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ANSI/TIA/EIA-568-A (CSA T529-95)

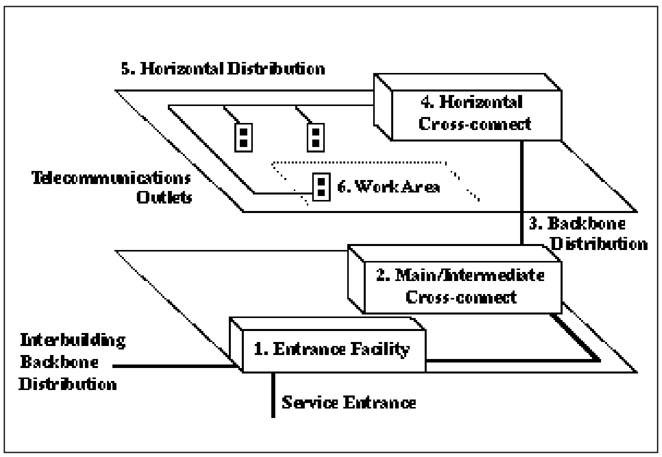
COMMERCIAL BUILDING TELECOMMUNICATIONS STANDARD

Standards

The purpose of this standard is to provide the minimum requirements for telecommunications cabling within a commercial building or campus environment.

The standard addresses the six major components of a structured wiring system:

- Entrance facility
- Main/Interconnect cross-connect
- Backbone distribution
- Horizontal cross-connect
- Horizontal distribution
- Work area.



Scope of ANSI/TIA/EIA-568-A (CSA T529-95)

ENTRANCE FACILITY

The entrance facility contains the cables, connecting hardware, protection devices and other equipment required to connect outside plant facilities to premise cabling. The components within this room may be used for public or private network connections.

The demarcation point between service providers and the customer owned premises cabling is typically located in this room.

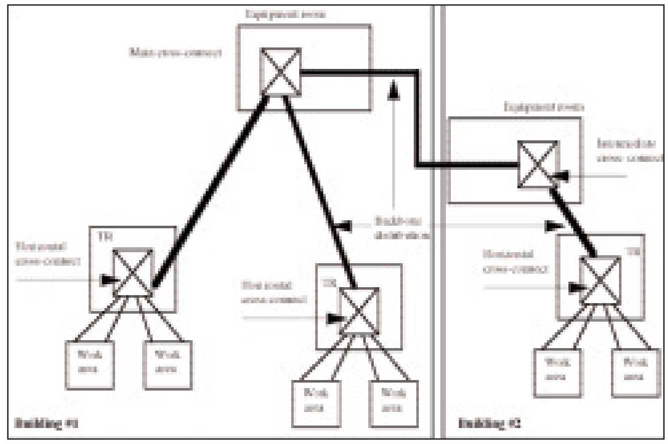
MAIN/INTERMEDIATE CROSS-CONNECT

The telecommunications equipment room could be the same location as the main/intermediate cross-connect. Cabling practices that apply to telecommunications rooms (TR) apply to equipment rooms.

BACKBONE DISTRIBUTION

Backbone cable provides the interconnection between TRs, equipment rooms and entrance facilities. The components involved in backbone distribution include:

- Backbone cables
- Intermediate and main cross-connects
- Mechanical terminations
- Patch cords or jumpers for backbone-to-backbone connections.



Backbone Distribution

GENERAL DESIGN GUIDELINES

The useful life of backbone cable is at least ten years.

- Planning should consider the maximum amount of backbone cable, media additions (optical fiber) and number of connections required during this period.

Consider the proximity of metallic cables to possible sources of electromagnetic interference.

TOPOLOGY

The backbone distribution system is to follow a hierarchical star topology.

- Each horizontal cross-connect in a TR is cabled to a main cross-connect or an intermediate cross-connect and then a main cross-connect

There cannot be more than two hierarchical levels of cross-connect.

- At most, one cross-connect can be passed through to go from the horizontal cross-connect to the main cross-connect
- Three or fewer cross-connects can be passed through to go from one horizontal cross-connect to a second horizontal cross-connect.

Systems designed for non-star configurations (ring, bus or tree) can usually be accommodate by the hierarchical star topology.

- If special requirements for bus or ring configurations are expected, it is allowable to cable directly between telecommunications rooms.
  - This cabling is in addition to the basic star topology.

RECOGNIZED BACKBONE DISTRIBUTION MEDIA

Recognized media may be used individually or in combination. These media are:

- 100 Ω UTP cable
- 50/125 µm optical fiber cable proposed additions/deleting in TIA568-B/standard (under development)
- 62.5/125 µm optical fiber cable
- single-mode optical fiber cable
- 50 Ω coaxial or 150 Ω STP-A cable proposed additions/deleting in TIA568-B/standard (under development). Cables are still a recognized media but are not recommended for new installations.

MEDIA SELECTION CRITERIA

The choice of backbone distribution media will depend on the characteristics of specific applications. Factors to consider in making a selection include:

- flexibility with respect to supported services
- required useful life of backbone cable
- site size and user population.

IN-BUILDING AND INTER-BUILDING BACKBONE CABLING DISTANCES

Recommended maximum distances are application dependent. It is not assured that all applications will function properly over the specified distances.

Maximum backbone distribution distances

Media type	Horizontal cross-connect to Main cross-connect	Horizontal cross-connect to Intermediate cross-connect	Main cross-connect to Intermediate cross-connect
UTP	800 m (2 624 ft)	500 m (1640 ft)	300 m (984 ft)
62.5/125 µm optical fiber	2 000 m (6 560 ft)	300 m (984 ft)	1 700 m (5 576 ft)
Single-mode optical fiber	3 000 m (9 840 ft)	300 m (984 ft)	2 700 m (8 856 ft)

- For high-speed data applications the use of category 3, 4 or 5 100 Ω UTP backbone cable shall be limited to a total distance of 90 m (295 ft); this assumes 5 m (16 ft) at each end for connection to equipment.
- The capability of single-mode optical may allow for distance up to 60 km (37 miles). However, this is outside the scope of the standard.

HORIZONTAL CROSS-CONNECT

The termination of horizontal cable is the primary function of the horizontal cross-connect that is housed in a telecommunications room. Cable of all media types are terminated on compatible connecting hardware. Backbone cable is also terminated on compatible hardware.

Connecting hardware, jumper wire and patch cords are collectively referred to as the horizontal cross-connect.

TELECOMMUNICATIONS ROOM FUNCTIONS

The primary function is to contain horizontal cable terminations of all recognized types.

Recognized types of backbone cable are also terminated here.

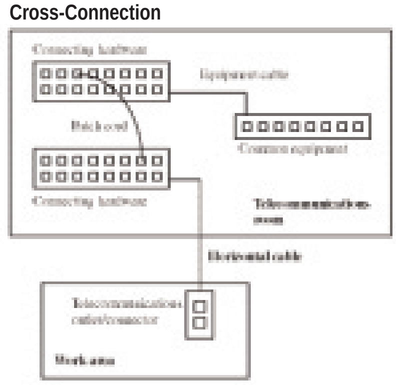
Cross-connections of horizontal and backbone terminations using jumper wire or patch cords allow for flexibility to extend services to telecommunications outlet/connectors.

The intermediate or main cross-connect for portions of the backbone cabling system may also be found in the telecommunications room separate from the horizontal cross-connect.

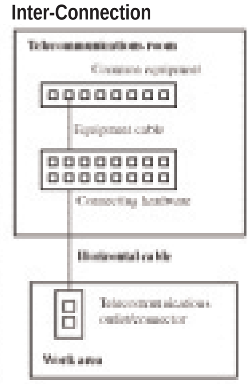
CROSS-CONNECTIONS AND INTERCONNECTIONS

Moves, add-ons or changes are to completed by performing cross-connects or interconnects. Cross-connects are connections between horizontal cabling and backbone or equipment connecting hardware (i.e,. patch panels). Connections made directly between equipment and horizontal cabling are called interconnects.

Cross-Connection



Inter-Connection



ANSI/TIA/EIA-568-A (CSA T529-95)

Commercial Building Telecommunications Standard

HORIZONTAL DISTRIBUTION

Horizontal distribution is the part of the telecommunications cabling system running from the work area to the horizontal cross-connect in the TR.

Horizontal cabling includes:

- Horizontal distribution cables
- Telecommunications outlet/connector in the work area
- Mechanical termination of the cable media
- Patch cords/jumpers in the TR.

GENERAL DESIGN GUIDELINES

The horizontal distribution system must satisfy current requirements and should facilitate ongoing maintenance and relocation. Also consider future equipment and service changes.

- After installation, horizontal cabling is usually less accessible than other cabling
- Horizontal cabling is subject to the greatest amount of activity in the building (approx. 90%)
- Consider the diversity of possible services/applications to be used.

Consider the proximity of cables to possible sources of electromagnetic interference.

TOPOLOGY

The horizontal distribution system must follow a star topology.

- The telecommunications outlet/connector in the work area is to be directly connected to a horizontal cross-connect in a telecommunications room located on the same floor as the work area
- Bridged taps and splices are not permitted.

DISTANCES

Regardless of the media type used for horizontal distribution, the maximum distance is 90 m (295 ft).

- This maximum distance is for the amount of cable required to get from the work area outlet to the horizontal cross-connect in the TR
- For each horizontal channel a maximum of 10 m (33 ft) is permitted for work area cords, patch cords, jumper wires and equipment cords (inclusive)
  - At the horizontal cross-connect the maximum length of patch cords/jumpers used to connect horizontal cable to equipment or backbone cable is not to exceed 6 m (20 ft)
  - It is recommended the maximum length of cord used in the work area should not exceed 3 m (10 ft).

RECOGNIZED HORIZONTAL DISTRIBUTION MEDIA

Three types of media are recommended for use:

- Four-pair 100 Ω unshielded twisted-pair (UTP cable
- Two-pair 150 Ω shielded twisted-pair (STP-A) cable
- Two-fiber, 62.5/125 mm optical fiber cable
- 50 Ω co-axial cable is still a recognized media but is not recommended for new installations.

Hybrid cables (multiple types of media under a single sheath) may be used in the horizontal distribution system if each recognized cable type meets the transmission requirements and color-code specifications for that cable type.

- 100 UTP cables of mixed categories are not recommended under the same sheath
- Cross-talk specifications between cables of a hybrid cable should be met
- It must be possible to distinguish hybrid UTP cables from multipair UTP backbone cable
- Hybrid cable made up of optical fiber and copper conductors may be referred to as composite cable.

MEDIA SELECTION CRITERIA

Each work area must be equipped with at least two telecommunications outlets/connectors.

One outlet may be associated with voice and the other with data.

- The first outlet shall be a 4-pair 100 Ω UTP cable, Category 3 or higher.
- The second outlet may be supported by one of the following media:
  - Four-pair 100 Ω UTP cable, Category 5 recommended
  - Two-fiber 50/125 µm optical fiber cable
  - Two-fiber, 62.5/125 µm optical fiber cable.

WORK AREA

Work area components are from the outlet to the work area equipment. It is assumed a maximum of 3 m (10 ft) is used for the modular cord at the work area. Four-pair UTP cables are terminated in 8-position modular jacks at the work area.

The recommended pin/pair assignment is referred to as T568A-ISDN. However, if required, T568B-ALT can also be used.

WORK AREA COMPONENTS

Work area components fall outside the scope of the standard.

Work area equipment includes a large variety of equipment. Included are telephones, fax machines, data terminals and computers.

Work areas are generally considered to be non-permanent, and are expected to change. Therefore, work areas should be designed to be relatively easy to change.

TELECOMMUNICATIONS OUTLET/CONNECTOR

Pin/pair assignment for 100 Ω UTP cable is recommended to follow the T568A configuration. To accommodate certain cabling systems, the T568B configuration is accepted.

U.S. Federal Government publication FIPS PUB 174 recognizes designation T568A only.

Legend

W	White
G	Green
O	Orange
BL	Blue
BR	Brown

Designation T568A 8-position jack pin/pair assignments

1	2	3	4	5	6	7	8
W-G	G	W-O	BL	W-BL	O	W-BR	BR

Designation T568B 8-position jack pin/pair assignments

1	2	3	4	5	6	7	8
W-O	O	W-G	BL	W-BL	G	W-BR	BR

Front view of telecommunications outlet

WORK AREA CORDS

The horizontal distribution system assumes a maximum cord length of 3 m (10 ft).

- Cables and connectors should meet or exceed patch cord recommended requirements.

SPECIAL ADAPTATIONS

If application specific adaptations such as impedance matching devices are required, they must be external to the telecommunications outlet/connector.

Some commonly used adapters include the following:

- A special cable or adapter when the equipment connector is different from the outlet/connector
- "Y" adapters to permit two services to run on a single cable
- Passive adapters used when the horizontal cable type is different from that required by the equipment
- Active adapters when connecting devices using different signaling schemes
- Adapters allowing pair transposition for compatibility purposes
- Termination resistors.

Consider adapter compatibility with premises cabling and equipment. Adapters may have detrimental effects on the transmission performance of the telecommunications cabling system.

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Commercial Building Telecommunications Standard

ADDENDUM 1: PROPAGATION DELAY AND DELAY SKEW SPECIFICATIONS FOR 100 Ω 4-PAIR CABLE (SEPT. 97).

The introduction of high-speed applications has created needs for additional transmission requirements such as propagation delay and delay skew for 100 Ω 4-pair cabling systems. The effects of these parameters are mostly found when applications require multiple pairs for parallel transmission. It is important to specify that although these are new specifications, most of the existing TIA/EIA-568-A compliant cable will likely meet these two additional parameters. This addendum was created to set a standard in the cables manufacturing business. It was developed to ensure that all recognized 4-pair cables manufactured to the TIA/EIA 568-A standard comply with known application requirements, such as 100BASE-T4.

The new parameters are:

- Propagation Delay is the time needed for the transmission of a signal over a single pair of 100 Ω 4-pair cable.
- Delay Skew is the difference in the propagation delay between any two pairs within the same cable sheath. The worst case scenario for delay skew is obtained when the difference is calculated between the fastest and the slowest pair in the cable.

ADDENDUM 2: CORRECTIONS AND ADDITIONS TO TIA/EIA-568-A (AUGUST 98).

This addendum was created to modify certain requirements in the existing TIA/EIA-568-A and provide additional requirements, for items effected by the fast growth of technology.

Some changes include additional references to the documents TSB 72: Centralized Optical Fiber Cabling Guidelines and TSB 67: Transmission Performance Testing Specifications for Field Testing of UTP Cabling Systems.

Also this addendum provides additional details on Resistance Measurement, common mode termination for cabling components and the required test set-up configuration for those components. It will complete the information found in the standard TIA/EIA-568-A.

ADDENDUM 3: HYBRID AND BUNDLED CABLES (DEC. 98).

The purpose of this one page addendum is to add a new definition for bundled cable and additional requirements.

- A Bundled Cable is a cable assembly containing two or more recognized cables continuously bound together to form a single cable entity.
- A Hybrid Cable is a cable assembly containing two or more recognized cables of the same type or different types of conductors covered by a single sheath.

Additional requirements are specified and can be applied to both Hybrid and Bundled cables.

- Bundled or Hybrid Cables may be use as horizontal cabling if each recognized cable type meets the transmission and color-coded as specified by that type of cable.
- The PowerSum NEXT loss caused by all pairs external to the disturbed pair's jacket within the bundled or hybrid cable assembly shall be 3 dB better than the specified pair-to-pair NEXT loss of that recognized type of cable at all of the specified frequencies.

*Note: Hybrid cable consisting of optical fiber and copper conductors can also be referred to as composite cable.

ADDENDUM 4: PRODUCTION MODULAR CORD NEXT LOSS TEST METHOD AND REQUIREMENTS FOR UTP CABLING (AUGUST 99).

The objective of this addendum is to provide to the manufacturers of modular plug cord assemblies, a simple and effective method to ensure modular plug cords are compatible with the performance requirements given by ANSI/TIA/EIA-568-A. It provides a non-destructive methodology to test modular plug cords for the NEXT Loss parameter. The 8-pin modular plug cords are use in a channel configuration as an equipment cord, a patch cord or a work area cord.

The test method used to measure the NEXT loss of an 8-pin modular plug is called de-embedded NEXT (DNEXT). This test method defines the construction of a reference jack that is measured for NEXT and the procedure for obtaining the NEXT loss (both magnitude and phase) of the reference jack at all specified frequencies. This reference jack is then used as a test head for testing plugs or patch cords. The de-embedded NEXT of a test plug is obtained by subtracting the NEXT of the reference jack from the mated plug/reference jack measurement. The difference is called the DNEXT of the plug. Plugs with different DNEXT values are used to test the mated NEXT of connecting hardware, which can be used to determine plug and mated plug/jack performance. This will determine backward compatibility and interoperability.

ADDENDUM 5: TRANSMISSION PERFORMANCE SPECIFICATIONS FOR 4-PAIR 100 Ω CATEGORY 5e CABLING (JANUARY 2000).

This document has been approved for publication by ANSI in January 2000 as ANSI/TIA/EIA 568-A-5.

It covers the following topics:

- Definitions, test configurations and transmission requirements for Category 5e components
- Field test requirements and test procedures for Category 5e channels and basic links including power sum near-end crosstalk (PSNEXT), power sum equal level far-end crosstalk (PSELFEXT) and return loss
- Accuracy requirements for enhanced level II (Level II-E) testers
- New de-embedded test procedures and requirements for modular test plug qualification
- New test procedures and requirements for the return loss of Category 5e modular patch cords
- New channel model for the development of component return loss limits.

The most noteworthy changes to the enhanced Category 5 cabling standard are summarized in Tables 1, 2 and 3 for channels, cables and connectors, respectively.

WHAT IS THE SIGNIFICANCE OF THE ENHANCED CATEGORY 5 STANDARD?

The new transmission parameters and requirements are a major improvement over Category 5. These performance improvements will enable Category 5e cabling to support gigabit applications such as 1000BASE-T for worst-case channel topologies that can include up to four connectors and 100 meters of cabling.

The most demanding requirements are on cabling return loss performance. A higher return loss in dB requires a more uniform cable impedance (more precise manufacturing process), better patch cords (stable impedance) and better impedance matching between components. This will translate into a cleaner signal and more reliable transmission performance (fewer data errors).

TRANSMISSION REQUIREMENTS FOR A CATEGORY 5e CHANNEL

CHANNEL (100 M)	CATEGORY 5 TIA/EIA 568-A/TSB-67	CATEGORY 5e TIA/EIA 568-A-5
PSNEXT @ 100 MHz	not specified	27.1 dB
PSELFEXT @ 100 MHz	not specified	14.4 dB
Return Loss @ 20 MHz	not specified	17 dB
Return Loss @ 100 MHz	not specified	10 dB

TRANSMISSION REQUIREMENTS FOR CATEGORY 5e CABLES

CABLE (100 M)	CATEGORY 5 TIA/EIA 568-A/TSB-67	CATEGORY 5e TIA/EIA 568-A-5
PSNEXT @ 100 MHz	not specified	32.3 dB
PSELFEXT @ 100 MHz	not specified	20.8 dB
Return Loss @ 20 MHz	not specified	25 dB
Return Loss @ 100 MHz	not specified	20.1 dB/19.0 dB*

*designates stranded cable

TRANSMISSION REQUIREMENTS FOR CATEGORY 5e CONNECTORS

CONNECTOR (100 M)	Category 5 TIA/EIA 568-A/TSB-67	Category 5e TIA/EIA 568-A-5
NEXT @ 100 MHz	40 dB	43 dB
FEXT @ 100 MHz	not specified	35.1 dB
Return Loss @ 20 MHz	23 dB	34 dB
Return Loss @ 100 MHz	14 dB	20 dB