging. Consider solid bottom tray for higher density applications.

Cable Tray Sizing

Step	Instructions	Example
1	Determine cable diameter and total number of cables	.30" diameter each, 100 cables total
2	Square the cable diameter	.30 x .30 = .09
3	Multiply result by number of cables	.09 x 100 = 9
4	Multiply result by .785 to factor for cable roundness (This result is the total cross-sectional area of your cables)	9 x .785 = 7.065 sq in
5	Multiply result by 4 to obtain pathway size at 25% fill	7.065 x 4 = 28.26 sq in

Consolidation Points & Zone Enclosures

TIA standards allow an optional consolidation point (CP) within a permanent link. Consolidation points may be mounted into a zone enclosure, which are available in several styles:

- Ceiling- or floor-mount
- Plenum-rated
- Active or passive equipment rated

Zone enclosures also accept patch panels and/or active equipment, and are then considered telecom enclosures (TEs).

STRAIN RELIEF

Cables shall be free of physical stress over the entire length of the run. Use of cable supports, Velcro ties are recommended for strain relieving. Do not over tighten straps or tie-wraps to avoid damage to the cable.
Velcro ties shall always be used for bundling cables properly in channels and raceways.
Cables distributed to the same work area zone may be bundled together.
The maximum number of cables per bundle shall not exceed 50 cables.

DEFINITIONS

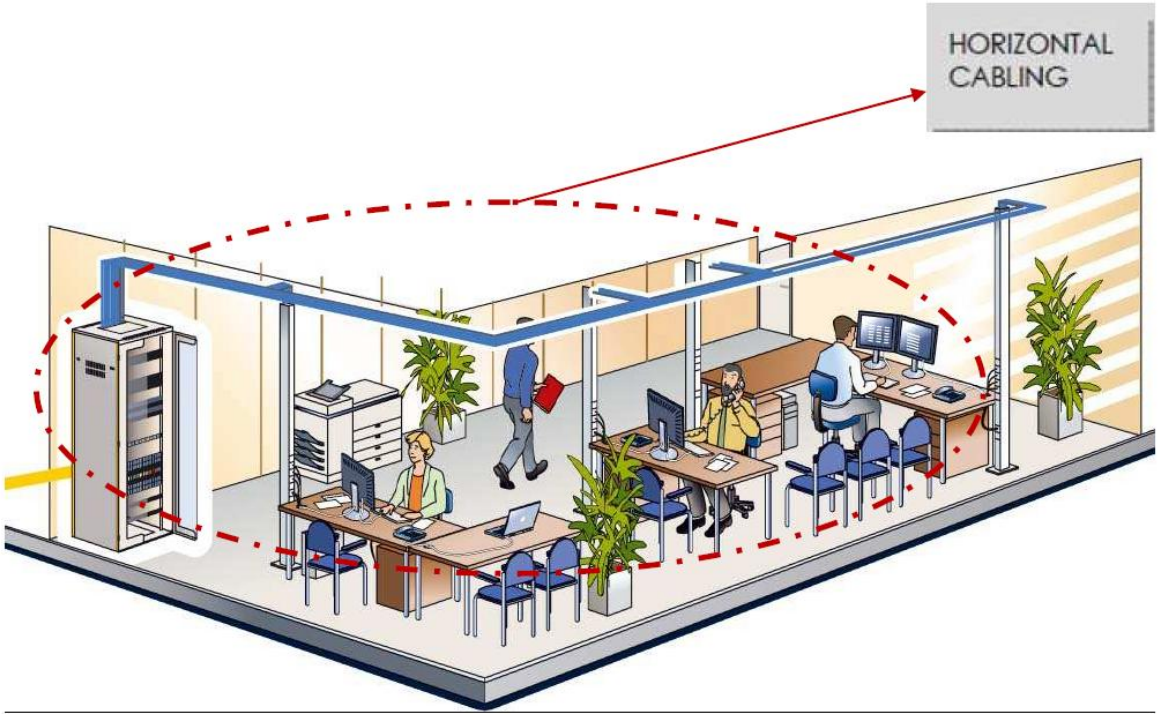
CP: Consolidation Point - a location for the interconnection between horizontal cables that extend from building pathways and horizontal cables that extend into work areas.
MUTOA: Multi-user Telecommunications Outlet Assembly - a grouping in one housing of several telecommunications outlets/connectors.
Open Office - a floor space division provided by furniture, movable partitions, or other means, instead of building walls.

4.1.4 HORIZONTAL CABLING SYSTEM

The specifications in this section make specific reference to the horizontal cabling requirements stated in ANSI/TIA/EIA-568-B.l, Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements.
The internationally recognized standard for premises cabling is ISO/IEC 11801 Ed.2:2002.
In this section, the Students will learn
1) The definition and Scope of the Horizontal Cabling System.
2) Primary design objective of the Horizontal Cabling Design.
3) Key Design Considerations of the Horizontal Cabling System.

Definition and Scope of the Horizontal Cabling System

The horizontal cabling is the portion of the telecommunications cabling system that extends from the work area telecommunications outlet/connector to the horizontal cross-connect in the telecommunication's closet. It includes
a) Horizontal cables;
b) Telecommunications outlet/connector in the work area,
c) The mechanical terminations,
d) Patch cords or jumpers located in the telecommunications closet and
e) May include multi-user telecommunications outlet assemblies (MUTOA's) and consolidation points (CP's).



Design goals

A good cabling plant design always considers possible changes in user requirements in the future. The horizontal cabling is often very inaccessible after the building is completed and can incur high cost of changes and result in disruption to occupants and their work.

Electromagnetic Interference (EMI)

Sources of EMI should be considered when selecting types of horizontal cabling and designing the layout of horizontal pathways.

Potential sources of EMI include:
• Electric motors and transformers that reside in close proximity to telecommunications cabling.
• Copiers that share space with telecommunications cables and equipment.
• Electrical power cables that support such equipment.

Avoiding EMI

1. Maintain physical separation between possible sources and the telecommunications cabling.

Types of Power Line/Equipment	<2 kVA	2 to 5 kVA	> 5 kVA
Unshielded	127mm	305mm	610mm
Unshielded with cable enclosed in a grounded metallic conduit	64mm	152mm	305mm
Lead sheathed power lines with cable enclosed in a separate grounded metallic conduit.	38mm	76mm	152mm

1. Optical fiber and shielded cable should be used for buildings with high levels of ambient EMI.
2. Balanced twisted-pair cabling, such as Category 5e or better (Category 6 recommended), can offer a certain degree of noise immunity that ensures reliable transmission in most environments (e.g., electrical field intensity less than 3 volts per meter [V/m]).

Grounding and Bonding Considerations

For FTP or STP cable used in the horizontal cabling system, Schneider-Electric recommends that the telecommunications grounding/bonding installation shall conform with ANSI J-STD-607-A and ANSI/TIA/EIA-568-B.1-2, Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements, Addendum 2, Grounding and Bonding Specifications for Screened Horizontal Cabling.
Note: ANSI/TIA/EIA-607-A: Commercial Building Grounding and Bonding Requirements for Telecommunications are
superseded by J-STD-607-A.

In General, the following guidelines shall be followed,
a) An approved ground shall be made available at the TC for
– Patch Panel frames.
– Equipment Racks and Cabinets.
– All Active Equipment.

b) The shield of FTP cables shall be bonded through a conducting path to the telecommunications grounding bus-bar (TGB) in the telecommunications room.
c) Shielded connections at the work area are accomplished through a FTP patch cord.
d) Grounding at the work area is usually accomplished through the equipment power connection.
e) At the work area end of the horizontal cabling, the voltage measured between the shield and the ground wire of the electrical outlet used to supply power to the work station shall not exceed Vrms.
f) All patch panel and RJ45 connector have to be direct earthing.

Administration

Schneider Electric Network Connectivity requires proper and systematic methods and procedures for labelling and management of horizontal cabling. The guidelines and requirements for the administration of horizontal cabling systems comply to and make references to ANSI/TIE/EIA-606-A.
1) All cabling must be identified at both ends of the run.
2) Markings on the cable must be:
a) Clearly visible after installation.
b) Easily distinguishable from any manufacturers marking on the cable.
c) Can last the full duration of the warranty

Standard Horizontal Cabling Configuration

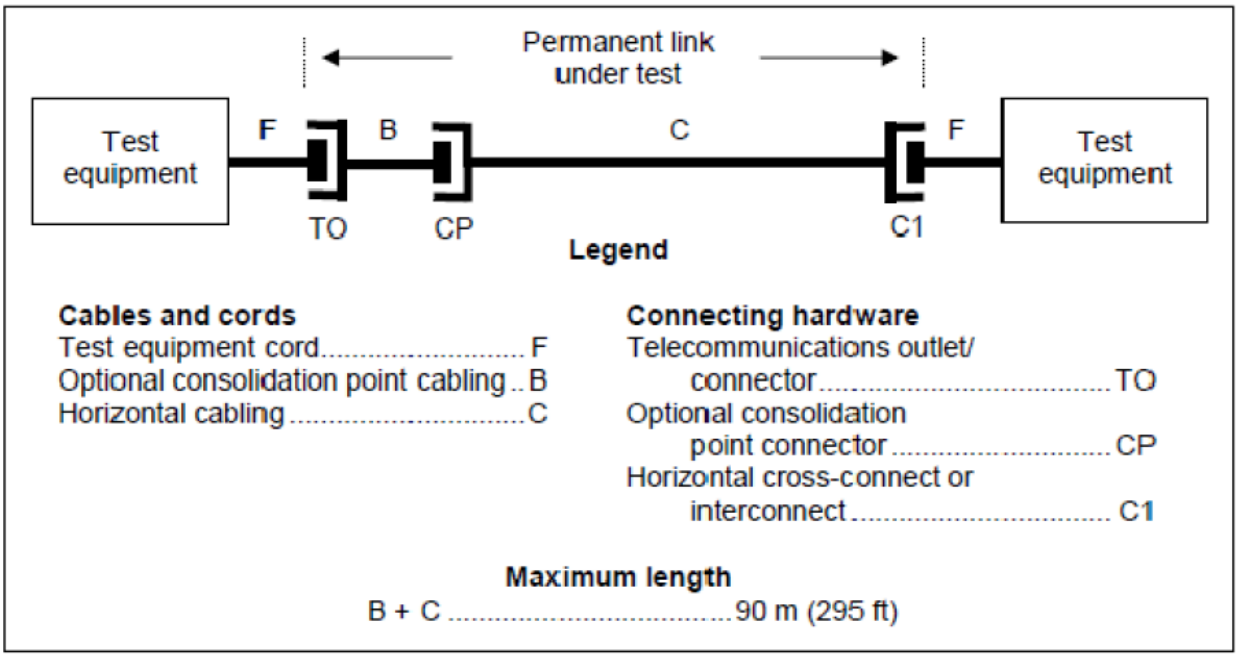


Figure 1.8a: Permanent Link
(Extract from ANSI/EIA/TIA 568-B.2-10)

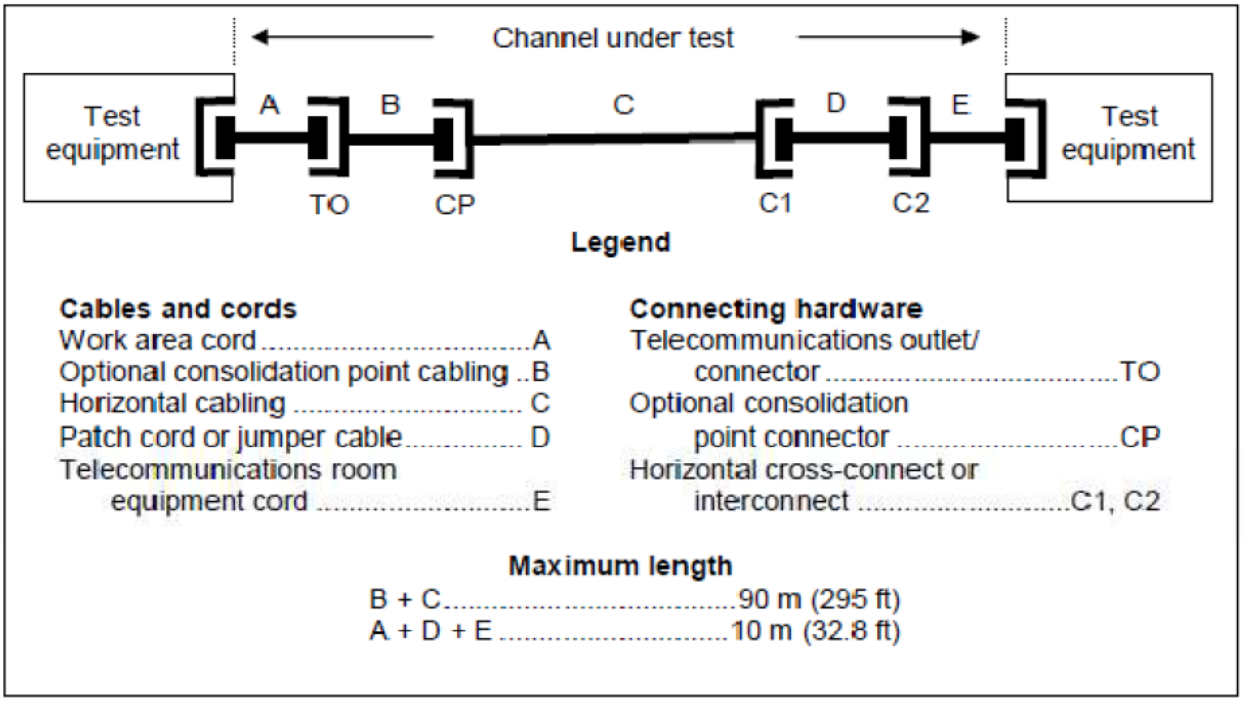


Figure 1.8b: Channel
(Extract from ANSI/EIA/TIA 568-B.2-10)

Connection Schemes

For horizontal cabling, there are 2 recognized schemes for making connections:
1. Cross-connection — A connection scheme that uses patch cords or jumpers that attach to connecting hardware on each end.
2. Interconnection — A connection scheme that facilitates the direct connection of individual cables to another cable or to equipment without a patch cord. The two connection schemes are as follows:

Recognised horizontal cable types

For the link and channel configuration, the recognized horizontal cable type varies depending on standards. The following table summarizes the difference between the various standards.

Horizontal Cable Types	ANSI/TIA/EIA-568-B	ISO/IEC 11801 Ed.2:2002	CENELEC EN 50173 .1:2002
COPPER	100 ohm	100 ohm Class D, E, E_A, F	100 ohm Class D, E, E_A, F
FIBER	50 or 62.5 µm MM Optical Fiber 8 -10 µm SM Optical Fiber	50 or 62.5 µm MM Optical Fiber OM1, OM2, OM3, SM fiber OS1	50 or 62.5 µm MM Optical Fiber OM1, OM2, OM3 SM fiber, OS1

- OM1 62,5µm is not anymore used on the market.

Copper performance categories

There are several performance categories for 100 ohm balanced twisted-pair cable and connecting hardware categories specified in the ANSI/TIA/EIA-568-B series and addenda or ISO/I EC 11801 Ed.2:2002.
The connecting hardware and patch cords used for a horizontal run must be rated in the same category as the cable, or higher. The various category definitions are found in the following table:

Category	Definition
Category 3	Cables and connecting hardware are specified up to 16Mhz Cat3 performance correspond to application CLASS C as specified in ISO/IEC 11801 Ed2:2002
Category 5e	Cables and connecting hardware are specified up to 100Mhz Cat5e performance correspond to application CLASS D as specified in ISO/IEC 11801 Ed2:2002 and ANSI/TIA/EIA-568-B series
Category 6	Cables and connecting hardware are specified up to 250Mhz Cat6 performance correspond to application CLASS E as specified in ISO/IEC 11801 Ed2:2002 and CENELEC EN50173-1
Category 6_A	Cables and connecting hardware are specified up to 500Mhz $Cat6_A$ performance correspond to application CLASS E_A as specified in ISO/IEC 11801 Ed2:2002 and CENELEC EN50173-1:Ed2/A1

Category 7	Cables and connecting hardware are specified up to 600Mhz Cat7 performance correspond to application CLASS F as specified in ISO/IEC 11801 Ed2:2002 and CENELEC EN50173-1
Category 7_A	Cables and connecting hardware are specified up to 1000Mhz Cat7_A performance correspond to application CLASS F_A as specified in ISO/IEC 11801 Ed2:2002 and CENELEC EN50173-1 Am2

NOTE: Categories 2, 4, and 5 cables are not recognized

Category Mixture

Multiple-category balanced twisted-pair system can be confusing and costly to maintain. Schneider Electric endorses the use of single category of cabling components, selected for use in a cabling system. Schneider Electric system warranty does not recognize the use of mix and match categories in a installed cabling system.

Crossovers/Polarity

When there is a need to connect a transmitter on one end and a receiver on the other, a cross over cable is required of the copper pair or fiber cores.

Copper

– If crossover cables are required for copper based cable application, they may be used only outside of the horizontal cabling system. Active equipment will provide the right polarity if need (MDI/MDI-X).

Optical Fiber

– The optical fiber cabling link shall be installed in a pair-wise crossover orientation in which the optical fibers of a pair identified as Position A and Position B at one end are reversed and identified as Position B and Position A (respectively) at the other end.

– This pair-wise crossover for optical fibers is achieved by using connector polarity and labelling methodologies that apply to horizontal cables, patch cords, equipment cords, and duplex optical fiber adapters.

Horizontal Connecting Hardware

General

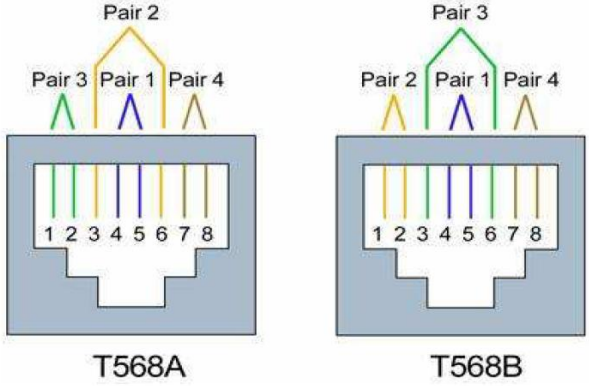
Connecting hardware for horizontal cabling includes:

• Telecommunications outlet/connectors.
• Connectors used in the HCs (FDs).
• CP connectors (optional).

All connecting hardware used for horizontal cable connections must meet the requirements for reliability, safety, and transmission performance specified in the:

• ANSI/TIA/EIA-568-B series or ISO/I EC 11801 Ed.2:2002.
• NEC in the United States.

Figure 1.19b: Eight-position jack pin/pair assignments (front view of connectors)



NOTE: The colours indicated are associated with horizontal balanced twisted-pair cable. Colour coding for equipment cables, work area cords, patch cords, and jumpers may vary.

Centralized Fiber Cabling

Centralized optical fiber cabling is designed to support centralized communications equipment.

Centralized cabling connects the work areas to the centralized cross-connect by allowing the use of interconnect, pull-through cables, or a splice in the TR.

Length limitation

1) The installation length limit of 300m applies to the interconnection and splice methods. It is based on the combined length of horizontal cable, backbone cable, equipment cables, cross-connections, and patch cords.

Within the 300 m limit, multimode cabling system will support gigabit services using centralized networking devices with appropriate optical fiber cable.

2) The cabling length limitation of 90m is associated with the pull-through method. It is based on the length of horizontal cable from the MC (CD) to the TO/WA.

The total allowable length of additional equipment cables at the MC (CD) and equipment cables in the work area is 10m with the pull-through method.

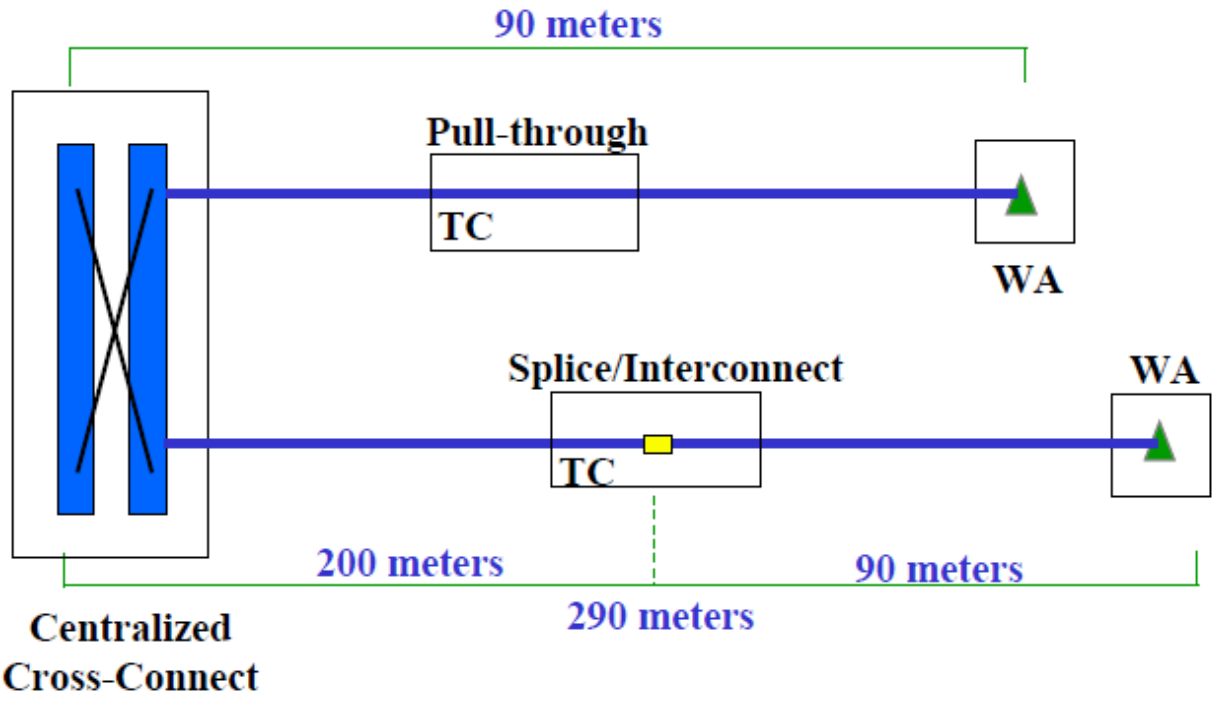


Figure 1.6.1a: Example of centralized optical fiber cabling.

4.1.5 FLOOR DISTRIBUTOR (FD)

They are used to connect between the horizontal cable and other cabling subsystems or equipment. A minimum of one floor distributor should be provided for every floor ; for floor spaces exceeding 1 000 m², a minimum of one floor distributor should be provided for every 1 000 m² of floor space reserved for offices. If a floor space is sparsely populated (for example a lobby), it is permissible to serve this floor from the floor distributor located on an adjacent floor.

A floor distributor combines :
• Identification and management of the horizontal links (through a clear labelling)
• The cross-connection for data networks by mean of copper patch cords and/or fiber optic jumpers. Horizontal (19" panels) and vertical (rings) patch cords routing accessories are compulsory to facilitate a clear organisation of the cross-connections inside a single cabinet.
• The housing of active equipment intended for concentrating, switching or supervising, Data, Video and access control networks.

4.1.6 19" FLOOR STANDING CABINETS :

GENERAL TERMS

COMPLIANCE WITH THE STANDARDS

Standard	Title	Use
IEC 60297-3-100	Mechanical Structure for Electronic Equipment	- Dimension of Mechanical structures of the 19”
EIA-310-E	Cabinets Racks Panels and associated Equipments	- US cabinets and racks standard
IEC60529	Degrees of protection provided by enclosures (IP code)	Degree of protection against liquids and dust to enter the enclosure. - IP 20
IEC62262	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)	Degree of protection from solid bodies to enter the enclosure. - IK10 For plain door - IK08 for glass door

SPECIFIC REQUIREMENTS

4.1.7 ENCLOSURE :

Floor-standing cabinet made of galvanized steel symmetric uprights and following dimension Height:1200, 1400, 1600, 1800, 2000, 2200, Width: 600/750, 800, Depth: 600/800,1000, 1060,1200. Cabinet should be coated with epoxy-polyester powder hot polymerized in textured RAL 7035 for better corrosion resistance.

All the side panels must be flush with the framework to avoid surprises during the installation process. For joined enclosures the total length of the set must be the sum of the individual enclosures that form it to avoid surprises during the installation.

For easier installation and maintenance the cabinet must allow installation of doors on front and back sides (without special accessories) and installation of 2 doors in the same upright.

In case that two or more enclosures are installed together the doors should be able to open without interfering with the adjacent enclosures.

Doors:
Sheet steel plain / transparent door , provided with foamed-in polyurethane gasket and front door opening. Door shall be provided of adjustable reinforcement frame for increased ruggedness and assembly of accessories.

Door shall be supplied with an opening handle to allow easy door managing when equipped,
and shall be provided with a closing system locked by a key number 333.

The impact strength as per IEC 62262 shall be IK10. For enclosures with transparent door must not have any effect on IP degree however, IK08 is acceptable.

Enclosure should allow door opening change. For safety reasons the door must not fall off when totally open and the pins are off the axis of the hinge. Door opening of 180º for easy maintenance.

Accessories:
Enclosure shall be supplied with 19" uprights, 100mm / 200mm / no mm base/plinth, with/without document pocket, earthing straps, with/without 19" profiles, eyebolts / lifting brackets / lifting bars, with/without door switch & lamp.

4.1.8 THERMAL STUDY:

For ED switchboards and Industrial Control boards the supplier must present a thermal study clearly indicating if thermal management measures are needed, and:
> Highest temperature of the board without temperature management
> Necessary cooling power
> Cooling power offered by the solution
> & the calculations made

Operation & Maintenance

4.1.9 QUALITY ASSURANCE

All materials and products shall be new, sound and uniform in quality, size, shape, color and texture.
The assembler shall be responsible for ensuring that the required standards of quality control as mentioned in relative sections are maintained for the proposed enclosures.
If requested by the client, the supplier shall provide proof of application of a quality procedure complying with standards. This means:

- Use of a quality manual approved and signed by a management representative.
- regular updating of this manual so that it reflects the most recent applicable quality control procedures,
- ISO 9001 or ISO 14001 certification

4.1.10 PRODUCT DELIVERY, STORAGE AND HANDLING

- Deliver, store, protect and handle products to site as per manufacturer's instructions.
- Store enclosures in clean and dry space. Inspect for exterior damage. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris and traffic.

- Lift only with lugs provided for the purpose. Handle carefully to avoid damage to enclosure and finish.

4.1.11 SUSTAINABLE DEVELOPMENT

- Production site organisation shall be non polluting and certified to comply with ISO 9001 and ISO 14001 standards.
- Enclosures shall be designed according to Eco-design and the materials shall be of halogen free type.
- Enclosure painting process shall be complying with environmental directives RoHS and REACH.
- Packaging ecological and re-usable as a must.

4.1.12 EQUIPMENT ROOM (ER) SPECIFICATIONS

The Equipment Room houses electronic equipment (PBX, video, computing equipment, etc.) serving building occupants. Many of the TR's installed today can be classed as ER's because they may contain active electronic equipment and need to provide space and maintain a suitable operating environment for large telecommunications and/or computer equipment.
ER's are different and are generally considered to serve a building, a campus, a tenant, or a service provider (SP), and are connected to backbone pathways that run both within and between buildings.
ER's typically contain active equipment, terminations, interconnections, and cross-connections for telecommunications distribution cables.

LOCATION OF THE ER

Consider the following when choosing a location for the ER,

- Distance from telecommunications cable pathways
- Space required for the equipment.
- Expandability
- Cater for access for large equipment and cables.
- Facilities that serve and are served by the ER.
- Service Provider (SP) equipment requirements.
- Distance from electrical service and mechanical equipment.
- Sources of electromagnetic interference (EMI).

Ceiling Requirements

The recommended height of the ceiling in an ER is at least 3 m (10 ft). Ceiling protrusions (e.g., sprinkler heads) must be placed to assure a minimum clear height of 2.4 m (8 ft) that is clear of obstructions, to provide space over the equipment frames for cables and suspended cable trays.
Some equipment may require additional ceiling clearance, depending upon the manufacturer's specifications.

The ceiling finish must:
• Minimize dust.
• Be light coloured to enhance the room lighting.

For fewer than 200 work areas, the minimum ER size shall be no less than 14 m2.

Number of Workstations	Estimated Equipment-Room Floor Space
1 to 100	15 m^2
101 to 400	40 m^2
401 to 800	80 m^2
801 to 1,200	120 m^2

ER shall have access to the main HVAC 24 hours per day, 365 days per year.
• Temperature will be controlled to 18°-24°C (64°-7 5°F).
• Humidity shall be in the range of 30 to 50%. Both humidity and temperature will be measured 1.5m off the floor.

LIGHTING

• Provide a minimum equivalent of 500 lux (50 foot-candles) measured 1 m above finished floors.
• Avoid dimmer switches.
• Coordinate closely with the rack placements.
• Light fixtures mounted min 2.6m above finished floor.
• Emergency lighting is recommended. Place emergency lighting to ensure that the loss of power to normal lights will not hamper an emergency exit from the ER.
• Power for lighting should not come from the power panel inside the ER. At least one light should be on normal power, and one light should be on emergency power, if available.

FIRE SAFETY

Appropriate portable fire extinguishers shall be kept in ER near the entry or exit.

Electrical Power Requirements

Active equipment and systems have strict electrical power requirements. To ensure adequate electrical power closely follow the following:
• Dedicated, non-switched, 3-cable, 240 volt (V) alternating current (ac) duplex electrical outlets for equipment power to prevent interference and accidental power-off for critical equipment.
• Electrical outlets must be on non-switched circuits (electrical outlet power must not be controlled by a wall switch or other device that may lead to inadvertent loss of service).
• Comply with equipment manufacturer's requirements and guidelines.
• Comply with local electrical code requirements.
• Branch circuits for equipment power that are protected and cabled for 20 A (240V) capacity.
• Separate duplex 240 Vac convenience electrical outlets (for tools, field test instruments, located at least 150 mm (6 in) above finished floor and spaced at 1.8 m (6 ft) intervals around perimeter walls.

• Light switch locations should be easily access upon entry.
• Consider providing emergency power to the ER with automatic switchover capability. Consider UPS backup for essential active equipment.
• Distribution panels that serve telecommunications equipment should be separate from those that serve lighting fixtures.
• At least one electrical outlet should be on normal power, and one electrical outlet should be
on emergency power, if available.

Power Conditioning

The sensitivity of telecommunications equipment to electrical power fluctuations is a significant issue in assuring system reliability and longevity. Assess the need for power conditioner before telecommunications equipment is installed. Many UPS devices will provide the required power conditioning.

4.1.13 BACKBONES :

Telephone building distributor (TBD)

It is the link between the Private Block Exchange (PBX) and the telephone network, it permit the allocation of telephone extensions to any floor distributor by the only mean of cross connections.
Telephone lines within building distributor can be either terminated on 8 pairs modules or dedicated RJ45 patch panel (ref. VDIG141501 Schneider-Electric). The TBD is to be located next to the PBX in an area with no electromagnetic disturbances.

Telephone backbones :

As these cables are designed to carry only telephone signals at 64 Kbits cat.3 performance level is sufficient. They will consist of VDIC235212 (Schneider-Electric) Multi-pair cable (128 pairs).
Note : To comply with the principle of standardisation of horizontal links, capillary cables will address the general performance requirements of the cabling system (cat.5^{e} of above).

Data backbones :

Data backbone cat.5e F/UTP :

These cable will reach category 5 performance level with a maximum capacity of 25 pairs (ref. VDIC235225 Schneider-Electric, 100 ohms). Intermediary screens have to be included to avoid power sum NEXT effects.

copper cable colour: should be either green or blue. A white colour is allowed for LSFROH (IEC60332-3C) cable only.

Fiber optic backbone :

Several type of fiber may be used depending on the site specificity :

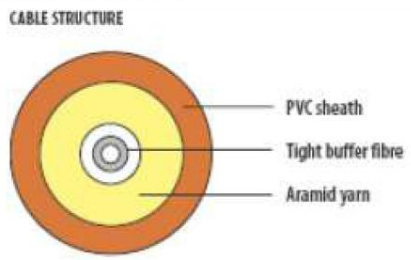
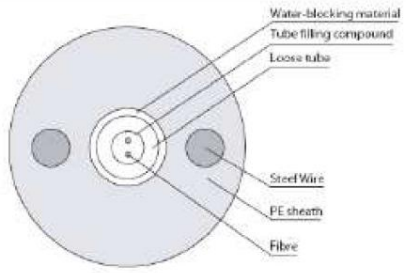
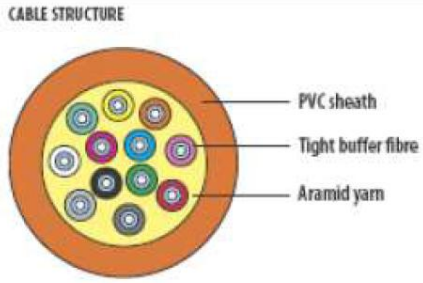
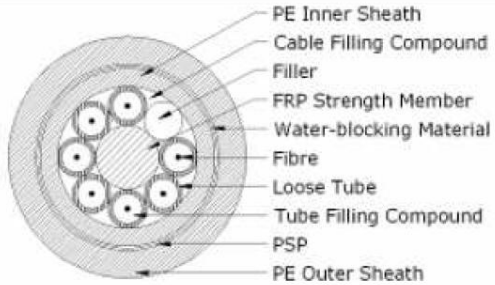
- For indoor use, the fiber cable will be non-armoured. An anti-rodent protection may be included. It should have a tight buffered structure.
- For outdoor use, the fiber cable will be armoured and provide an anti-rodent protection. It should either have a tight buffered or loose tube structure.

Further fiber optic specificity :

LAN fiber optic cables are multimode 50/125 µm type OM3 or OM 4 in a tight buffer structure, connected to SC, ST or LC connectors. For greater sites, the use of dedicated fiber cables (12 or 24 cores) is advisable (ref. VDIC52412T or VDIC52424T)

Cable types

CHARACTERISTICS	
Tight Buffer	**Loose Buffer (Tube)**
More sensitive than loose-buffered cables to: • Adverse temperatures. • Mechanical stresses.	Can operate in wider range of temperature and mechanical stress.
Increased physical flexibility.	Less flexibility due to higher fiber count.
Smaller bend radius for low fiber count cables.	Bigger bend radius
Distribution design: Single jacket protecting all the tight-buffered optical fibers.	
Breakout design: Individual jacket for each tight-buffered optical fiber.	

TIGHT BUFFER	LOOSE BUFFER(TUBE)
	
	
Constructed of materials that meet building fire code requirements.	Constructed of materials that meet outside plant requirements.
Unfilled	Filled
Used as intra-building backbone.	Have a 900 µm plastic coating applied directly to the fiber.
Used in horizontal distribution.	Used for interbuilding backbone distribution.
Used for making patch cords and equipment cables.	

Classifications of copper by functions

Standard copper LAN cables for your day-to-day installations, based on U/UTP and F/UTP cables, from category 5 to category 6_A. The CL-C cables are reliable and well-known, with good performance.

High-end copper LAN cables for performances from category 6 to category 6_A 500 Mhz. While exceeding international standards by 3 dB minimum on NEXT & RL, the cable should have better resistance to the mechanical constraints.

LAN copper cables for category 6_A with a single-foil metallic cross-filler, providing high performance and reliable shielded installations. While exceeding international standards by 3 dB minimum on NEXT & RL, the cable must provide superior shielding, faster installations and increased efficiency.

Also, in order to facilitate cable laying, the cables should be available in dual version.
This will allow only one operation to install two cables.

Classifications of fiber by Buffering mechanism.

The two types of buffering mechanisms for optical fiber cable are:
• Tight buffer (inside plant and underground OSP cables).
• Loose buffer (OSP and some inside plant cables).

Certificates

All LAN cables from Category 6 have to be certified at a component level by the independent third-party laboratory Delta. Certificates are regularly updated to be compliant to the latest and highest international standards.

Category 5E U/UTP 155Mhz cabling :

Specifications

Horizontal cables will be made of 4 twisted copper pairs cable cat.5E UTP. They will consist of CL-C UTP cable (100 ohms) AWG24, 4 pairs or 2x4 twisted pairs without screen from Schneider-Electric or equivalent.
These cables will be made of halogen free compound.
The total length of a single link should not exceed 90 meters (it is admitted that an average length of 40m per link is a maximum).
The cable should support the compatibility of PoE standards (Power over Ethernet) and PoEP (Power over Ethernet Plus) which allow to supply equipments (IP phone, camera, WIFI hotspot…) until 13W or 25W (IEEE 802.3AF and IEEE802.3AT)
Performances
Compliant to EN50173-1, ISO/IEC 11801:2011 Ed2.2, IEC61156-5 Ed2 and TIA/EIA-568-C.2 standards
Cable sheath should be green and the NVP should be printed

Category 5E F/UTP 155Mhz cabling :

Horizontal cables will be made of 4 or 2x4 twisted copper pairs cable cat.5E UTP. They will consist of CL-C cable (100 ohms) from Schneider-Electric or equivalent.
These cables will be made of halogen free compound and should offer a shielding made of an Aluminium foil laid longitudinally throughout the cable. The foil (or the foils) should respect the Snail technology features to improve EMC.
The total length of a single link should not exceed 90 meters.
Cable sheath should be green and the NVP should be printed.

The cable should have superior headroom and bandwidth, exceeding international and local standards.
Improved safety in case of fire
The outer-sheath of the CL-MX should be available in LSFRZH to comply with IEC 60332-1 and 60332-3c standards. This means reduction of the emissions of opaque smoke and acid gases. Thus helps reducing damages to equipment and allows people to escape from the building more easily.
LSZH
LSZH (Low Smoke Zero Halogen) sheath according to test methods IEC 61034 (smoke density), IEC 60754-1 (gas toxicity), IEC 60754-2 (gas corrosiveness) for Tight buffered and Loose tube cables.
Flame retardant
Flame retardant (self extinguishing) according to IEC 60332-1 for Tight buffered and Loose tube cables.
Fire retardant
Fire retardant (no fire propagation along the cable) according to IEC 60332-3C for Tight buffered cables.

The CL-MX cable is wrapped in one single foil, this means less cutting and improved quality of cable preparation.

The total length of a single link should not exceed 90 meters.

High-speed transmission protocols beyond 10Gbit/s highlight ANEXT sensitivity and noise immunity as key performance factors for efficient, secure and robust installations. The single-foil structure of the metallic cross filler acts like a triple screen protection around the copper twisted pairs. This specific design enhances EMC performances to reach grade 1 on the transfer impedance parameter, which is better than a shielded design with braid.

Cable sheath should be blue, and the NVP should be printed

The total length of a single link should not exceed 90 meters.
Cable sheath should be blue or white, and the NVP should be printed.
The outer-sheath of the CL-MX should be available in LSFRZH to comply with IEC 60332-1 and 60332-3c standards. This means reduction of the emissions of opaque smoke and acid gases. Thus helps reducing damages to equipment and allows people to escape from the building more easily.

LSZH

LSZH (Low Smoke Zero Halogen) sheath according to test methods IEC 61034 (smoke density), IEC 60754-1 (gas toxicity), IEC 60754-2 (gas corrosiveness) for Tight buffered and Loose tube cables.

Flame retardant

Flame retardant (self extinguishing) according to IEC 60332-1 for Tight buffered and Loose tube cables.

Fire retardant

Fire retardant (no fire propagation along the cable) according to IEC 60332-3C for Tight buffered cables.

4.1.14 CLASSIFICATIONS OF FIBER BY FUNCTIONS

Intra-building Backbone

The Actassi Indoor and Indoor//Outdoor LSZH Cable is a low smoke zero halogen (LSZH) cable that provides excellent anti flame performance. The need for splicing between indoor and outdoor cables can be eliminated. The buffered tubes are surrounded by Aramid yarns and covered by a low smoke, flame-retardant jacket for protection. A direct outdoor to indoor transition can be completed with this single cable.
The Actassi Indoor LSZH Tight buffered Cables pass most of the following tests:
1) IEC 60754 part 3, Acidity/Corrosively based on pH and Conductivity Measurements
2) IEC 60332-3C, Fire Retardant
3) NES 713, Toxicity Index
4) IEC 61034, Smoke Emissions

The Actassi Indoor/Outdoor Loose tube LSZH Cables pass most of the following tests:
1) IEC 60754 part 3, Acidity/Corrosively based on pH and Conductivity Measurements
2) IEC 60332-1, Flame Retardant
3) NES 713, Toxicity Index
4) IEC 61034, Smoke Emissions

I. Eight fiber-type performances:
a. Normal offer: Multimode OM1, OM2, OM3, OM4; Single-mode OS1,OS2 (G.652D).

The Fiber indoor/outdoor must have a green sheath colour.

4.1.15 BACKBONES CABLING – MULTIMODE FIBER

Fiber

All fiber shall be complete with graded index optical fiber waveguide with mode field diameter of 50um ± 0.5um and cladding diameter of 125um ± 2 um;
Optical fiber shall conform to the OM3 standard defined in ISO-11801 2nd Edition, to support 10Gb Ethernet over increased distances;
Optical fiber shall be in compliance with IEC 60793 and TIA/EIA 492 specifications;
Each fiber shall be contained in a colour-coded nylon jacket for easy identification;
The jacket of each fiber shall ensure colour retention, minimize micro-bending losses, improve handling and be mechanically strippable;
The non-circularity of the core and cladding of each fiber shall be less than 6% and 2% respectively;
The core/cladding concentricity error of each fiber shall be less than 3 um;
All fibers shall operate in both 850nm and 1300nm optical windows with maximum attenuation of 3.1dB/km and 1.3dB/km respectively;
All fibers shall have its minimum information transmission capacity for 850nm and 1300nm optical windows as 200 MHz-km and 500 MHz-km respectively;
Each overall cable diameter shall not exceed 16mm;
All fiber cables shall be of a dry and dielectric construction. No gel or metallic content shall be allowed;
The cable shall have water swell able yarn located with the fibers to prevent the migration of water should the sheath material become punctured;
The minimum allowable bending radius of the cable shall be 10D and 20D during and after installation respectively where D stands for the overall cable diameter;
The cable marking shall include traceable part numbers from the manufacturer packaging to assist in quality validation of the installed cable;

The cable should be a 4 pair or 2x4 pairs categorie 5e , U/UTP.
The screen will be made of aluminium in order to maintain the Electromagnetic Immunity robustness and to meet the quality and performance criteria for high frequencies during all the warranty time of the system.
In case of fire, the sheath of the cable shouldn't produce toxic fumes (HALOGEN FREE) and flame retardant.

All cables shall be 4-pair unshielded Twisted Pair (UTP) cables meeting or exceeding the quality and performance requirements for Category 6 UTP cables stipulated in EIA/TIA-568-B.2-1 standard. Each Category 6 UTP cable shall be terminated on an 8-conductor Category 6 jack in accordance with the EIA/TIA-568B wiring code;
The cable shall be solid or stranded copper conductors of 23 AWG insulated with high density, PVC or LSZH sheath. **Cross filler with optimized design and micro-blades, is preferred**
The cable shall be accompanied with traceable serial numbers from the manufacturer indicated on the packaging to assist in quality validation of the installed cables;
The cable shall provide the guaranteed channel performance specifications of the Category 6 Channel complies to EIA/TIA-568-B.2-1 standard.

Each pair should have an impedance of 100 Ohms, with+/- 15 Ohms, tolerance.

A valid certificate should be delivered by the manufacturer in order to demonstrate the ISO/IEC 11801: 2002 or au standard TIA/EIA 568 B2-10 standard compliance.

Cords (Copper – Fiber):

All patch cord should be RAL 7035 colour coded, pre-wired and tested in factory. These patch cords have to be delivered with colour clip identifier. The connector of these patch cords have to be snag-free to protect the plug-clip from breakage.
For performance purpose, all the patch cords must comply to :
ISO/IEC 11801 Ed 2.2
DELTA Certified
EN 50173 Ed.3.
EIA/TIA 568-C.2
IEC61935-2
For security purpose, all patch cord must be LSZH compliant

Copper :
Patch cords or work area cords, category 5E U/UTP 155Mhz:

Cords are to be of the same manufacturer than cables and connectors used in horizontal links to obtain optimised performances. They will be unshielded and have an impedance of 100 Ohms (ref. VDIP181546020 Schneider-Electric for a 2m length).
Cords must always be as short as possible to ease their management inside cabinets and higher the global performances of the horizontal links.
Cords have to be compliant with : ISO / IEC 11801 Ed 2.2 and third part, updated Delta certified - EN50173ed.3. , EIA/TIA 568 - C.2, IEC 61935-2
Specifications Low Smoke Zero Halogen (LSZH), 4 pairs, 100 ohms, pre-wired and tested in factory, with light grey colour design (RAL7035)
Connectors with grey over-moulding, Snag-free connection to protect the plug-clip from breakage. In order to identify, a pair of COLOR clips Covering either shielded or unshielded will be provided. Each patch cord will be delivered in individual packaging.

Patch cords or work area cords, category 5E F/UTP 155Mhz:

Cords are to be of the same manufacturer than cables and connectors used in horizontal links to obtain optimal performances. They will be shielded and have an impedance of 100 Ohms (ref. VDIP184546020 Schneider-Electric for a 2m length).
Cords must always be as short as possible to ease their management inside cabinets and higher the global performances of the horizontal links.
Cords have to be compliant with : ISO / IEC 11801 Ed 2.2 and third part, updated Delta certified - EN50173ed.3. , EIA/TIA 568 - C.2, IEC 61935-2
Specifications Low Smoke Zero Halogen (LSZH), 4 pairs, 100 ohms, pre-wired and tested in factory, with light grey colour design (RAL7035)

Connectors with grey over-moulding, Snag-free connection to protect the plug-clip from breakage. In order to identify, a pair of COLOR clips Covering either shielded or unshielded will be provided. Each patch cord will be delivered in individual packaging.

Fiber optic jumpers :

The connection to opto-electronic equipment or the cross-connection of two fiber optic links is to be done through fiber optic jumpers fitted to each fiber optic connector on both ends.

Geometrical characteristics of fiber optic jumpers are to be the same than fiber optic links cables.

A minimum length of 2m is to be respected in order to cancel the effect of disturbing signal propagation inside the cladding.

They will be from Schneider-Electric brand or equivalent.

OPTICAL FIBER TELECOMMUNICATIONS OUTLET CONNECTOR

For optical fiber cabling, optical fiber connectors and optical fiber adapters are available in many different sizes and shapes.

Performance of Optical fiber type

STANDARD NOTES

• Horizontal optical fibers at the work area outlet shall be terminated to a duplex optical fibers outlet/connector meeting the requirements of ANSI/TIA/EIA-568B.3.

• To facilitate inter-office moves, consider the use of one style of duplex connector for the work area outlet.

• The 568SC connector/adapter has been recognized by industry standards for many years. This connector/adapter type and any additional standards-compliant connector/adapter styles, including the Small Form Factor (SFF) styles (e.g. LC), may also be considered.

OM3 and OM4 have an additional laser launch modal bandwidth as OM3 and OM4 are designed to be laser optimized. The difference between “Overfilled Launch" and “Laser Launch" is the test method. A new test method simulating a VCSEL laser launch (TIA-455-220A and IEC 60793-1-49) was deemed appropriate for these fibers which are intended for use with VCSELs at higher speeds.

Fiber Type	Max. attenuation (db/km)		Min. modal bandwidth (MHz x km)		
			Overfilled launch		*Laser launch*
	850nm	1300nm	850nm	1300nm	850nm
OM1	3,5	1,5	200	500	Not specified
OM2	3,5	1,5	500	500	Not specified
OM3	3,5	1,5	1500	500	2000
OM4	3,5	1,5	3500	500	4700

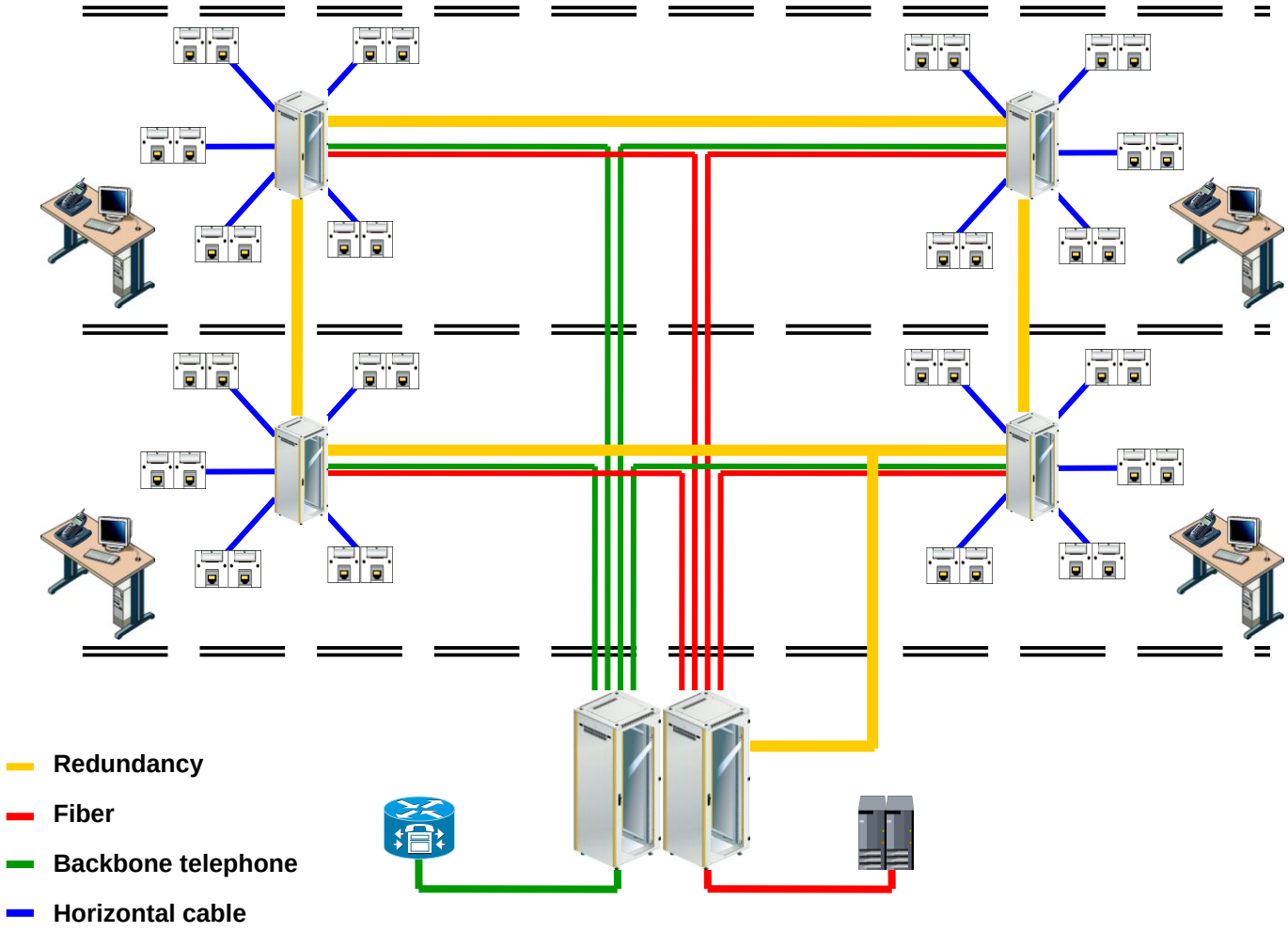
OM4 fiber is a laser-optimized, high bandwidth 50um multimode fiber. Formerly, it was called OM3-550 fiber. TIA approved EIA/TIA 492AAAD (OM4) on August 5, 2009

OM4 fiber is designed to enhance the system cost benefits enabled by 850nm VCSELs for existing 1 Gb/s and 10 Gb/s applications as well as future 40 Gb/s and 100 Gb/s systems.

OM4 fiber supports Ethernet, Fiber Channel, and OIF applications, allowing extended reach upwards of 550 meters at 10 Gb/s for ultra long building backbones and medium length campus backbones.

Star topology network with redundancy links

The basis of a cabling system organisation is shown by the following diagram. It shows a star organisation model of FD around the BD. It is to notice that the redundant backbone links shown are not compulsory but offer a higher security margin against breaks.



Universal components used for telephone and data networks : Category 5E UTP RJ45 connector :

- ***Terminal outlet :***

All terminal outlets are to be universal.

A workstation will include a minimum of 2 (two) outlets (e.g. one for telephone application, the other one assigned to the data network).

Terminal outlets are to be made of **cat.5E RJ45 8-pin modular jacks**, normalised by ISO 8877 (reference VDIB17725U12 Schneider-Electric or equivalent).

RJ45 modular jacks are to be mounted on faceplate from the local standards. The faceplate have to be properly equipped to accept screw-on adapters and splitters (i.e. have a build-in nut).
Note : The outer size of the faceplate may be different if the screwing feature described above is respected (e.g. ref. 5034 Schneider-Electric Italian plate).

Bridged taps and splitters shall not be used as part of the backbone cabling. (TIA/EIA-568-B.1)

Category 5E FTP RJ45 connector :

- ***Terminal outlet :***

All terminal outlets are to be universal.

A workstation will include a minimum of 2 (two) outlets (e.g. one for telephone application, the other one assigned to the data network).

Terminal outlets are to be made of **cat.5E RJ45 8-pin modular jacks**, normalised by ISO 8877 (reference VDIB17725B12 Schneider-Electric or equivalent).

RJ45 modular jacks are to be mounted on faceplate from the local standards. The faceplate have to be properly equipped to accept screw-on adapters and splitters (i.e. have a build-in nut).
Note : The outer size of the faceplate may be different if the screwing feature described above is respected (e.g. ref. 5034 Schneider-Electric Italian plate).

Bridged taps and splitters shall not be used as part of the backbone cabling. (TIA/EIA-568-B.1)

6 ENTRANCE FACILITY (EF)

The Entrance Facility consists of service entrance to the building including the building wall penetration and continuing to the ER. The EF may also contain backbone paths to link other buildings as well as antenna entrances.
• All carriers and telecommunications providers involved in providing service shall be contacted to establish their requirements.
• Easements, permits and rights of way may be required.
• A service entrance pathway shall be provided (underground, aerial, buried).
• See standard for specifications defining manholes, penetrations, etc.
• Grounding and bonding to NEC or local code guidelines.

NOTES	DETIALS
Terminating space should be located where the facilities enter the building	• Limit the amount of exposed cable in the building (possibility of fire) to < 15 m (50 ft) of exposed non-fire-rated entrance cable within a building. • If more than 15m of cable is required between the entry point and the termination point, use rigid • Metallic conduit to enclose the cable. • Conduit must be grounded. Fire-rated tape wrap is not acceptable.
Ensure accessibility at all time	• Termination space should never be located within one tenant's space in a multi-dwelling building. • The termination room, telecommunications room, or space in a multi-dwelling building must be accessible through a common corridor or an outside door. • Entry to any locked termination space must be • available through: 1. 1 Maintenance personnel, or 2. 2 A common key provided to each tenant.
Safe and environmentally clean	• Safely accessible. • Free of any storage material or other obstructions. • Standard working height without the need for ladder or scaffold. • Free from moisture and severe temperature conditions.
Properly powered	An individual branch circuit is required for testing and Maintenance.
Lighting	500 lux minimum (50 foot-candles).

7 TELECOMMUNICATIONS ROOMS :

Dedicated telecommunications room :

A telecommunications room should provide all the facilities (space, power, environmental control etc.) for passive components, active devices (HUB, Switches, routers etc.), and external network interfaces housed within it. Each telecommunications room should have direct access to the backbone cabling subsystem. It has to be of a sufficient surface (6 m² minimum) and secured (intrusion, fire, water flood). The use of raised floor is advisable. It is compulsory cool or ventilate the telecommunications room.

Among a direct access to the backbones, the telecommunications room are to be installed as close as possible to the centre of the served area to shorten the horizontal links lengths (better performances and lower costs).

TR SPECIFICATIONS

a. The telecommunications room must be dedicated to telecommunications functions.
b. Equipment not related to telecommunications shall not be installed in telecommunications
room.
c. Two walls 2.5 meters (8 ft) high covered with 20mm (3/4 inch) A-C void-free plywood
d. Minimum Floor Loading Capacity
• 2.4 kPa (50 lbf/ft2)
d. False ceilings are not permitted

LIGHTING

• Provide a minimum equivalent of 500 lux (50 foot-candles) measured 1 m (3 ft) above finished floors.
• Avoid dimmer switches.
• Coordinate closely with the rack placements.
• Light fixtures mounted min 2.6m (8.5 ft) above finished floor.
• Emergency lighting is recommended. Place emergency lighting to ensure that the loss of power to normal lights will not hamper an emergency exit from the TR.
• Power for lighting should not come from the power panel inside the TR. At least one light should be on normal power, and one light should be on emergency power, if available.

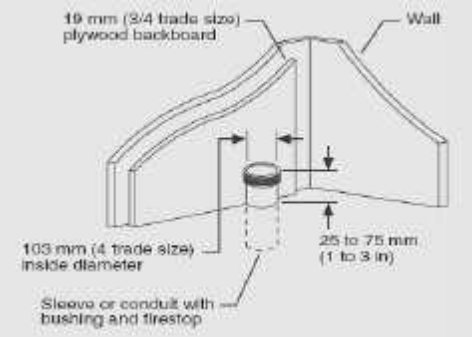
DOORS

• Fully open (180 degrees) lockable doors with minimum door size 0.9 m (36 in) wide by 2m (80 in) high.
• Door sills are not allowed because they impede the movement of equipment.
• Doors that open outward provide additional usable space and reduce constraints on TR layout.
• Door should have a lock.

POWER SUPPLY

• Branch circuits for equipment power that are protected and cabled for 20 Amp capacity (240 volts depending on the local utilities regulation)
• Minimum of two dedicated, non-switched, 3-cable, 240 volts (V) alternating current (ac) duplex electrical outlets for equipment power, each on separate branch circuits.
• Separate duplex 240 Vac convenience electrical outlets (for tools, field test instruments, located at least 150 mm (6 in) above finished floor and spaced at 1.8 m (6 ft) intervals around perimeter walls.
• Light switch locations should be easily access upon entry.
• Electrical outlets must be on non-switched circuits (electrical outlet power must not be controlled by a wall switch or other device that may lead to inadvertent loss of service).

• Consider providing emergency power or UPS backup to the TR with automatic switchover capability, to ensure continuous operation of any active equipment located in the TR.
• Distribution panels that serve telecommunications equipment should be separate from those that serve lighting fixtures.
• At least one electrical outlet should be on normal power, and one electrical outlet should be
on emergency power, if available.
• Sleeves or slots should be located adjacent to door and fire stopped except during cable installation.



Flood Prevention

Do not locate TRs in areas prone to flooding. Avoid locations that are below or adjacent to areas of potential water hazard (e.g., areas below water table, restrooms and kitchens).

Cross-Connect Field Identification

Well-organized colour coding helps to identify backbone and horizontal cables quickly and helps ensure that cable topology requirements are met. Accepted methods for colour coding cross-connect fields include coloured backboards, connections, covers or labels. The following is per ANSI/TIA/EIA 606A recommendations:

Color	Identification
Orange	Demarcation point (e.g., central office connections).
Green	Network connections (e.g., network and auxiliary equipment).
Purple	Common equipment (e.g., connections to private branch exchange [PBX], Local Area Networks [LANs], mainframe computer, multiplexer).
White	First-level backbone (e.g., termination of building backbone cable connecting MC [CD] to ICs [BDs]).
Gray	Second-level backbone (e.g., termination of building backbone cable connecting ICs [BDs] to HCs [FDs]).
Blue	Horizontal cable (e.g., horizontal connections to telecommunications outlet/ connectors).
Brown	Interbuilding backbone (campus cable terminations). NOTE: Brown takes precedence over white or gray for interbuilding runs.
Yellow	Miscellaneous (e.g., auxiliary, alarms, security).
Red	Reserved for future use (also, key telephone systems).

Clearances

• Minimum m (3 ft) of clear working space from equipment and cross-connect fields.
• 150 mm (6 in) depth off wall for wall-mounted equipment.
• Allocate a space of at least 1000 mm wide, 1000 mm deep, and 2.3 m high for each equipment rack or cabinet.
• Provide space for an aisle of at least 1000 mm wide in the front and in the rear of the space allocated for each equipment rack or cabinet.

PATCH PANELS

Category 5e patch panels :

Empty or equipped sliding panel 1U 24 port RJ45.
The patch panel will have 24 RJ45 port with a QUICKFIX function on both sides to allow a simple, quick fixing position and sliding feature. Automatic earthing for STP version will be done.
The patch panel will have individual cable management at the back and also rear position numbers to keep track on the installation. Labelling has to be integrated on each side of the QUICKFIX system.

Patch panels will be equipped with RJ45 cat.5e shielded (ref. VDIB118241F50 ACTASSI S-ONE with a 360° shielding), or RJ45 cat.5e unshielded (ref. VDIB118241U50 Schneider-Electric).

One patch cord guiding panel (ref. VDIG188141 Schneider-Electric) is to be forecasted each 24 ports.

Alternatively vertical patch cord routing rings (ref. VDIM189111 FOR 600X600 OR VDIM189112 FOR 800X800 Schneider-Electric) will be placed on the 19" uprights at each side of the cabinet (4 rings per uprights is to be forecasted).

The active equipment to be housed in cabinet will be subjected to independent technical specifications proposal.

Shielded panels should include shutters removable from the panel for dust proof. Optional colouredearthing shutters should be supported to increase port identification.

The preferred colour of the patch panel is RAL 7016 (dark grey) in order to be homogeneous with all the RACK and other patch panels.

Category 6 patch panels :

Empty or equipped sliding panel 1U 24 port RJ45

The patch panel will have 24 rj45 port with a QUICKFIX function on both sides to allow a simple, quick fixing position and sliding feature. Automatic earthing for STP version will be done.
The patch panel will have individual cable management at the back and also rear position numbers to keep track on the installation. Labelling has to be integrated on each side of the QUICKFIX system.

Patch panels will be pre-equipped with RJ45 cat.5e shielded (ref. VDIG17725B12 ACTASSI S-ONE with a 360° shielding), or RJ45 cat.5e unshielded (ref. VDIG17725U12 Schneider-Electric).

One patch cord guiding panel (ref. VDIG188141 Schneider-Electric) is to be forecasted each 24 ports.

Alternatively vertical patch cord routing rings (ref. VDIM189111 for 600X600 or VDIM189112 for 800X800 Schneider-Electric) will be placed on the 19" uprights at each side of the cabinet (4 rings per uprights is to be forecasted).

The active equipment to be housed in cabinet will be subjected to independent technical specifications proposal.

Shielded panels should include shutters removable from the panel for dust proof. Optional coloured shutters should be supported to increase port identification.

The preferred colour of the patch panel is RAL 7016 (dark grey) in order to be homogeneous with all the RACK and other patch panels.

Category 6A patch panels :

Empty or equipped sliding panel 1U 24 port RJ45
The patch panel will have 24 RJ45 port with a QUICKFIX function on both sides to allow a simple, quick fixing position and sliding feature. Automatic earthing for STP version will be done.
The patch panel will have individual cable management at the back and also rear position numbers to keep track on the installation. Labelling has to be integrated on each side of the QUICKFIX system.

Patch panels will be pre-equipped with RJ45 cat.6_A shielded (ref. VDIG118241BX0 ACTASSI S-ONE with a 360° shielding), or RJ45 cat.6_A unshielded (ref. VDIG118241UX0 Schneider-Electric).

One patch cord guiding panel (ref. VDIG188141 Schneider-Electric) is to be forecasted each 24 ports.

Alternatively vertical patch cord routing rings (ref. VDIM189111 FOR 600X600 or VDIM189112 for 800X800 Schneider-Electric) will be placed on the 19" uprights at each side of the cabinet (4 rings per uprights is to be forecasted).

The active equipment to be housed in cabinet will be subjected to independent technical specifications proposal.

Shielded panels should include shutters removable from the panel for dust proof. Optional coloured shutters should be supported to increase port identification.

The preferred colour of the patch panel is RAL 7016 (dark grey) in order to be homogeneous with all the RACK and other patch panels.

telecom panels

The sliding function does permit the use of the punch down tool for LSA contacts with the panel in a sliding-out position. The telecom panel must have a cable identification to avoid the need trying to figure out which cable goes where. The cable identification is very clear on the clever fixing guides. Out of this identification a clear marking with pre-printed labels and openable label holders will be part of the patch panel.
Finally, the panel has to have two earthing connection points for both shielded cables and for the rack, easily accessible at the rear.

Sliding Fiber optic panel 1U:

They will have a capacity of 4 positions equipped with 3 blank plates. Each plates will have 3 SC/ST/LC or 6 ST SIMPLEX/LC DUPLEX.
The fiber patch panel will have a 0U cable management at the front with integrated clear marking number in order to identify the cables. At the rear of the sliding fiber panel, a rear quick fixation to use with a cable gland provide with the panel.
The patch panel has to be equipped with a transparent cover protection at the front, and on the top of the panel. Finally, the panel will have one or two coiling wheels to avoid tension on the connectors, and to respect the fiber bend radius. Labelling has to be integrated on each side of the QUICKFIX system.

The preferred colour of the patch panel is RAL 7016 (dark grey) in order to be homogeneous with all the RACK and other patch panels.

Cable management:

Patchcord guiding panel :

In between each patch panel a patch cord guiding panel should be inserted. This patch cord guiding panel should have 1 U height and be fixed with ONLY 2 screws. This

guiding panel must have 4 OPENABLE rings for ease of use, and as they have OPENABLE, they also have to be able to be CLOSED.

Each of these 4 rings should be removable for maintenance purpose.

Vertical rings :

In order to organise in a proper way the cabling in a rack, we recommend to use openable vertical rings. For rack 800x800mm a large capacity of up to 48 cords is recommended.
In a rack of 600X600mm a VELCRO openable vertical ring is best suitable.

Cable ties to bundle the cable are forbidden. Velcro should be used instead.

Telephone backbone wiring

Multipair backbones cables coming from the Telephone Building Distributor will either be terminated on 8-pairs modules or dedicated patch panels offering 50 RJ45 cat.3 ports on 1U (ref. VDIP141501 Schneider-Electric).
50 ports in 2 rows RJ45 patch panels will be given priority as it suits the universality feature of a cabling system. Cable organizer and label holders is mandatory.
A cross connection from the telephone backbone to the horizontal cables will allocate an extension number to the chosen telecommunication outlet.
A quickfix function on both sides to allow simple fixing and sliding feature.

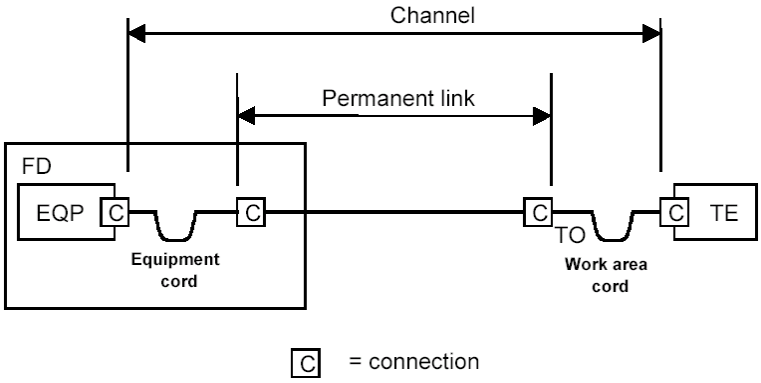
Transmission performances :

The performance of a horizontal cabling is specified for channels and permanent links.

The channel is the end-to-end transmission path connecting any two pieces of application specific equipment. It includes both work area and equipment cords which are inserted into the tester and remote equipment.

The permanent link is the transmission path between the telecommunication outlet and the floor distributor. The permanent link does not include work area cords, equipment cords and jumpers, but includes the connection at each end. It can include a CP link. In this case, the test cords to be used are the one of the testing equipment.

Permanent link and channel



Interpreting test results should always take into account that the ultimate goal is "to be sure that any application will run on the cabling".

Values according to ISO 11801 – Ed:2.2 - ISO/IEC 2010(E)

Class D @ 100 MHz

Class D, permanent link (90m with consolidation point)									
Frequency	Insertion loss	NEXT p/p*	ACR p/p	PS NEXT*	PS ACR	PP EL FEXT*	PS EL FEXT*	Return Loss**	Propagation delay
MHz	**dB**	**dB**	**dB**	**dB**	**dB**	**dB**	**dB**	**dB**	**ns**
1	**4,0***	**64,2**	**60,0**	**57,0**	**53,0**	**58,6**	**55,6**	**19,0**	**521**
16	**7,7**	**45,2**	**37,5**	**42,2**	**34,5**	**34,5**	**31,5**	**19,0**	**496**
100	**20,4**	**32,3**	**11,9**	**29,3**	**8,9**	**18,6**	**15,6**	**12,0**	**491**

Class E @ 250 MHz

Class E, permanent link (90m with consolidation point)									
Frequency	Insertion loss	NEXT p/p*	ACR p/p	PS NEXT*	PS ACR	PP EL FEXT*	PS EL FEXT*	Return Loss**	Propagation delay
MHz	**dB**	**dB**	**dB**	**dB**	**dB**	**dB**	**dB**	**dB**	**ns**
1	**4,0**	**65,0**	**61,0**	**62,0**	**58,0**	**64,2**	**61,2**	**21,0**	**521**
16	**7,1**	**54,6**	**47,5**	**52,2**	**45,1**	**40,1**	**37,1**	**20,0**	**496**
100	**18,5**	**41,8**	**23,3**	**39,3**	**20,8**	**24,2**	**21,2**	**14,0**	**491**
250	**30,7**	**35,3**	**4,7**	**32,7**	**2,0**	**16,2**	**13,2**	**10,0**	**490**

Class E_A @ 500 MHz

Class E_A, permanent link (90m with consolidation point)										
Frequency	Insertion loss	NEXT p/p*	ACR p/p	PS NEXT*	PS ACR	PS ANEXT	PP EL FEXT*	PS EL FEXT*	Return Loss**	Propagation delay
MHz	**dB**	**dB**	**DB**	**dB**	**dB**	**dB**	**dB**	**dB**	**dB**	**ns**
1	**4,0**	**65,0**	**61,0**	**62,0**	**58,0**	**67,0**	**64,2**	**61,2**	**21,0**	**521**
16	**7,0**	**54,6**	**47,6**	**52,2**	**45,2**	**-**	**40,1**	**37,1**	**20,0**	**496**
100	**17,8**	**41,8**	**24**	**39,3**	**21,5**	**60,0**	**24,2**	**21,2**	**14,0**	**491**
250	**28,9**	**35,3**	**6,4**	**32,7**	**3,8**	**54,0**	**16,2**	**13,2**	**10,0**	**490**
500	**42,10**	**29,2**	**-12,9**	**26,4**	**-15,7**	**49,5**	**10,2**	**7,2**	**8,0**	**490**

Class F @ 600 MHz

Class F, permanent link (90m with consolidation point)									
Frequency	Insertion loss	NEXT p/p*	ACR p/p	PS NEXT*	PS ACR	PP EL FEXT*	PS EL FEXT*	Return Loss**	Propagation delay
MHz	**dB**	**dB**	**dB**	**dB**	**dB**	**dB**	**dB**	**dB**	**ns**
1	**4,0**	**65,0**	**61,0**	**62,0**	**58,0**	**65,0**	**62,0**	**21,0**	**521**
16	**6,9**	**65,0**	**58,1**	**62,0**	**55,1**	**59,3**	**56,3**	**20,0**	**496**
100	**17,7**	**65,0**	**47,3**	**62,0**	**44,3**	**46,0**	**43,0**	**14,0**	**491**
250	**28,8**	**60,4**	**31,6**	**57,4**	**28,6**	**39,2**	**36,2**	**10,0**	**490**
500	**42,1**	**55,9**	**13,8**	**52,9**	**10,8**	**34,0**	**31,0**	**10,0**	**490**
600	**46,6**	**54,7**	**8,1**	**51,7**	**5,1**	**32,6**	**29,6**	**10,0**	**489**

Class F_A @ 1000 MHz

Class F_A, permanent link (90m with consolidation point)									
Frequency	Insertion loss	NEXT p/p*	ACR p/p	PS NEXT*	PS ACR	PP EL FEXT*	PS EL FEXT*	Return Loss**	Propagation delay
MHz	dB	dB	dB	dB	dB	dB	dB	dB	ns
1	**4,0**	**65,0**	**61,0**	**62,0**	**58,0**	**65,0**	**62,0**	**21,0**	**521**
16	**6,8**	**65,0**	**58,2**	**62,0**	**55,2**	**64,7**	**61,7**	**20,0**	**496**
100	**17,3**	**65,0**	**47,7**	**62,0**	**44,7**	**48,8**	**45,8**	**14,0**	**491**
250	**27,7**	**61,7**	**34,0**	**58,7**	**31,0**	**40,8**	**37,8**	**10,0**	**490**
500	**39,8**	**56,1**	**16,4**	**53,1**	**13,4**	**34,8**	**31,8**	**10,0**	**490**
600	**43,9**	**54,7**	**10,8**	**51,7**	**7,8**	**33,2**	**30,2**	**10,0**	**489**
1000	**57,6**	**49,1**	**-8,5**	**46,1**	**-11,5**	**28,8**	**25,8**	**8,0**	**489**

If NEXT and PS NEXT values are above standards and insertion loss is below 4 dB, ACR and PS ACR values are to be used as reference.

Cable routings inside buildings :

Horizontal routings through cable trays :

Cable trays will be grounded. They should be sized to allow cable strands to be not thicker than 50mm (an average section of 200mm² is to be forecasted for each 4 pairs cable).

Vertical routings through dry risers :

Dry risers should offer 50% available space to enable the re-cabling of a complete area. Between two floors, cable-through have to be sealed off (fire protection).

Workstations supply :

In theory, a workstation is designed for the connection of all the equipment of a user in a space measuring approximately 10m². The faculty of doubling applications to allow two users to be connected instead of one is particularly interesting but should remain an exceptional measure.

The choice of workstation supports is particularly important because it governs the flexibility of the working areas. Wall boxes and cable routings on or in removable partitions are to be eliminated.

Distribution modes will be designed to directly receive high power and data connectors to the 45x45mm standard shape. The chosen distribution modes according to the building layout are described here after :

- Open spaces : PVC trunking system with 3 compartments ref. 64560 Schneider-Electric, which allow to easily move outlets within the central compartment and also insures an optimal distance between power supply cables and data cables.

- Offices with trays in false ceiling : distribution poles ref. Schneider-Electric 64543 (basic), 64541 (1 box) or 64542 (2 boxes).

- Offices with trays in raised floor : under carpet latch (ref. 6510 Schneider-Electric) and low profile boxes or multifunctional boxes (Schneider-Electric or equivalent).

- Refurbishment : individual wall mounted boxes housing both high voltage and data cables.

8 PATHWAYS AND SPACES

ANSI/TIA/EIA 569-B – COMMERCIAL BUILDING STANDARD FOR TELECOMMUNICATIONS PATHWAYS AND SPACES

The purpose of this standard is to standardize design and construction practices intra-and interbuildings (commercial premises) related to pathways and spaces for supporting telecommunications media and equipment.
Standards are given for different types of rooms found in a commercial premise and the cabling pathways leading into the rooms. The following are the different type of spaces and pathways found in a typical commercial building shown in diagram 4.2.
Horizontal pathways and related spaces: Those facilities that serve as pathways for the installation of telecommunications media from the telecommunications room (TR) to the work area (WA).
Intrabuilding backbone pathways and related spaces: Those facilities that may exist in a building that are usually formed by vertically stacking TRs with floor openings between them. Tie pathways may also exist to permit installation of backbone media between multiple TRs on the same floor.

Work area (WA): A building space where the occupant normally interacts with telecommunications equipment. That part of the building known as your office or cubicle. That part of a building where your telephone and PC are located.
Telecommunications Room (TR): A floor serving space that houses telecommunications equipment, cable terminations, and related cross-connections. It may also be referred to as the connection point between backbone and horizontal pathways.
Equipment room (ER): A building or campus serving space that satisfies the space and environmental needs of larger telecommunications equipment. Equipment rooms are connected to backbone facilities (pathways). Note: in our modern telecommunication systems, the room we usually refer to as a TR in the 568 Standard is actually an ER in this standard because it contains active equipment.
Entrance facilities (EF): Include Inter-building backbone pathways, service entrance pathway, entrance point, entrance room or space, alternate entrance, and antenna entrance.

8.1 HORIZONTAL PATHWAYS

8.1.1 RECOGNIZED HORIZONTAL PATHWAYS

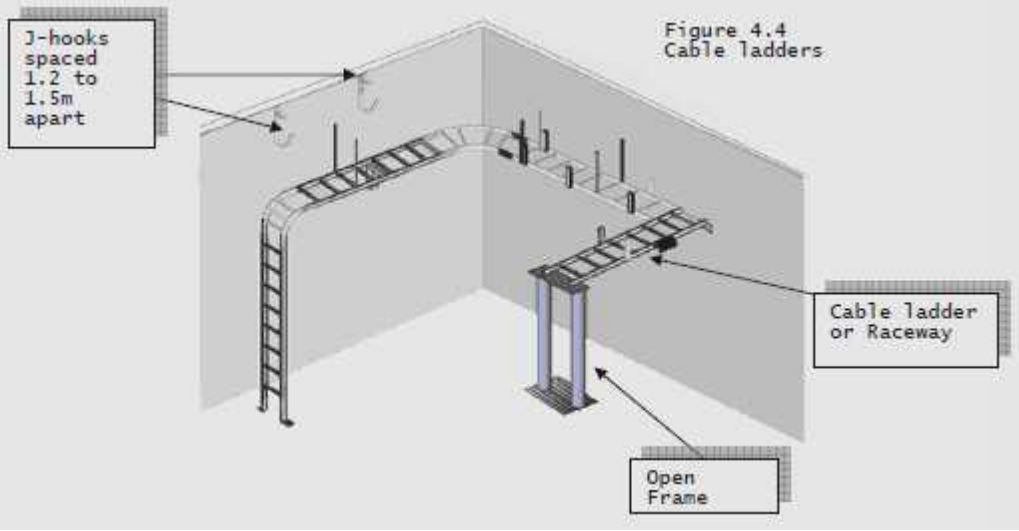
a. Conduit, Cable trays and Raceways
b. Access (raised) floor
c. Ceiling (Utility columns [power poles], Zones, Wall, and Partition cabling)
d. Perimeter pathways (Surface, Recessed, Moulding, and Multi-channel raceways)
e. Miscellaneous
• Consolidation points
• MUTOAs
• Interstud
• Under-carpet

8.1.2 HORIZONTAL PATHWAYS NOT COVERED

• Over floor raceway
• Exposed cabling
• Poke-thru
• Curtain wall
• Under floor (steel and concrete cells)

8.1.3 Cable Trays

As an alternative to conduit, cable trays can be installed to route your cable. Cable trays are typically wire racks specially designed to support the weight of a cable infrastructure. They provide an ideal way to manage a large number of horizontal runs. Cables simply lie within the tray and are very accessible when it comes to maintenance. The ANSI/TIA/EIA-569-B Standard provides for cable trays to be used for both horizontal and backbone cables.
Figure 4.4 below shows a cable runway system inside the TR. This type of runway looks like a ladder that is mounted horizontally inside the ceiling space or over the top of equipment racks. This type of runway keeps cables from being installed near the top of fluorescent lights, HVAC equipment, or ceiling tiles.
This method is useful in preventing cable from crossing electrical conduit. Separating the cable is especially useful near telecommunication and equipment rooms where there may be much horizontal cable coming together.
When used in a telecommunications or equipment room, this runway can keep cables off the floor or run from a rack of patch panels to an equipment rack.



As per ANSI/TIA/EIA-569-B Standard, conduit can be used to route horizontal and backbone cables.
Fire-stopped conduit should be used to connect wiring Rooms in multitenant buildings.
Although there are some local building codes that require the use of conduit for all cable, both telecommunication and electrical, communication cables shall NOT be installed in the same conduit as electrical cables without any physical barrier between them.
Conduit installation is cost effective. However, conduit installation has limited flexibility in terms of expansion and making cable changes.

8.1.4 Ceiling distribution systems

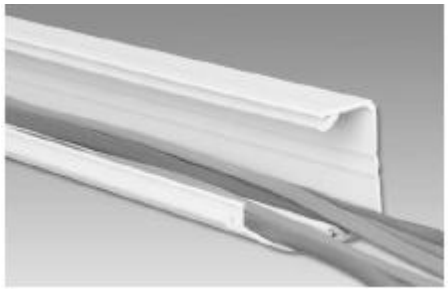
Utilizes the space between:
- The structural ceiling and
- An accessible ceiling grid suspended below the structural ceiling.

General Guide for using ceiling distribution:
- Lock tile, drywall, and plaster ceilings shall not be used as pathways.
- Removable tiles placed at maximum 3.5 m (11 feet) above floor; minimum 2.5 m (eight feet) above floor.
- Cable will NOT be laid directly on top of ceiling tiles.
- Cable will NOT be supported by, or attached to, ceiling hanger-wire or rod.
- Minimum clearance of 75 mm (three inch) vertical space above tiles.
- Utility poles will be attached to, and supported by, main ceiling structure.
- Entrances into hollow (capped) walls shall be reamed and bushed.
- Cables shall be supported every 1.2 – 1.5 meters (48 to 60 inches).

8.1.5 Perimeter Raceway Systems

Raceways are considered to be special types of conduits used for surface mounting horizontal cables and are usually pieced together in a modular fashion with vendors providing connectors that do not exceed the minimum bend radius.
Raceways are useful where cable cannot be installed inside the wall and are commonly installed on walls made of brick or concrete where no telecommunications conduit can be installed. Raceways are usually manufactured in modular parts.
Raceway systems usually provide a flexible joint for opening the raceway to access cables; after which the raceway can be snapped shut. To meet information-outlet needs, raceway vendors sometimes produce modular connectors to integrate with their raceway systems, or enter into partnerships with recognized outlet vendors

Raceways are available in:
1. Plastic, metal, or wood.
2. Recessed or surface-mounted designs.



In most designs:
• The front panel is removable.
• Telecommunications outlet/connectors may be placed at any point along the run and may be moved or added after initial installation

• In a perimeter raceway, electrical power and telecommunications services must be run in SEPERATE compartments and must comply with applicable electrical codes.
• When a metallic barrier is provided, it must be bonded to ground.

8.2 BACKBONE PATHWAYS

Intra-building (in same building) pathways may consist of:
• Conduit
• Sleeves and slots
• Trays
between the ERs, TRs, and EFs.

8.3 Conduits

Enclosed metallic raceways or conduits can be used as backbone pathways. Due to its limited capacity, it is not effective for backbone distribution. Conduits can only be used to run cables point-to-point when intermediate splices or terminations are not required. However due to its high degree of shielding effectiveness and the security and physical protection, many military installations prefer enclosed metallic raceways or conduits to be used as backbone pathways.

Conduit Fill for Backbone Cable

Trade Size Designator, mm (in)	*Internal Diameter mm (in)	Area of Conduit, mm^2 (in^2)				Min. Bend Radius	
		Area = .79D^2	Max. Occupancy Recommended				
			A	B	C	D	E
		Total 100%	1 Cable 53% Fill	2 Cables 31% Fill	3 Cables & Over 40%	Layers of Steel within Sheath	Other Sheaths
21 (¾)	20.9 (.82)	345 (.53)	183 (.28)	107 (.16)	138 (.21)	210 (8)	130 (5)
27 (1)	26.7 (1.05)	559 (.87)	296 (.46)	173 (.27)	224 (.35)	270 (11)	160 (6)
35 (1¼)	35.1 (1.38)	973 (1.51)	516 (.80)	302 (.47)	389 (.60)	350 (14)	210 (8)
41 (1½)	40.9 (1.61)	1322 (2.05)	701 (1.09)	410 (.64)	529 (.82)	410 (16)	250 (10)
53 (2)	52.5 (2.07)	2177 (3.39)	1154 (1.80)	675 (1.05)	871 (1.36)	530 (21)	320 (12)
63 (2½)	62.7 (2.47)	3106 (4.82)	1646 (2.56)	963 (1.49)	1242 (1.93)	630 (25)	630 (25)
78 (3)	77.9 (3.07)	4794 (7.45)	2541 (3.95)	1486 (2.31)	1918 (2.98)	780 (31)	780 (31)
91 (3½)	90.1 (3.55)	6413 (9.96)	3399 (5.28)	1988 (3.09)	2565 (3.98)	900 (36)	900 (36)
103 (4)	102.3 (4.03)	8268 (12.83)	4382 (6.80)	2563 (3.98)	3307 (5.13)	1020 (40)	1020 (40)
129 (5)	128.2 (5.05)	12984 (20.15)	6882 (10.68)	4025 (6.25)	5194 (8.06)	1280 (50)	1280 (50)
155 (6)	154.1 (6.07)	18760 (29.11)	9943 (15.43)	5816 (9.02)	7504 (11.64)	1540 (60)	1540 (60)

NOTES:
1) Column A is used when one cable is to be placed in conduit.
2) Column B is used when two cables are to be placed together. The percentage fill of conduit is applied to straight runs with nominal offset equivalent to no more than two 90º bends.
3) Column C is used when three or more cables are to be placed in a conduit.

4) Column D indicates a bend of 10X the conduit diameter for cable sheaths consisting partly of steel tape.
5) Column E indicates a bend of 6X the conduit diameter up to 53 (2) trade size, and 10X the diameter above 53 (2) trade size conduit.
6) See annex clause B.1.3 for conduit dimensions.
7) The number of cables that can be installed in a conduit can be limited by the allowed maximum pulling tension of the cables.

8.4 Sleeves and slots

Vertical backbone consists of:
• TRs vertically stacked and tied together by sleeves or slots.
• A single 100mm conduit sleeve shall be used for every 5000 square meters of usable floor space PLUS two spares (for a total of three 100mm sleeves minimum).
• Conduit sleeves will protrude through floor or ceiling 25mm to 75mm.

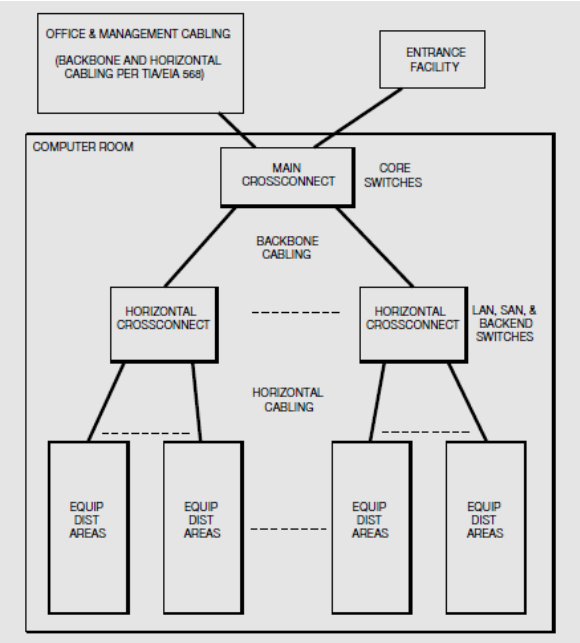
Sleeve Quantity and Configuration

Cable sleeves should be allocated adjacent to a wall on which the backbone cables can be supported. Sleeves must not obstruct wall terminating space. i.e, they should not be directly above or below the wall space that is to be used for termination fields.

BEST PRACTISE
Sleeves to extend a minimum of 25 mm above the floor level

8.5 Vertically Aligned Telecommunications Room (TRs)

Aligning TR vertically with connecting sleeves or slots are the most common type of backbone pathway due to its flexibility

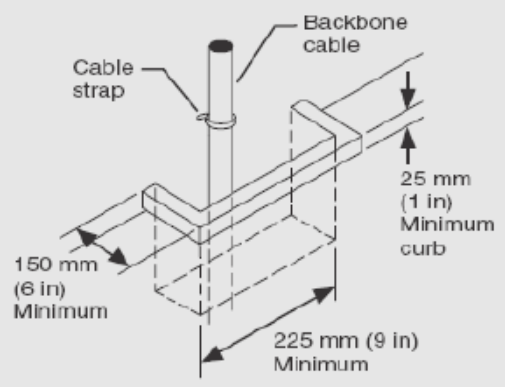


.Slot Quantity and Configuration

Cable slots should be allocated adjacent to a wall on which the backbone cables can be supported. Slots must not obstruct wall terminating space. i.e, they should not be directly above or below the wall space that is to be used for termination fields.

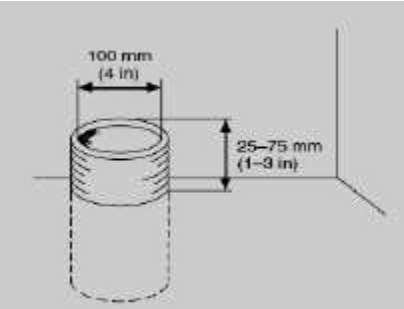
BEST PRACTICES

1. Slots are typically located flush against the wall within a space
2. Slots SHALL BE constructed with a minimum 25 mm high curb.
3. Shall be designed at a depth (the dimension perpendicular to the wall) of 150–600 mm.
4. The location and configuration of the slot(s) shall be approved by a structural engineer.

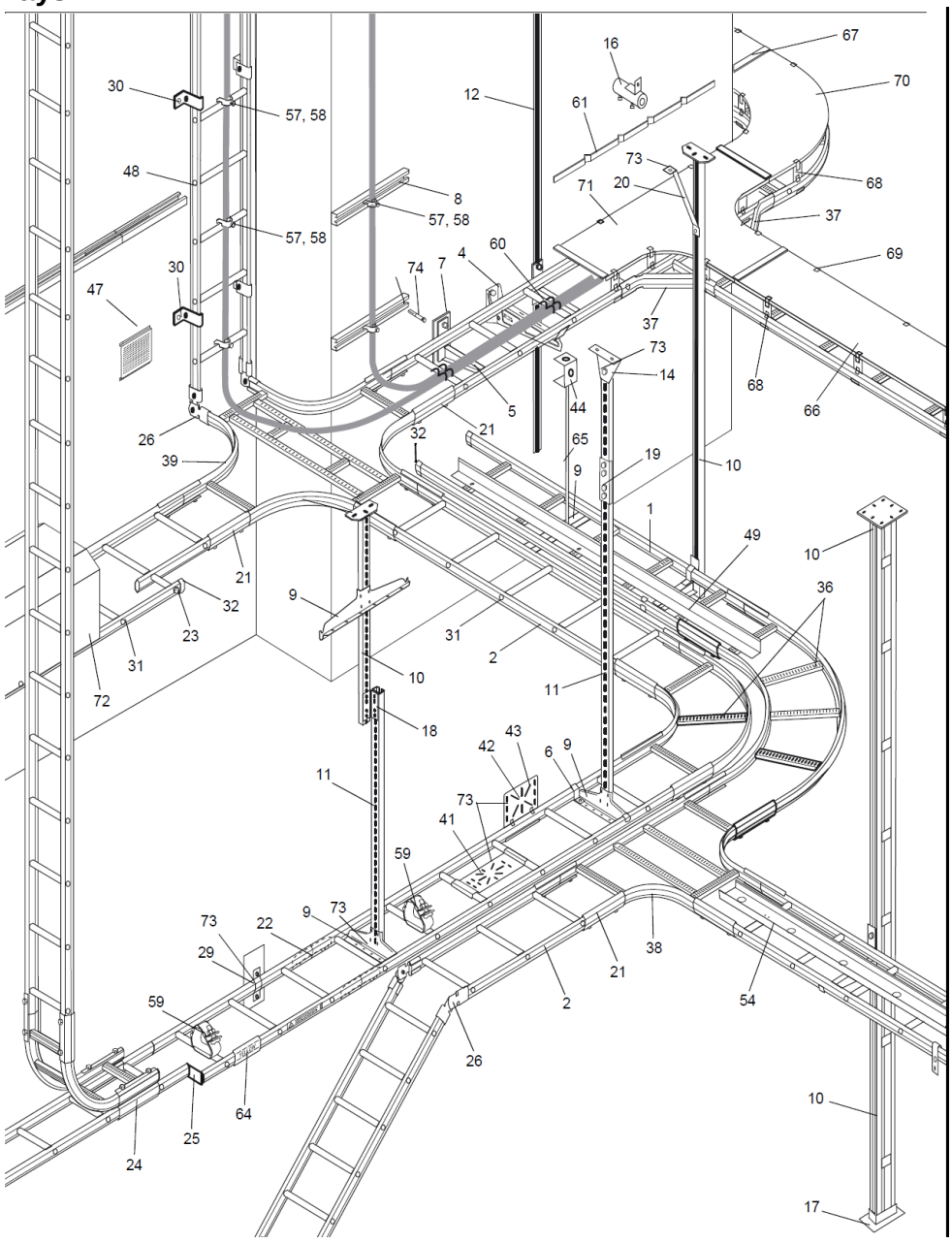


SIZING
According to ANSI/TIA/EIA-569-B

Slot size	Usable floor space served.
0.04 m^2	Every 4000 m^2



Trays



8.6 Visual inspection :

Visual inspection are performed in order to make sure the installation is done with respect to the technical specifications, state of the art rules and latest relevant standards.

Important points to control are :

• adequacy of the part numbers on each installed component,
• to make sure that there is no mechanical constraints on cables (minimum bending radii are respected, clamping collars are gently tightened, no scratch on cable sheath caused by violent pulling),
• wiring codes at the workstation and patch panel side are respected, screening, distance between last twisting pitch and connection point.

Caution : For cat.6 components, it is crucial to comply with manufacturer's recommendations.
• check the connection and distribution of ground and earth over the cable trays, cabinets and distribution racks,
• ensure that minimum distances to disturbing sources are kept.

9 Field Testing

Use an industry-recognized UL Level 4 field tester capable of testing to 500 MHz. Contact the test equipment manufacturer for any necessary hardware or software upgrades, including AXT testing capabilities, for testing CAT 6A installations. Perform permanent link or channel tests for all installed drops. Upon completion, provide the customer with all test results.

9.1 AXT Testing Preparation

AXT testing measures the unwanted noise coupled to the cable being tested (called the “Victim” or “Disturbed”) by six surrounding cables (called “Disturbers”). Two tests need to be performed: The Power Sum Alien Near-end Crosstalk (PSANEXT) test and the Power Sum Alien Attenuation-to-Crosstalk Ratio, Far-end (PSAACRF) test. Results for the remaining AXT tests are taken as part of these two, so although they are not directly provided, a “pass” result for PSANEXT and PSAACRF ensures passing results for AACRF, AFEXT, ANEXT, and PSAFEXT. A 2% sample of the installed cables is typically recommended; testing the longest cables in the installation will provide the most meaningful results.

9.2 High frequency transmission tests :

Test should verify the transmission performance level of the global cabling.
All links are to be tested.

Class E and class D standards define two links architecture and their associated performances. The testing is to be done accordingly to the chosen level of performance and methodology (permanent link or channel).

If a test fails because of a non-relevant parameter, functional qualities of the link are to be taken into account (e.g. on a very short link, the NEXT parameter could issue a fail result but insertion loss and ACR are, however, excellent)

Tests reports file :

A tests reports file should compulsory include :

- a copy of the technical specifications
- a detailed description of the installation architecture : maps of the site, cable paths structure, labelling method used and drawings showing location of each TO
- a short presentation on the materials used in the cabling as well as a documentation issued by the manufacturer
- a checklist including all criteria reviewed during the visual inspection of the installation as well as a commentary on any non-conformity that were discovered
- test results at low and high frequencies.

10 Warranties :

10.1 Product warranty

Every product (except patch-cords, termination tools and active products) are to be warranted 15 years against production defects.

10.2 System warranty

In addition to the above Product warranty and according to the Class of performance of the solution installed, the installation should be warranted during 15 years, to be conformed to the correspondent MSPR (Minimum performance required by the Standards ISO 11801 Edition 2, September 2002), provided the installation is not modified or extended.

10.3 Application warranty

In addition to the standard compliance warranty and according to the solution installed, the well functioning of any future data applications which could be implemented on the warranted cabling system (providing they are listed into ISO 11801 Annex F), should be warranted as follow :

- **With Class D/Cat5e solutions :**

warranting the well functioning of any future networks defined in the correspondent bandwidth (up to 100 MHz) which could appeared and be implemented within 5 years after the installation.

- **With Class E/Cat 6 solutions:**

warranting the well functioning of any future networks defined in the correspondent bandwidth (up to 250 MHz) which could appeared and be implemented within 10 years after the installation.

- **With Class E_A/Cat 6A solutions:**

warranting the well functioning of any future networks defined in the correspondent bandwidth (up to 500 MHz) which could appeared and be implemented within 10 years after the installation.

- **With Class F/Cat 7 solutions:**

warranting the well functioning of any future networks defined in the correspondent bandwidth (up to 600 MHz) which could appeared and be implemented within 15 years after the installation..

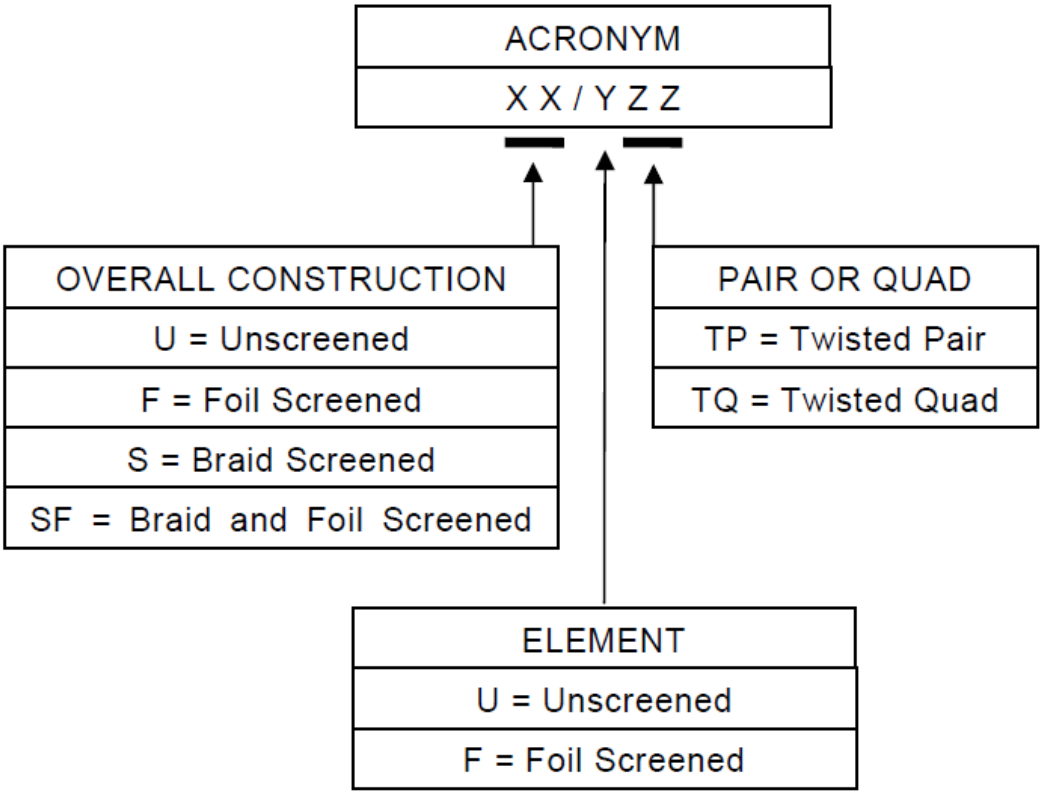
- **With Class F_A/Cat 7A solutions:**

warranting the well functioning of any future networks defined in the correspondent bandwidth (up to 1000 MHz) which could appeared and be implemented within 15 years after the installation..

Contractor must also justify their technical skills on the installed cabling system by presenting certificates of attendance to specific training and manufacturer approval.

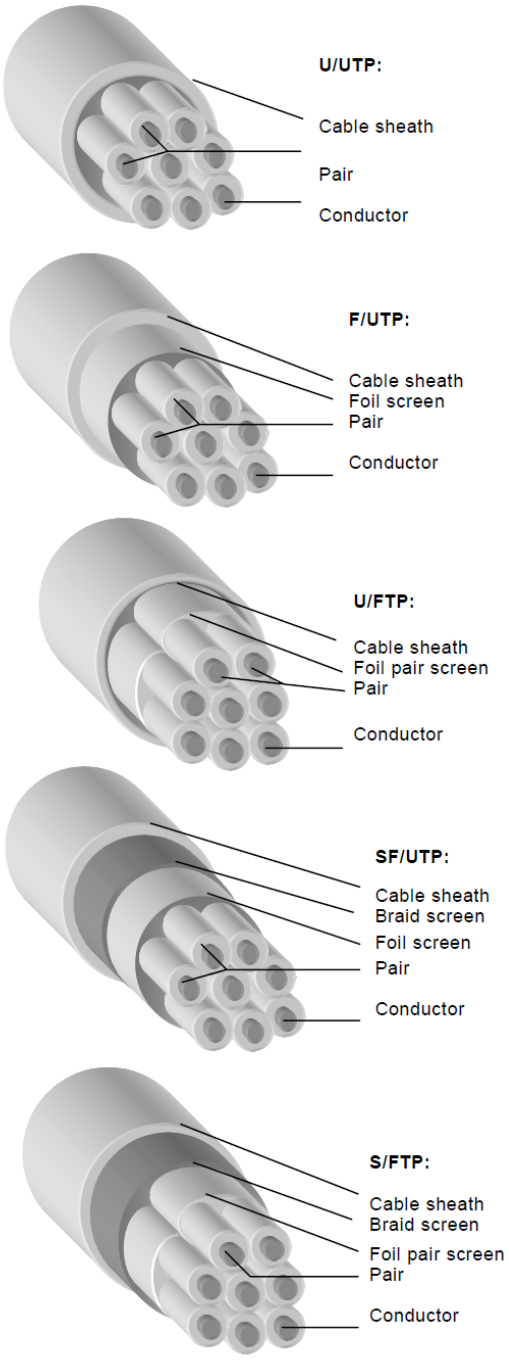
ANNEXE 1 : ACRONYMS FOR BALANCED CABLES

Acronyms for balanced cables



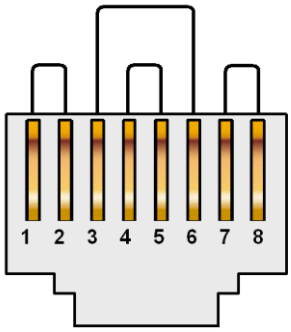
ANNEXE 2 : CÂBLE NAMING SCHEMA

Cable naming schema



ANNEXE 3 : PIN ASSIGNMENT ON RJ45 CONNECTORS

Pin assignment on RJ45 connectors:



	PIN ASSIGNEMENT RJ45	WIRING CODE EIA/TIA 568B
P1	4/5	Blue / white blue
P2	1/2	Orange / white orange
P3	3/6	Green / white green
P4	7/8	Brown / white brown

ANNEXE 4 : PROTECTION IP

Ingress Protection (IP) ratings are developed by the European Committee for Electro Technical Standardization (CENELEC) (NEMA IEC 60529 Degrees of Protection Provided by Enclosures - IP Code), specifying the environmental protection the enclosure provides.

The IP rating normally has two (or three) numbers:

1. Protection from solid objects or materials
2. Protection from liquids (water)
3. Protection against mechanical impacts (commonly omitted, the third number is not a part of IEC 60529)

Example - IP Rating

With the IP rating IP 54, **5** describes the level of protection from solid objects and **4** describes the level of protection from liquids.

An "X" can used for one of the digits if there is only one class of protection, i.e. IPX1 which addresses protection against vertically falling drops of water e.g. condensation..

IP First number - Protection against solid objects

0	No special protection
1	Protected against solid objects over 50 mm, e.g. accidental touch by persons hands.
2	Protected against solid objects over 12 mm, e.g. persons fingers.
3	Protected against solid objects over 2.5 mm (tools and wires).

4	Protected against solid objects over 1 mm (tools, wires, and small wires).
5	Protected against dust limited ingress (no harmful deposit).
6	Totally protected against dust.

IP Second number - Protection against liquids

0	No protection.
1	Protection against vertically falling drops of water e.g. condensation.
2	Protection against direct sprays of water up to 15o from the vertical.
3	Protected against direct sprays of water up to 60o from the vertical.
4	Protection against water sprayed from all directions - limited ingress permitted.
5	Protected against low pressure jets of water from all directions - limited ingress.
6	Protected against temporary flooding of water, e.g. for use on ship decks - limited ingress permitted.
7	Protected against the effect of immersion between 15 cm and 1 m.
8	Protects against long periods of immersion under pressure.

ANNEXE 5 : GLOSSARY

10 Gigabit Ethernet IEEE 802.3 is the standard specifying 10 Gb/s transmission for single-mode fiber or 50 µm multimode fiber
ACR see Attenuation to Crosstalk Ratio
ADM see Add/Drop Multiplexing
ANSI see American National Standards Institute
APD see Avalanche Photodiode
ASTM see American Society for Testing and Materials
ATM see Asynchronous Transfer Mode
AWG see American Wire Gauge
Acceptance Angle largest possible angle for launching light into an optical fiber; this angle is used to determine the numerical aperture (NA) of a fiber
Access Connection the physical connection at a central office connecting a local channel to an interoffice channel
Access Floor a system of raised flooring that has removable and interchangeable floor panels
Adapter a mechanical media termination device designed to align and join fiber optic connectors; often referred to as a coupling, bulkhead or interconnect sleeve
Add/Drop (ADM) multiplexers used at a network node to separate a signal from a multiplexed signal or to combine a lowerspeed local signal into a higher-speed transport signal
Administration the method for labeling, identification, documentation and usage needed to implement moves, adds and changes to the telecommunications infrastructure; TIA/EIA 606
Aerial a type of cable installation where the cable is connected to poles or towers by means of cable clamps or other pole attachment hardware; refer to lashed, messenger, figure-eight or self-support
Aerial cable telecommunication cable installed on aerial supporting structures such as poles, sides of buildings, and other structures
Air Handling Plenum a compartment or chamber with one or more air ducts connected and that forms part of the environmental air distribution system
All-Dielectric Self-Supporting refers to an aerial cable design that is intended for long spans where electric fields from lightning or nearby high-voltage cabled could cause elevated temperatures or other unwanted effects in cables with metallic elements; it is used as an alternative to OPGW on electric power company aerial high-voltage transmission routes
Alternate Entrance a supplemental entrance facility into a building using a different routing to provide diversity of service and assurance of service continuity
Ambient Temperature the temperature of a medium (gas or liquid) surrounding an object American National Standards Institute (ANSI) refers to a standards organization that organizes committees and oversees the development and publication of standards, including standards for network interfaces, communication protocols, and other communication technologies
American Society for Testing and Materials(ASTM) a nonprofit industry-wide organization which publishes standards, methods of test, recommended practices, definitions and other related material
American Wire Gauge (AWG) a standard system for designation wire diameter; also referred to as the Brown and Sharpe (B&S) wire gauge
Ampere the unit of current; one ampere is the current flowing through one ohm of resistance at one volt potential

Analog a continuously varying signal; analog signals may have an unlimited number of values, as amplitude and/or frequency may vary

ANSI/TIA/EIA 568 Commercial Building Telecommunications Standard; it gives guidelines on implementing structured cabling within a building; it also defines the minimum mechanical and transmission performance criteria for U/UTP, F/UTP, S/FTP, coax, and fiber optic cabling

ANSI X3T9.5 the ANSI committee responsible for FDDI

Approved Ground a grounding bus or strap approved for use as a telecommunications ground; refer to EIA/TIA 607 and the National Electric Code

Aramid Yarn a non-conductive strength element used in cable to provide support and additional protection of fiber bundles

Armor the protective element added to cables; it is usually made of steel, but can also be heavy plastic or aluminum

Armored additional protection between jacketing layers to provide protection against severe outdoor elements; usually made of plastic-coated steel, corrugated for flexibility; may also be called armoring

ASCII American Standard Code for Information Interchange

Asynchronous (or Async) a transmission and switching technology that relies on the use of bits or strings of bits at the beginning and the end of the data payload; these are called “farming bits”; this technology differs from synchronous transmission, where the data payload is referenced to a clock

Asynchronous Transfer Mode (ATM) standard for cell switching to route packets of digital information, designed to accommodate burst data transmission; an ATM cell has fixed length of 53 bytes: 5 operation at bit rates from 1.544 Mbps up to 2 Gbps; the standard defines both the multiplexing and cell relay protocols

Attenuation loss of signal in a length of cable (in dB)

Attenuation Coefficient attenuation expressed as a function of distance (dB/km); sometimes listed as the Greek letter alpha (aor α)

Attenuation to Crosstalk Ratio (ACR) calculated as the crosstalk value (dB) minus the attenuation value (dB); typically, ACR may be given for a cable, link or channel and is a key indicator of performance for U/UTP systems

Backboard a panel, wood or metal, used for mounting equipment

Backbone the part of the distribution system that include the main cable routing from the equipment room to remote locations; this may include distribution to the same or different floors within a building.

Backbone Raceway the portion of the pathway system that permits the placing of main or high-volume cables between the entrance location and all cross-connect points within a building or between buildings

Backfill materials used to fill an excavation; may be crushed stone, sand or soil

Backscattering the scattering of a fiber optic signal in the opposite direction from its intended course

Balanced Transmission refers to the transmission of equal but opposite voltages across each conductor of a pair; if each conductor is identical, with respect to each other and the environment, then the pair is said to be perfectly balanced and the transmission will be immune to ElectroMagnetic Interference (EMI)

Bandwidth or Bandwidth-Distance Product
the information-carrying capacity of a transmission medium is normally referred to in units of MHz•km; this is called the bandwidth distance product or, more commonly, bandwidth; the amount of information that can be transmitted over any medium changes according to distance; the relationship is not linear, however; a 500 MHz•km fiber does not translate to 250 MHz for a 2 kilometer length or 1000 MHz for a 0.5 kilometer length; it is important, therefore, when comparing media to ensure that the same units of distance are being used

Barrier a permanent partition installed in a raceway or cable tray to provide complete separation of the adjacent compartment

Baud a unit for characterizing the signalling rate of a digital data link or transmission device; it refers to the number of digital signal transitions in one second; with some data encoding formulas, the baud rate is equal to the bits per second; this would be the case with non-return-to-zero formats; in others, such as Manchester, two transitions per bit are required

Beamsplitter a device used to divide a optical beam into two or more beams

Bend Radius the radius a cable may be bent before the risk of breakage or an increase in attenuation, may also be called cable bend radius

Bend Radius, **Minimum** the radius of curvature of the fiber or cable that will result in excessive signal loss or breakage

Binder Groups for fiber, the grouping of fibers into units of 12, using a thread; the color code for binder groups is: Blue-orangegreen-brown-slate-white-red-black-yellow-violetrose-aqua for fiber; for copper, group of 25 pairs identified by colored material

Bit basic unit of information in digital transmission

Bonding Conductor for Telecommunications
the conductor interconnecting the telecommunications bonding infrastructure to the building's service equipment (electrical power) ground

Braid a fibrous or metallic group of filaments interwoven in cylindrical form to form a covering over one or more wires

Braid Angle the smaller of the two angles formed by the shielding strand and the axis of the cable being shielded

Breakout Cable a multifiber cable where each fiber is further protected by an additional jacket and optional strength elements

Buffering a protective material extruded directly on the fiber coating to protect the fiber from the environment; or extruding a tube around the coated fiber to allow isolation of the fiber from stresses on the cable

Buffer Tubes loose-fitting covers over optical fibers, used for protection and isolation

Building Backbone this refers to a network segment between at least two equipment closets and the network interface for the building; see section 5 of EIA/TIA 568 Commercial Building Wiring Standards for the maximum distance for building backbone segments

Building Backbone Cable from ISO/IEC 11801: connects the building distributor to the floor distributor, which may also connect floor distributors in the same building Building Distributor from ISO/IEC 11801: a distributor in which the building backbone cable(s) terminate(s) and where connections to the campus backbone cable(s) may be made

Building Entrance Facilities from ISO/IEC 11801: provides all necessary mechanical and electrical services for the entry of telecommunications cable into a building Buried communications cable that is installed in direct contact with the earth; common installation methods include trenching, plowing or boring

Buried Cable a cable installed directly in the earth without use of underground conduit; also called "direct burial cable"

Byte one character of information, usually 8 bits

CATV see Cable Television (Community Antenna TV)

CCTV see Closed Circuit Television

CPE see Customer Premises Equipment

CSA see Canadian Standards Association

CO see Central Office

CT see Central Tube

Cable Assembly a completed cable and its associated hardware ready to install

Cable Bend Radius cable bend radius during installation infers that the cable is experiencing a tensile load; free bend infers a smaller allowable bend radius, because it is at a condition of no load

Cable Element from Cenelec EN5017: smallest construction unit in a cable, may have a screen; e.g., a pair, a quad and a single fiber are cable elements

Cable Rack vertical or horizontal open support attached to a ceiling or wall

Cable Sheath a covering over the conductor assembly that may include one or more metallic members, strength members or jackets

Cable Television (CATV) the initials derive originally from Community Antenna Television; the CATV industry or its networks also are sometimes referred to as "cable" which can be confusing in discussions of cable markets

Cable Tray a ladder, trough, solid bottom or channel raceway intended for, but not limited to, the support of telecommunications cable

Cable Unit from Cenelec EN50173: single assembly of one or more cable elements, may have a screen

Cabling the twisting together of two or more insulated conductors to form a cable

Campus the building and grounds of a complex; e.g., a university, college, industrial park, or military establishment

Campus Backbone this refers to a network region between at least two buildings; see TIA/EIA 568 Commercial Building Wiring Standards for the maximum distance for campus backbone segments

Campus Backbone Cable from ISO/IEC 11801: connects the campus distributor to the building distributor; may also connect building distributors directly

Campus Distributor from ISO/IEC 11801: a distributor from which the campus backbone emanates

Canadian Standards Association (CSA) a non-profit, independent organization which operates a listing service for electrical and electronic materials and equipment; the Canadian counterpart of the Underwriters Laboratories (CSA T527 see EIA 607; CSA T528 see EIA 606; CSA T529 see EIA 568; CSA T530 see EIA 569

Capacitance the ratio of the electrostatic charge on a conductor to the potential difference between the conductors required to maintain that charge

Capacitance Unbalance a measurement of a cable's impedance based on a curve fit equation using the cable's raw input impedance; specified by ANSI/TIA/EIA 568A but not ISO/IEC11801

Cenelec EN50173 European standard for generic cabling systems; based on ISO/IEC 11801

Centralized Cabling a cabling topology used with centralized electronics, connecting the optical horizontal cabling with the building backbone cabling passively in the telecommunications room

Central Member the center component of a cable; an anti-buckling element to resist temperature-induced stress; constructed of steel, fiberglass or glass-reinforced plastic; also sometimes a strength element

Central Office (CO) refers to a phone company's switch or exchange location or the building that houses the switch; also called "serving office" and "exchange"

Central Tube (CT) refers to the type of cable that has the fibers housed in a single buffer tube; the fibers may either be bundled together with a binder yarn, or loose within the central tube; the bundled approach usually is used for counts of 12 or more; most central tube cables usually have multiple strength members on opposite sides of the central tube

Channel the end-to-end communications path between two points including equipment cords and patch cords; also a photonic communications path between two or more points of termination

Characteristic Impedance the impedance that, when connected to the output terminals of a transmission line of any length, makes the line appear infinitely long; the ratio of voltage to current at every point along a transmission line on which there are no standing waves

Chromatic Dispersion the effect of different wavelengths of light traveling at different speeds within the optical fiber; this effect will cause a change in shape of a pulse travelling within the fiber

Cladding the optically transparent material, which surrounds the core of an optical fiber; for standard fibers, this material is a glass, which has a lower refractive index than the core glass; material surrounding the core of an optical waveguide

Closed Circuit Television (CCTV) refers to any security video system

Coarse Wave Division Multiplexing refers to wavelength division multiplexing systems with relatively wide channel spacing (typically 20nm)

Coating the plastic protective layer(s) that are applied to the cladding during the drawing process for protection

Coaxial Cable a cable consisting of two cylindrical conductors with a common axis, separated by a dielectric

Collapsed Backbone a star topology that connects desktop devices directly to the equipment room without going through a crossconnect the telecommunications room (TR)

Color Code a system for identification through use of colors; fiber specified in ANSI/TIA/EIA-598-A "Optical Fiber Cable Color Coding"

Composite Cable a cable containing both fiber and copper media per NEC article 770; can also be a fiber cable with both singlemode and multimode fibers

Compression a method to reduce the number of bits required to represent data Concentrator a device which concentrates many lower-speed channels in or out of one or more higher-speed channels

Conduit a raceway of circular cross-section
Connecting Hardware a device providing mechanical cable terminations
Connector a mechanical device used to align or attach two conductors
Connector Panel a panel designed for use with patch panels; it contains either 6, 8, or 12 adapters pre-installed for use when fieldconnectorizing fibers
Connector Panel Module a module designed for use with patch panels; it contains either 6 or 12 connectorized fibers that are spliced to backbone cable fibers
Continuity Check a test to determine end-to end viability of a transmission media
Core central region of an optical fiber through which light is transmitted
Core Area that horizontal section of a building core set aside or used for utility service
Core Concentricity a measure of the relationship between the geometric center of the core of an optical fiber with the geometric center of the cladding
Core Ovality a ratio of the minimum to maximum diameters of the core within an optical fiber
Count Loop Diversity loop diversity that assigns circuits among different binder groups within one cable
Coverage expressed in percent (%), represents the percent coverage by the braid of the underlying surface
Crossconnect a facility enabling the termination of cable elements and their interconnection, and/or cross-connection, usually by means of a patch cord or patchcord
Crossconnection a connection scheme between cabling runs, subsystems and equipment using patch cords or patch cords that attach to connecting hardware at each end
Crosstalk a measure of conductor uniformity within a pair, hence the cable's balance; the lower the unbalance, the better the cable will support balanced transmission
CSMA/CA Carrier Sense Multiple Access/Collision Avoidance
Customer Premises Equipment (CPE) telephones, answering machines, or other terminal equipment located within the customer's premises
Cut-Off Wavelength the shortest waveleng that which the propagation of one path of light can occur
dB see Decibel
DCR see Direct Current Resistance
DMD see Differential Mode Delay
DWDM see Dense Wave Division Multiplexing
Dark Fiber unused fiber through which no light is transmitted, or installed fiber optic cable not carrying a signal; the dark fiber is sold without light communications transmission equipment, and the customer is expected to install electronics and signals on the fiber and light it
Data Center a room or network of rooms that houses the interconnected data processing, storage and communications assets of one or more enterprises, as defined by TIA-942 and EN 50173-5.200X
Decibel (dB) a unit for measuring the relative strength of a signal
Demarcation Point a point where operational control or ownership changes
Dense Wavelength Division Multiplexing (DWDM) refers to wavelength division multiplexing systems with very tight spacing in the same transmission window; see also WDM
Dielectric a material, which does not conduct electricity, a material that is non-metallic and non-conductive; this term is typically used to describe a non-metallic cable

Dielectric Constant (K) the ratio of the capacitance of a condenser with dielectric between the electrodes to the capacitance when air is between the electrodes; also called Permitivity and Specific Inductive Capacity

Dielectric Strength the voltage which an insulation can withstand before breakdown occurs; usually expressed as a voltage gradient (such as volts per mil)

Differential Mode Delay (DMD) the measurement of the difference between the leading edge of the fastest path and the trailing edge of the slowest path of light through a multimode fiber; this measurement is a type of modal dispersion within multimode fibers; DMD testing of fiber becomes more important with higher bandwidth requirements

Diffraction bending of radio, sound or lightwaves around an object, barrier or aperture edge

Digital a signal having a limited number of discrete values, such as two (a binary system)

Direct Current Resistance (DCR) the resistance offered by any circuit to the flow of direct current

Dispersion the cause of bandwidth limitations in a fiber; dispersion causes a broadening of input pulses along the length of the fiber; three major types are: (1) modal dispersion caused by differential optical path lengths in a multimode fiber; (2) chromatic dispersion caused by a differential delay of various wavelengths of light in a waveguide material; and (3) waveguide dispersion caused by light traveling in both the core and cladding materials in single-mode fibers

Dissipation Factor the tangent of the loss angle of the insulation material; also referred to as loss tangent, tan, and approximate power factor

Distributed Backbone a star topology that connects desktop devices to the equipment room through horizontal crossconnects in the telecommunications room (TR)

Distribution Frame a structure with terminations for connecting the permanent cabling of a facility in such a manner that interconnection or crossconnection may be readily made

Drain Wire in a cable, the uninsulated wire laid over the component(s), used as a common connection

Duct a single enclosed raceway for wires or cables; a single enclosed raceway for wires or cables usually in soil or concrete; an enclosure in which air is moved

Duct Bank an arrangement of ducts in tiers or groups

Duplex simultaneous two-way independent transmission

ELFEXT see Equal Level Far End Crosstalk

EMI see Electromagnetic Interference

ER see Equipment Rooms

Eccentricity like concentricity, a measure of the center of a conductor's location with respect to the circular cross section of the insulation; expressed as a percentage of displacement of one circle within the other

EIA Electronic Industries Association

ELFEXT (Equal Level Far End Crosstalk) a method to mathematically subtract out the cable's attenuation in order to accurately compare FEXT values from one cable to another; see FEXT

Electromagnetic Interference (EMI) the interference in signal transmission resulting from the radiation of nearby electrical and/ or magnetic fields; for U/UTP, EMI can be coupled onto a conducting pair and cause circuit noise; crosstalk is one type of EMI Elongation the fractional increase in length of a material stressed in tension

End User someone who owns or uses the premises wiring system

Entrance Facility an entrance to a building for both public and private network service cables, including the entrance point at the building wall and continuing to the entrance room or space

Equipment Cord cable used to connect telecommunications equipment to horizontal or backbone cabling

Equipment Rooms (ER) from ISO/IEC 11801: dedicated to housing distributors and specific equipment

ESCON (Enterprise Systems Connection) this refers to a proprietary parallel signal-processing transmission protocol as well as a data network architecture, which were developed and commercialized by IBM in the early 1990s; non-stop high bandwidth data transfer characterizes ESCON across distances up to 9 km with multimode technologies, and up to 60-km with single-mode technologies

Ethernet this IEEE transmission protocol standard uses Carrier Sense Multiple Access/Collision Detection (CSMA/CD) to transmit data in a network; there are three different network topologies that support Ethernet transmissions: active ring, passive star and active star

Excess Length the extra length of fiber contained in a cable; this extra length is present because the fiber does not lie parallel to the cable axis

FDDI see Fiber Distributed Data Interface

FEP Fluorinated Ethylene Propylene

FEXT see Far End Crosstalk

FRP see Fiber Reinforced Plastic

Feeder the segment of telecom networks that includes equipment, cable, and other hardware for transporting traffic from the switch location into the loop, usually to an outside plant equipment location where there is a passive cross-connect or an active demultiplex function; feeder cables can include high-count copper pair cables, where each pair supports one circuit, as well as cables carrying electronically derived circuits; such electronic feeder technologies include “pair gain” and “digital loop carrier”; “Fiber optic feeder equipment” usually refers to DLC or other access multiplexers

Ferrule a mechanical fixture, usually a rigid tube, used to confine and align the stripped end of a fiber

FEXT (Far End Crosstalk) crosstalk that occurs at the end opposite the location of the disturbed pair’s receiver; Normally, FEXT is only important in short links or full duplex transmission

FFEP Foamed Fluorinated Ethylene Propylene

Fiber thin filament of glass; an optical waveguide consisting of a core and a cladding that is capable of carrying information in the form of light

Fiber Bend Radius radius a fiber can bend before the risk of breakage or increase in attenuation occurs

Fiber Distributed Data Interface (FDDI) refers to a 100-Mbs LAN standard that was developed specifically for fiber; the standards organization is ANSI; the standard’s specifications at the physical layer include the optoelectronic component footprint and interfaces

Fiber Optics thin filaments of glass or plastic through which light beams are transmitted over long distances and which can carry enormous amounts of voice and data traffic; benefits include high capacity, relatively low cost, low power consumption, small space needs, insensitivity to electromagnetic interference (EMI) and improved privacy

Fiber-Reinforced Plastic (FRP) a material used as an alternative to aramid yarns for strength members in some cables, either as central strength members or other strengthening elements; the material is a resin with filament filaments of fiberglass (not optical fiber); it is also known as glass-reinforced plastic (GRP)

Fiber Channel an interface standard for serial data transmission developed for communications between workstations and file servers, between computers and storage systems, and between other hosts and peripherals; the standard defines bidirectional point-to-point channels so that the communications path or medium is not shared between multiple modes; a circuit or packet switching technology can be used to achieve multimode networking; the standard defines a hierarchy of serial data-transfer bit rates and several families of transmission media and sources; the lowest speeds can be implemented on twisted pair, coax, and multimode fiber; the highest speeds can be implemented on multimode and single-mode fiber; the bit rates range from 132 Mbps to 1.06 Gbps

Figure-Eight a type of aerial cable where the messenger strand and the communications cable are encased in a single extruded sheath; when viewed in cross-section, the cable/messenger arrangement resembles a figure eight

Firestop a material, device or assembly of parts installed within a cable system in a fire-rated wall or floor to prevent the passage of flame, smoke or gases through the rated barrier

Flame Resistance the ability of a material not to propagate flame once the heat source is removed

Flex Life the measurement of the ability of a conductor or cable to withstand repeated bending

Flooded Launch a condition in which the light source exceeds the NA of the fiber

Forward Path transmission from the headed toward the subscriber, also known as "downstream"

FR-1 a flammability rating established by Underwriters Laboratories for wires and cables that pass a specially designed vertical flame test; this designation has been replaced by VW-1

Frequency of a periodic wave, the number of identical cycles per second

Fresnel Reflection Losses reflection losses that are incurred at the input and output of optical fibers due to the differences in refraction index between the core glass and immersion medium

Full Duplex simultaneous two-way independent transmission; a method used to increase transmission throughput e.g. gigabit Ethernet where 250 Mb/s is sent bi-directionally across each of the four pairs

Fusion Splice a permanent joint accomplished by applying localized heat sufficient to fuse or melt the ends of optical fiber, forming a single continuous fiber

F/UTP a 100 ohm cable with an overall foil shield and drain wire: formerly called Screened Twisted Pair (ScTP)

GHz see GigaHertz

GRP see Glass Reinforced Plastic

Gauge a term used to denote the physical size of a wire

GbE Gigabit Ethernet
Gb/s millions of bits per second
General Purpose Cable this type of cable meets specifications for general-purpose ratings (UL-1581), and is one of three types installed in premises networks; multimode general-purpose cables usually have loosetube construction and are suitable for outdoor installation in campus network segments
Giga numerical prefix denoting one billion
Gigahertz (GHz) a unit of frequency that is equal to one billion cycles per second
Glass-Reinforced Plastic (GRP) a strength member material, see FRP
Graded-Index Fiber a fiber design where the refractive index of the fiber is lower toward the outside of the fiber core
Ground a connection, whether intentional or accidental, between an electrical circuit or equipment and the earth, or to some conducting body that serves in place of the earth
Grounding see bonding
HC see Horizontal Crossconnect
HVAC Heating, Ventilating and Air Conditioning
Hz see Hertz
Half Duplex a method of transmitting or receiving signals in one direction at a time
Handhole an access opening, provided in equipment or in a below-the-surface enclosure into which personnel reach, but do not enter to work with or place cable (also known as maintenance access handhole)
Hard Drawn Copper Wire copper wire that has not been annealed after drawing; sometimes called HD wire
Harmonic full multiple of a base frequency
Headend facility in a CATV network where the broadcast video signals are transmitted into the feeder and distribution network; headends are linked together with supertrunks and are linked to satellite downlink facilities with supertrunks
Helical Stranding a stranding method in which the elements are stranded in one continuous direction
Home Run a common term used to describe telecommunications cabling run in a star topology; e.g. direct from outlet to the telecommunications room
Horizontal Cable from ISO/IEC 11801: Connects the floor distributor to the telecommunication(s) outlet; the cabling between and including the telecommunications outlet/connector and the horizontal cross-connect
Horizontal Cross-connect (HC) a crossconnect of horizontal cabling to other cabling
Hub a device which connects to several other devices, usually in a star topology or refers to the facilities where all customer facilities are terminated for purposes if interconnection to trunks and/or cross-connection to distant ends
Hybrid Cable an assembly of one or more cables, of the same or different types or categories, covered by one overall sheath
Hz Hertz, cycle per second
IC see Intermediate Crossconnect or Integrated Circuit
ISDN see Integrated Services Digital Network
ICEA Insulated Cable Engineers Association
IEC International Electrotechnical Commission

IEEE Institute for Electrical and Electronics Engineers; this refers to a standards writing organization that organizes committees and oversees the development and publication of standards, including standards for network interfaces, communications protocols, and other communication technologies

Impedance The total opposition that a circuit offers to the flow of alternating current or any other varying current at a particular frequency; it is a combination of resistance R and reactance X, measured in ohms

Index-Matching Fluid or Gel a fluid with an index of refraction close to that of glass that reduces reflections caused by refractive-index differences

Index of Refraction ratio of velocity of light in a vacuum to the velocity of light within a given transmitting medium

Indoor Cable cable designed for use indoors; these cables typically have a flame resistance rating and are not suitable for the environmental conditions experienced by outdoor cables

Indoor /Outdoor Cable cable rated for use indoors and suitable for outdoor environmental conditions

Inductance the property of a circuit or circuit element that opposes a change in current flow, thus causing current changes to lag behind voltage changes; it is measured in henrys

Infrared the range of the electromagnetic spectrum from 780 nm to 1 mm; optical signal transmission takes place within the infrared portion of the spectrum

Infrastructure a collection of components, excluding equipment, that provides the basic support for the distribution of all information within a building or campus

Innerduct additional duct work (conduit) placed within a larger diameter duct (conduit), also known as subduct

Insertion Loss attenuation caused by insertion of a component into a transmission route/channel

Insulating Joint a splice in a cable sheath where the continuity of the sheath and shield are deliberately interrupted to prevent the flow of electrolytic currents which may cause corrosion

Insulation a material having high resistance to the flow of electric current; often called a dielectric in radio frequency cable

Insulation Displacement Connection the type of connection required by ANSI/TIA/EIA 568 for twisted pair

Insulation Resistance the ratio of the applied voltage to the total current between two electrodes in contact with a specific insulation, usually expressed in megaohms-M feet

Integrated Circuit A complex set of electronic components and their interconnections that are etched or imprinted on a chip.

Integrated Messenger Cable aerial plant communications cable with a messenger support cable within the outer cable jacket, also known as figure-eight or self-support Interconnection a connection scheme that provides for the direct connection of a cable to the other cable without a patch cord or patchcord

Intermediate Cross-connect (IC) a crossconnect between first and second level backbone cabling

Integrated Services Digital Network (ISDN)
a public switched network which provides end-to-end digital connections; refers to a standard for the simultaneous transmission of voice and data, including digital video, over telecom networks

ISO/IEC 11801 International standard for generic cabling system

Jacket an outer non-metallic protective covering applied over an insulated wire or cable
Kb/s Kilobits per second, one thousand bits per second
Kevlar a registered (Dupont) trade name for aramid fiber yarn, which is typically used as a non-conducting strength member in fiber optic cable
KHz Kilohertz, 1,000 cycles per second
Kilo numerical prefix denoting one thousand
Kilometer one thousand meters or approximately 3,281 feet; the kilometer is a standard unit of length measurement in fiber optics
kpsi a unit of force per area expressed in thousands of pounds per square inch; usually used as the specification for fiber proof test
LAN see Local Area Network
LC see Lucent Connector
LEC see Local Exchange Carrier
LED see Light Emitting Diode
LID see Local Injection and Detection
LT see Loose Tube
LSZH see Low Smoke Zero Halogen
LASER Diode Light Amplification by Stimulated Emission of Radiation; an electrooptic device that produces coherent light with a narrow range of wavelengths, typically centered around 780 nm, 1310 nm, or 1550 nm; lasers with wavelengths centered around 780 nm are commonly referred to as CD lasers
Lashing attaching a cable to a supporting strand or cable using a steel or dielectric filament around both cable and support
Lay the length measured along the axis of a wire or cable required for a single strand (in stranded wire) or conductor (in cable) to make one complete turn about the axis of the conductor or cable
Lucent Connector (LC) a type of fiber optic connector pioneered by Lucent
Light Emitting Diode (LED) a semiconductor light source without the coherent properties of a laser diode; typically used for less than 1 Gb/s transmission
LID (Local Injection and Detection) a method of measurement used for alignment of optical fibers, typically used for optimizing splice performance
Line Cord see work area cable
Link a transmission path between two points, not including terminal equipment, work area cables or equipment cables
Listed equipment included in a list published by an organization that maintains periodic inspection of production of listed equipment, and whose listing states either that the equipment meets appropriate standards or has been tested and found suitable for use
Local Access Network a term used to refer to that part of that connects the exchanges with the customers
Local Access Provider operator of facility used to convey telecommunications signals to and from a customer premises
Local Area Network (LAN) refers to an on-premises data communications network, usually for linking PCs together or linking PCs to a file server and other data processing equipment
Local Exchange Carrier (LEC) the local phone companies, which can be either a regional Bell Operating Company (RBOC), or an independent (e.g., GTE) which traditionally has the exclusive, franchised right and responsibility to provide local transmission and switching services; with the advent of deregulation and competition, LECs are now known as ILECs (Incumbent Local Exchange Carriers)
Longitudinal Shield a tape shield, flat or corrugated, applied longitudinally with the axis of the core being shielded

Loop Resistance sum of conductor resistance and shield resistance (DCR)
Loose Buffered Fiber buffered optical fiber in which the buffer material is applied such that the fiber is not in contact with the buffer material; typically, a gel is used to decouple the fiber from the buffer tube
Loose Tube (LT) refers to cable type with an oversized buffer tube that typically holds up to 12 fibers, with multiple tubes stranded around the center axis; in OSP cables, the buffer tubes usually are stranded around a central strength member
Loss energy dissipated without accomplishing useful work
Low Loss Dielectric an insulating material that has a relatively low dielectric loss, such as polyethylene or Teflon
Low Smoke Zero Halogen (LSZH) a class of cables made without halogens (i.e. chlorine and fluorine) to meet specific and strict fire safety codes
MAN see Metropolitan Area Network
MUTOA see Multi-User Telecommunications Outlet Assembly
MUX see Multiplexer
Macrobending relatively large deviations in the waveguide that can result in increased attenuation, or loss due to bend radius
Main Cross-connect (MC) a cross-connect for first level backbone cables, entrance cables and equipment cables
Material Dispersion dispersion caused by differential delay of various wavelengths of light in a waveguide material
Mechanical Splicing joining two fibers together by permanent or temporary mechanical means (vs. fusion splicing or connectors) to enable a continuous signal
Media telecommunications wire, cable or conductors used for telecommunications
Medium-Density Polyethylene (MDPE) a type of plastic material used to make cable jacketing
Meg or Mega a numerical prefix denoting 1,000,000 (106)
Megabits per second (Mb/s) million bits per second
Megahertz (MHz) a unit of frequency that is equal to one million cycles per second
Messenger a support strand, typically constructed of steel or Kevlar cable, used for attachment of communications cable for aerial plant
Metropolitan Area Network (MAN) a citywide or regional public access data and telecommunication network
Micro numerical prefix denoting one-millionth
Micron one-millionth of a meter
Microbending bends that take place on a microscopic level, which can result in increased attenuation, or loss due to local
Micrometer (µm) or micron one millionth of a meter; typically used to express the geometric dimension of fibers
Microwave portion of the electromagnetic spectrum above 760 MHz

Modal Dispersion propagation delay between modes within a multimode fiber; this will cause a change in shape (broadening) of a pulse traveling within a multimode fiber
Mode light path through a fiber, as in multimode or single mode
Mode Field Diameter a measure of the width of the energy distribution for optical fiber at 37% of the maximum energy level; the effective diameter of a single-mode fiber, taking into account the fact that some light travels within the cladding; accordingly, the mode field diameter is larger than the core diameter
Modulation a process where certain characteristics of a wave, which is often called the carrier, are varied or selected in accordance with a modulating function

Modulus of Elasticity the ratio of stress to strain in an elastic material

Modular Plastic Duct a type of telecommunications duct. Available in molded formations of 4, 6, or 9 ducts in lengths of 36in.; can be direct buried

Multimedia a system or a service, or a set of services characterized by two-way communications, interactive services, and the ability to combine data, voice, and video

Multimode an optical fiber that will allow many bound modes to propagate; may be graded-index or step-index; this refers to the propagation quality of transverse electromagnetic waves in a medium;
inside as optical fiber, multimode refers to the simultaneous transmission of several electromagnetic waves that interact with each other; emerging from an active device, multimode refers to the multiple wavefront spatial quality of the electromagnetic beam

Multiplexer (MUX) equipment used to combine multiple signals for transmission on a single channel

Multiplexing combination of independent signals for transmission within one waveguide

Multi-User Outlet a telecommunications outlet used to serve more than one work area, typically in open-systems furniture applications

Multi-User Telecommunications Outlet Assembly (MUTOA) an easily-reconfigured mid-channel consolidation point

Mutual Capacitance capacitance between two conductors when all other conductors including ground are connected together and then regarded as an ignored ground

NEC see National Electric Code

NESC see National Electrical Safety Code

Nano numerical prefix denoting one-billionth Nanometer unit of measurement equal to one billionth of a meter

National Electrical Code (NEC) identifies the construction techniques and materials necessary in building wiring requirements and was developed by the National Fire Protection Association's (NFPA's) National Electric Code committee. Committee members are professionals from the electrical and insurance industries. The NEC has been adopted by the American National Standards Institute (ANSI).

National Electrical Safety Code (NESC) are standards produced by the Institute of Electrical and Electronics Engineers (IEEE). The NESC relates to outside plant cabling as the NEC does to the inside of a building.

NEC Rated cable that has been certified as plenum-rated, riser-rated or general cable by passing of flame propagation testing

NEMA National Electrical Manufacturer's Association Near End Crosstalk (NEXT) crosstalk that occurs at the same end as the disturbed pair's receiver; normally, this is the largest contributor of noise because the disturbing pair's transmitted signal is strongest at this point

NFPA National Fire Protection Association

NID Network Interface Device Node device in a hybrid fiber-coax (HFC) system which converts optical signals on fiber optic cable to electrical signals on coaxial cable to the subscribers' premises; places at the end of the fiber optic cable in a local serving area, typically with 200 to 2,000 homes; also an addressable device attached to a computer network

Non-zero DS refers to an improved type of dispersion-shifted fiber in which dispersion at 1550 nm is substantially reduced compared with conventional single-mode fiber, but dispersion is not zero at 1550 nm; this fiber was designed to overcome the possible risk of "four-wave mixing," which is an effect that can degrade transmission quality in WDM systems having multiple channels in the 1550-nm window

Numerical Aperture measure, in radians, of the angle that expresses the light-gathering point of optical fiber

OSP see Outside Plant

OTDR see Optical Time Domain Reflectometer

OC-X (Optical Carrier - Level X) refers to the basic line-rate in the SONET hierarchy of line rates; all higher speed rates are integral multiples of OC-1, which is 51.84 Mbps (example: OC-12 is 12 x 51.84 or 622.08 Mbps)

Ohm a unit of electrical resistance or impedance

Optical Receiver an electronic device which converts optical signals to electrical signals

Optical Time Domain Reflectometer (OTDR) an instrument for analyzing fiber links which may be used to locate faults and to assess splices and connector interfaces; it operates by launching a pulsed laser input into the fiber under test, then analyzing the return signal that results from reflections and backscattering phenomena

OSHA Occupational Safety and Health Administration

Outdoor Cable cable designed for use outdoors; these cables are suitable for the environmental conditions experienced by outdoor cables, but do not typically have a flame resistance requirement

Outside Plant (OSP) refers to all cable and equipment located outside

PBX see Private Branch Exchange

PC see either Personal Computer or Positive Contact (for a fiber connector)

PE see Polyethylene

PSumXT see Power Sum Crosstalk

PVC see Polyvinyl Chloride

Packet a group of bits, including data and control elements, that are switched and transmitted together

Patchcord a cable assembly with connectors at both ends, used to join telecommunications
circuits or links at the cross-connect

Packet Switching a communications method where packets (messages) are individually routed between hosts, with no previously established communications path

Pair-to-Pair Crosstalk the crosstalk measurement of a single disturbing pair. It can be made for NEXT or FEXT

Passive Optical Components components, such as splitters, couplers and connectors, which do not require external power to perform their function

Patch Cable a length of cable with connectors on one or both ends to join telecommunications links

Patch Cord a length of cable with connectors on one or both ends used to join telecommunications circuits or links at the cross-connect

Patch Panel a cross-connect system of mateable connectors that facilitates administration

Pathway a facility for the placement of telecommunications cable

Periodicity the uniformly spaced variations in the insulation diameter of a transmission cable that result in reflections of a signal, when its wavelength or a multiple thereof is equal to the distance between two diameter variations

Personal Computer (PC) any general purpose computer whose size and capabilities make it useful for individuals and which is intended to be operated by an end user

Pico a numerical prefix denoting one-trillionth (10-12)

Pigtail a length of fiber attached to a device so that it can be spliced into the network; the pigtails on some active devices also may have a connector interface; if one is comparing the cost of pigtailed devices, it is important to check the specifications to see if a connector is included, and if so what the connector specifications are

Plenum Cables this type of cable meets specifications for plenum ratings (NFPA-262), and is one of three types installed in premises networks;

Point-To-Point a connection established between two specific locations, as between two buildings

Poke-through an unlimited or random penetration through a fire resistive floor structure to permit the installation of electrical or communications cables; not covered within TIA/EIA-569

Polyethylene (PE) a type of plastic material used for outside plant cable jackets

Polyvinyl Chloride (PVC) a type of plastic material used for cable jacketing; typically used in flame-retardant cables

Positive Contact or Physical Contact (PC) surface-to-surface contact between fibers in a connector-to-connector interface

Power Sum Crosstalk (PSumXT) a crosstalk measurement where the crosstalk from all adjacent disturbing pairs in a cable are mathematically summed to give a combined crosstalk value; it simulates the effects of multiple signals in a multi-pair cable or parallel transmission in a 4 pair cable; it can be made for NEXT, FEXT, or ELFEXT Premises Distribution System a cabling system as defined by ANSI/TIA/EIA 568 series Prewiring cabling installed either before walls are enclosed or finished; or in anticipation of future use or need

Private Branch Exchange (PBX) a private phone system owned by a customer, which allows communication within a business and between the business and the outside world

Protocol set of rules for communicating

Pull Box device to access a raceway in order to facilitate placing of wires and cables

Pull Cord cord or wire placed within a raceway used to pull wire and cable through the raceway

Pull Strength maximum pulling force that can be safely applied to a cable or raceway

Pulling Tension the pulling force that can be applied to a cable without effecting the specified characteristics for the cable

Quad-shield four layers of shielding

RF see Radio Frequency

RFI see Radio Frequency Interference

RL see Return Loss

Raceway any channel designed for holding wires or cables

Radio Frequency (RF) refers to analog signal processing and transmission technology for applications that include CATV; the term “RF” is sometimes used to refer to electronic or coaxial part of hybrid-fiber coax systems in CATV and other broadband applications

Radio Frequency Interference (RFI) the unintentional transmission of radio signals Rated Temperature the maximum temperature at which an electric component can operate for extended periods without loss of its basic properties

Rated Voltage the maximum voltage at which an electric component can operate for extended periods without undue degradation or safety hazard

Receiver an electronic package that converts optical signals to electrical signals

Reflectance the ratio of power reflected to the incident power at a connector junction or other component or device, usually measured in decibels (dB); reflectance is stated as a negative value; a connector that has a better reflectance performance would be a -40 dB connector or a value less than -30 dB; the term return loss, back reflection, and reflectivity are also used synonymously in the industry to describe device reflections, but they are stated as positive values

Reflection Loss the part of a signal which is lost due to reflection at a line discontinuity

Refraction bending of oblique (non-normal) incident electromagnetic waves as they pass from a transmission medium of one refractive index into a medium of a different refractive index

Refractive Index a ratio of the speed of light within the medium, as compared to the speed of light within a vacuum; refractive index is wavelength dependent and is important for accurate length measurement. Also the ratio of the sines of the incidence angle and the refraction angle of a media

Repeater device consisting of a receiver and transmitter, used to regenerate a signal to increase the system length

Return Loss (RL) a measure of standing waves independent of variation of input impedance, measured with a load equal to the desired characteristic impedance of the cable

Return Path transmission from a node in the distribution network toward the head-end; also known as “upstream”

RG/U “RG” is the military designation for “Radio Grade” coaxial cable, and “U” stands for “general Utility”

Ribbon a parallel array of optical fibers, which can be used as an organizational unit within a cable; ribbons offer consistent geometry, required for mass splicing of product, and offer a higher packing density in large fiber count cables

Riser Cable cable designed for use in elevator shafts, utilities columns, or other vertical shafts in multi-story buildings; because the cable connects different floors of multi-story buildings, it must be designed to meet safety codes that specify a low level of flammability; riser cables are also used in telephone company central offices to connect the equipment with the outside-plant cable, which enters a “vault”, which is usually below grade

Rope Lay Cable a cable composed of a central core surrounded by one or more layers of helically laid groups of wires or buffer tubes

Router a device that forwards traffic between networks or subnetworks; operates at the OSI Network Layer (Layer 3)

SC see Subscriber Connector

ScTP see F/UTP

SONET see Synchronous Optical Network

SRL see Structural Return Loss

ST see Straight Tip Connector

STP see Shielded Twisted Pair, see S/FTP

Scattering a property of glass that causes light to deflect from the fiber and contributes to optical attenuation

Screened Twisted Pair (ScTP) see F/UTP
Self-Support see figure-eight
S/FTP a 100 ohm cable with foil shields over the individual pairs; formerly Shielded Twisted Pair (STP)
Sheath the outer covering or jacket of a multiconductor cable.
Shield a metallic layer placed around a conductor or group of conductors; may be the metallic sheath of the cable or a metallic layer inside a nonmetallic sheath
Shield Effectiveness the relative ability of a shield to screen out undesirable radiation; frequently confused with the term shield percentage, which it is not
Side-Wall Pressure the crushing force exerted on a cable during installation
Simplex operation of a communications channel in one direction only with no capability of reversing
Single-mode Fiber optical fiber with a small core diameter, as compared to the wavelength of light guided, in which only one mode is propagated
Skin Effect the phenomenon in which the depth of penetration of electric currents into a conductor decreases as the frequency increases
Sleeve an opening, usually circular, through the wall, ceiling or floor to allow the passage of cables and wires
Slot an opening, usually rectangular, through the wall, ceiling or floor to allow the passage of cables and wires
Spiral Wrap the helical wrap of a tape or thread over a core
Splice a permanent joining of two fiber cables that cannot be easily disconnected; a splice will provide the lowest power loss for a connection of fibers
Splice Closure a device used to protect a cable or wire splice
Splice Tray device used within splice closures or cabinets to organize and protect spliced fibers
Star Coupler optical component which allows emulation of a bus topology in fiber optic systems
Star Topology a topology where each telecommunications outlet is directly cabled to the distribution device
Step-Index Fiber optical fiber which has an abrupt (or step) change in its refractive index due to a core and cladding that have different indices of refraction, typically single-mode fiber
Straight-tip Connector (ST) a type of fiber optic connector
Strand Vice a device that allows a stranded cable to enter it but grips it when pulled in the opposite direction
Stranded Cable multiple like units brought together; may be cable with an integral messenger support strand, see figure-eight or self-support
Stranded Conductor a conductor composed of groups of wires twisted together
Structural Return Loss (SRL) a measure of standing waves independent of variation of input impedance, measured with a load equal to the characteristic impedance of the cable at that frequency
Subscriber Connector (SC) a type of fiber optic connector
Support Strand a strong element used to carry the weight of the telecommunication cable and wiring; may be constructed of steel, aluminum or aramid fiber yarns, also known as messenger
Sweep Test pertaining to cable, checking frequency response by generation an rf voltage whose frequency is varied back and forth through a given frequency range at a rapid constant rate and observing the results of an oscilloscope

Synchronous Optical Network (SONET) a standard-or more specifically a set of standards-for synchronous transmission; the standards include signal rates, formats, and optical and electrical interface specifications; the standards organization is ASNI; the international counterpart of the SONET standards is SDH

SZ Stranding stranding methods in which the elements are stranded such that the direction of stranding changes intermittently down the length of the cable; this method of stranding offers advantages over helical stranding in mid-span access of cables where the core is not cut

TDM see Time Division Multiplexing

TO see Telecommunications Outlet

TR see Telecommunications Room

T1 carries 24 pulse code modulation signals using time-division multiplexing at an overall rate of 1.544 million bits per second (Mbps); T1 lines use copper wire and span distances within and between major metropolitan areas (T2, 6.312 Mbps; T3, 44.756 Mbps; T4, 273 Mbps)

Tape Wrap a spirally wound tape over an insulated or uninsulated wire

Tear Strength the force required to initiate or continue a tear in a material under specified conditions

Teflon® the DupontR brand name for FEP resin Telco a telephone company; a term from the telephone industry jargon; it usually refers to a local exchange carrier, but is not precise and also can refer to long-distance carriers; short for Telecommunications

Telecommunications Bonding Backbone the copper conductor extending from the telecommunications main grounding busbar to the farthest floor telecommunications grounding busbar

Telecommunications Room (TR) from ISO/IEC 11801: a cross-connect point between the backbone and horizontal cabling subsystem; houses telecommunications equipment, cable terminations and crossconnect cabling; formerly known as the telecommunications closet

Telecommunications Grounding Busbar a common point of connection for the telecommunications system and bonding to ground

Telecommunications Outlet (TO) from Cenelec EN50173: a fixed connecting device where the horizontal cable terminates; provides the interface to the work-area cabling

Tensile Strength the pull stress required to break a given specimen

Terminal a point at which information enter or leaves a communication network; the inputoutput associated equipment; or a device which connects wires or cables together

Termination Hardware an outmoded term; see connecting hardware

TIA Telecommunications Industry Association

TIA/EIA-568 Commercial Building Telecommunications Standard; the standard concerning acceptable cabling and connecting hardware performance for telecommunications infrastructures; “C” is the latest revision; this standard now has four parts 568 C.0 and C.1 cover general information, 568-C.2 covers 100 ohm twisted pair, and 568-C.3 covers fiber optics

TIA/EIA-569 Commercial Building Standards for Telecommunications Pathways and Spaces

TIA/EIA-606 the Administration Standard for the Telecommunications Infrastructure of Commercial Buildings; the standard concerning, telecommunications numbering and labeling, identifiers and linkages between components of the system

TIA/EIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications; the standard concerning grounding systems, practices, labeling and requirements

TIA/EIA TSB 72 Centralized Optical Fiber Cabling Guidelines (October 1995) Tight Buffer cable construction where each glass fiber is tightly buffered by a protective thermoplastic coating to a diameter of 900 microns

Tight Buffered Fiber buffered optical fiber in which the buffer material is directly applied to the fiber coating

Time-Division Multiplexing (TDM) signalling technology in which two or more signals can be transmitted over the same path by using different time slots or intervals for each signal; in telecommunications, this is done with digital signals so that packets from two or more lower-speed digital signals are interleaved into time slots on a higher-speed multiplexed signal; in TDM fiber optic systems, the digital signals are multiplexed electronically so that resulting aggregated or multiplexed highbit-rate signal is transmitted over fiber as a single high-speed signal; after it is received and converted to an electronic signal, it is demultiplexed electronically into the two (or more) original signals

Token Ring a network protocol in which the stations circulate a token in sequential order; the next logical station is also the next physical station on the ring, used by IBMR

Topology the physical or logical configuration of a telecommunications system

TSB Technical Systems Bulletin (issued by TIA/EIA)

Transceiver a module containing both transmitter and receiver; a “transceiver” is an example of a “transmitter/receiver pair” but other examples have separate packaging for the transmitter and the receiver

Transmitter electronic package which converts an electrical signal to an optical signal

Transmitter/Receiver Pair (Tx/Rx Pair) an abbreviation used to note the number of “transmitter/receiver pairs” in the market for a specific application or customer group; a transmitter/receiver pair consists of one transmitter (laser) plus one receiver (detector); they can be in a combined “transceiver” module or packaged separately

Tray a cable tray system is a unit or assembly of units or sections, and associated fittings, made or metal or other non-combustible materials forming a rigid structural system used to support cables; cable tray systems (previously termed continuous rigid cable supports) including ladders, troughs, channels,
solid bottom trays, and similar structures

Triaxial Cable a cable construction having three coincident axes, such as conductor, first shield and second shield all insulated from one another

Twisted Pair any of a family of data cables with two conductors twisted together; the cabled pairs may be unshielded (U/UTP), shielded (S/FTP) or screened (F/UTP)

UHF Ultra High Frequency (300 to 3,000 MHz)

Underfloor Raceways raceway of various cross-sections placed within the floor from which wires and cables emerge within a specific floor area

Underground Plant communications cable that is placed within a conduit or duct system

Underwriter's Laboratories (UL) a non-profit organization established by the insurance industry to test devices, materials and systems for safety

Upstream transmission direction from the subscriber towards the central office or headend

U/UTP or UTP Unshielded Twisted Pair

VCSEL see Vertical Cavity Surface-Emitting LASER

VSAT see Very Small Aperture Terminal

VP see Velocity of Propagation

Vault a subsurface enclosure that personnel may enter to work with or place cable and/ or equipment (also known as maintenance access hole or manhole)

Velocity of Propagation (VP) the speed of transmission of electrical energy within a cable as compared to its speed in air; also known as NVP, or nominal velocity of propagation

Vertical Cavity Surface-Emitting LASER (VCSEL) refers to a laser diode structure designed to emit the optical radiation in a vertical direction relative to the plane with the active region; most diode lasers emit from end facets in the plane of the active region; typically used for transmission speeds of 1 Gb/s and higher

Very Small Aperture Terminal (VSAT) a satellite communications system for data

VHF Very High Frequency (30 to 300 MHz)

Volt a unit of electromotive force

VW-1 a flammability rating established by Underwriters Laboratories for wires and cables that pass a specially designed vertical flame test, formerly designed FR-1

WDM see Wavelength-Division Multiplexing

WAN see Wide Area Network

Water Migration the act of water travelling through a breach in the outer jacket(s) of a telecommunications cable, moving along the conductors due to capillary action

Watt a unit of electric power

Waveguide Dispersion dispersion caused by light traveling in both the core and cladding materials in a single-mode fiber

Wavelength the length of a wave measured from any point on a wave to the corresponding point on the next wave, such as from crest to crest

Wavelength-Division Multiplexing (WDM) the simultaneous transmission of more than one optical signal through an optical fiber with each signal having a distinct wavelength; WDM technology is typically used to increase system capacity by adding channels onto a signal fiber and the demultiplexers that separate the signals of different wavelengths at the receive end; see also "DWDM"

Wide Area Network (WAN) refers to a network that uses switched long-distance, dedicated, or leased facilities to link two or more locations in different cities for data or other applications

Wire a conductor, either bare or insulated

Work-Area Cable from ISO/IEC 11801: connects the telecommunications outlet to the terminal equipment

Work-Area Telecommunications Outlet a connecting device located in a work area at which the horizontal cabling terminates and provides connectivity for work-area patch cords

Zero-Dispersion Wavelength wavelength at which the chromatic dispersion of an optical fiber is zero; occurs when waveguide dispersion cancels out material dispersion.