

STRUCTURED CABLING SYSTEMS FOR TELECOMMUNICATIONS

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DESIGN AND ENGINEERING PRACTICE



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1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for material specifications, installation practices, testing requirements and project deliverables for the design, supply, installation and commissioning of a structured cabling system for LAN and voice (PABX) systems. This DEP is not intended to cover every aspect of equipment and facility practices, although key areas are highlighted. Building security, electricity, and telemetry requirements are specifically excluded from the scope of this DEP.

This DEP is a revision of the DEP with the same number dated October 1995.

This DEP gives amendments and supplements to ISO/IEC 11801, EIA/TIA 568A and EIA/TIA 606 which are considered necessary. All requirements in this DEP are identified with their source, as follows:

- ISO/IEC 11801, EIA/TIA 568A and EIA/TIA 606 standards. Wording in this DEP indicated with a solid bullet is meant to clarify and/or choose from available alternatives. Consult the appropriate standards document for clarification.
- Shell internal recommendations. Sections in this DEP indicated with a hollow (white) bullet specify installation practices which are not covered within the Standards.

The companion Information and Computing document "Guidelines for Structured Cabling Systems", SIEP report number 98-5514, provides background information and explanatory notes; it is for the use of the Principal and not the Contractor.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

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This DEP is intended primarily for office facilities as described in ISO/IEC 11801 and EIA/TIA 568A. The specifications herein shall be applicable to other facilities after making necessary minor modifications. Other uses include oil refineries, gas handling installations, chemical plants, oil and gas production facilities, and supply/marketing installations.

If national and/or local regulations exist in which some of the requirements may be more stringent than indicated in this DEP, the Contractor shall determine, by careful scrutiny, which of the requirements are the more stringent and which combination of requirements will be acceptable as regards safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this DEP that is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned with the object of obtaining agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party which carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project, or operation or maintenance of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party which manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party which initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions

Cable outlet	A fixed socket in a work area (office) where a horizontal cable terminates, typically serving a single user and a single piece of equipment (PC or telephone).
Cross-connect	A facility for the interconnection and termination of cabling.
Faceplate	The cosmetic flat assembly which covers the outlet box, usually located within the office or work area.
Faceplate blank	A solid faceplate used to cover an outlet box when no cable outlet is installed.
Hub	Active equipment which provides connectivity between a user's device and the LAN. The hub is situated in a central location on a floor connecting to the horizontal cables.
Multimode fibre	Usually powered by light emitting diodes. 62.5/125 micrometre means "core" is 62.5 micrometres (where the light travels), and the cladding is 125 micrometres (refractive glass to enclose light within transparent core and support the brittle core). EIA/TIA standards recommend distances less than 2 km.
Outlet box	A hollow receptacle, buried in a wall or floor. The outlet box receives conduits, encloses the cable outlet, and is covered by a faceplate.
Patch panel	A cross-connect system of mateable connectors that facilitates easy administration.
Plenum	A building space where environmental air moves but cables are allowed, for example a suspended ceiling.
Pull box	An accessible box mounted in the path of a conduit which can be opened to access the cables within the conduit. The pull box is used to pull cables through length(s) of conduit.
Service core	The part of the building carrying the services between floors and usually offering main structural support. The service core is usually in the centre of the floor and provides elevators, toilets, HVAC equipment, and electrical services.
Single mode fibre	Finer specifications than multimode (usually 8.3/125 micrometre) and currently more expensive. Single mode constrains the light "path", and is powered by lasers. EIA/TIA standards recommend distances less than 10 km.
Sleeve	A usually circular opening through a wall, floor or ceiling to allow the passage of cables and wires.
Slot	A usually rectangular opening through a wall, floor or ceiling to allow the passage of cables and wires. Slots are not permitted (see 2.5).
Systimax	Lucent trademark for their cabling system.
Work area	An office or space within a building where the occupants use computer and communication equipment. In an office building, this would be the office or desk area.
Work area cable	Extension cable running from the work area telecommunications outlet to the user equipment (telephone or PC).

1.4 ABBREVIATIONS

ACR	Attenuation Cross-talk Ratio.
ATM	Asynchronous Transfer Mode (Cell Relay). Telecommunications transmission technology, based on fixed length cells, scalable from less than 25 Mbps to 622 Mbps and above (see Appendix 1).
AWG	American Wire Gauge measurement standard.
BFOC/2.5	Fibre optic cable connector, also known as an ST connector.
EIA	Electronic Industry Association (see Appendix 1).
EMI	Electromagnetic interference
FDDI	Fibre Distributed Data Interface LAN running at 100 Mbps over multimode fibre optic cable.
FOIRL	Fibre Optic Inter Repeater Link standard for connecting devices such as hubs over fibre.
HVAC	Heating, ventilation and air conditioning.
IEEE	Institute of Electrical and Electronics Engineers (see Appendix 1).
ISDN	Integrated Services Digital Network standard for digital telephony service.
IT	Information Technology. Refers either to a department providing computing services to the Principal, or to the discipline relating to computer and information technologies.
LAN	Local Area Network, a data communications system, with moderate to high data rates. Recently, the LAN has become the fundamental backbone of the entire IT infrastructure.
LDC	Local Distribution Centre - secondary wiring closet on a large area floor, where a single closet does not permit 90 m cable lengths.
Mbps	Mega (million) bits per second transmission speed.
MDF	Main Distribution Frame - telephony term for the main building cross-connect panel, terminating external cabling, riser cabling, and PABX cabling in a common location.
NEXT	Near-end Cross Talk, a measure of how much signal cross-couples between receive and transmit pairs.
NIDP	Network Interface Demarcation Point. Telephony term for interface between private network and the public network.
NVP	Nomial Velocity of Propagation.
PABX	Private Automatic Branch Exchange. Also called PBX (Private Branch Exchange) or CBX (Computerised Branch Exchange). This is a private telephone switch serving many telephone handsets and limited access trunks to the carrier, and often adding functions like voice mail, inter-PABX routing, speed dialling, etc.
PC	Personal Computer.
PVC	Polyvinylchloride, a material used for cable insulation. PVC is flammable and emits toxic fumes when in a fire.
RJ45	EIA/TIA and ISO standard 8-pin modular connector.
ST connector	Fibre optic cable connector, also known in EIA/TIA standards as BFOC/2.5.
TDR	Time Domain Reflectometer, device that measures cable length and the distance to faults

	distance to faults.
TIA	Telecommunications Industry Association, closely affiliated with EIA for cabling standards.
TSB	Technical Systems Bulletin, update to the EIA/TIA standards providing additional specifications.
UTP	Unshielded Twisted Pair cable (usually 4 pairs) without metal shielding.
WAN	Wide Area Network
10BaseT	IEEE 802.3 and ISO/IEC 8802-3 (Ethernet) LAN standard for UTP cables.
10BaseFX	Set of IEEE 802.3 and ISO/IEC 8802-3 (Ethernet) LAN standards for fibre optic cables.
568SC	Fibre optic cable connector, also known as a FDDI connector.

1.5 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets. Other documents referenced in this DEP are listed in (5).

1.6 ORDER OF PRECEDENCE

The Contractor shall apply, in order of precedence, all local and national regulations, all modifications specified in the contract, this DEP, ISO/IEC 11801 and EIA/TIA 568A documents, and finally the product installation guidelines from the Manufacturer.

2. DESIGN

2.1 BASIS OF DESIGN

The design shall include the supply, installation, and testing of: cable, faceplates and supporting hardware, connectors to terminate all cables, conduit, cable trays and supporting hardware, electrical grounding, cross-connects, patch panels, equipment racks, and labelling material, from the building access demarcation room to the office inclusive, unless otherwise directed by the Principal.

2.1.1 Standards

The cabling system as designed, supplied, installed, tested and delivered shall comply with and be certified to the following standards:

- ISO/IEC 11801 (1998). Generic Cabling System for Customer Premises, as amended/supplemented by this DEP. Copper cable shall conform to the enhanced Class D requirements of the 1998 amendment.
- EIA/TIA-568A Amendment 5, 1998. Commercial Building Telecommunications Cabling Standard, as amended/supplemented by this DEP. This standard covers overall cabling architecture, cable, connecting hardware, and design. Copper cable shall conform to the enhanced Cat5e requirements of the 1998 amendment.
- EIA/TIA-569 Commercial Building Cabling Standard for Telecommunications Pathways and Spaces, covering building architecture, space allocations and horizontal cable pathways
- EIA/TIA-570 Residential and Light Commercial Telecommunications Cabling Standard
- EIA/TIA-606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings, as amended/supplemented by this DEP. This standards covers administration practices
- IEEE 802.3ab 1000 BaseT addendum 1998
- IEEE 802.3z 1000 BaseF addendum 1998
- IEEE 802.5 / ISO/IEC 8802-5 (Token Ring)
- ISO/IEC 9314-3 (FDDI)
- ATM AF-PHY-0015.000

This DEP specifies a cabling system designed to meet the rigid technical performance criteria of IEEE 802.3/ISO/IEC 8802-3, IEEE 802.5 / ISO/IEC 8802-5, FDDI, and ATM. The intent is to provide flexibility to add outlets, cable and fibre to the desktop; add cable to the backbone; and to change technologies and configurations.

International standards and professional installation practices are stressed. A high performance cable that has been poorly installed, or installed with sub-standard cross-connects or patch cables, will have the qualifications of the lowest common denominator and may not meet the expectations or requirements.

IMPORTANT NOTE:

In September 1997, the technical committee that writes ISO/IEC 11801 announced that it was working on new standards:

Category 6 200 MHz channel performance;

Category 7 600 MHz channel performance (sometimes also known as "Cat 6" before Sept. 1997).

These standards will not be published until 1999 or 2000. The existing Cat 5 specification will also be uprated in 1998 by both ISO and TIA/EIA. The next edition of TIA/EIA 568A, to be known as TIA/EIA 568B, will probably call for an intermediate standard of enhanced Cat 5 to be known as Cat5e. The uprated standards will call for tighter values of NEXT, ACR,

Attenuation, Return Loss, Differential Delay and Overall Propagation Delay plus FEXT, ELFEXT and PSELFEXT.

It is essential that "Category 5" is not merely stated as a requirement or early obsolescence will result. The cabling system shall conform to the next generation of enhanced Cat 5. Installers and manufacturers shall explain how they will achieve this in any response to tender for cabling work.

2.1.2 Structure

(Figure 1) shows the structure of the cabling system in a typical office building.

2.1.3 Topology

- The topology shall be in the form of a hierarchical star in all parts of the infrastructure (horizontal, intra-building, inter-building) as shown in (Figure 2).
- There shall be no more than two hierarchical levels of cross-connects in the backbone cabling.

FIGURE 1 CABLING INFRASTRUCTURE MAJOR COMPONENTS

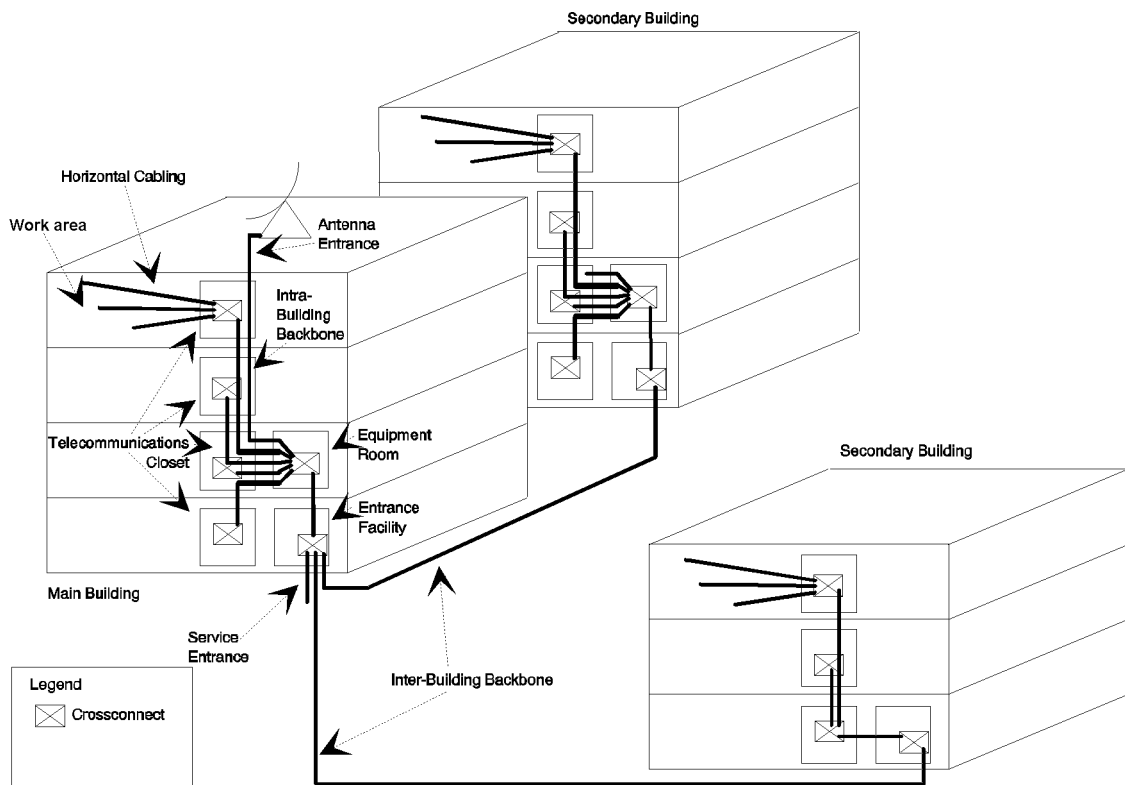
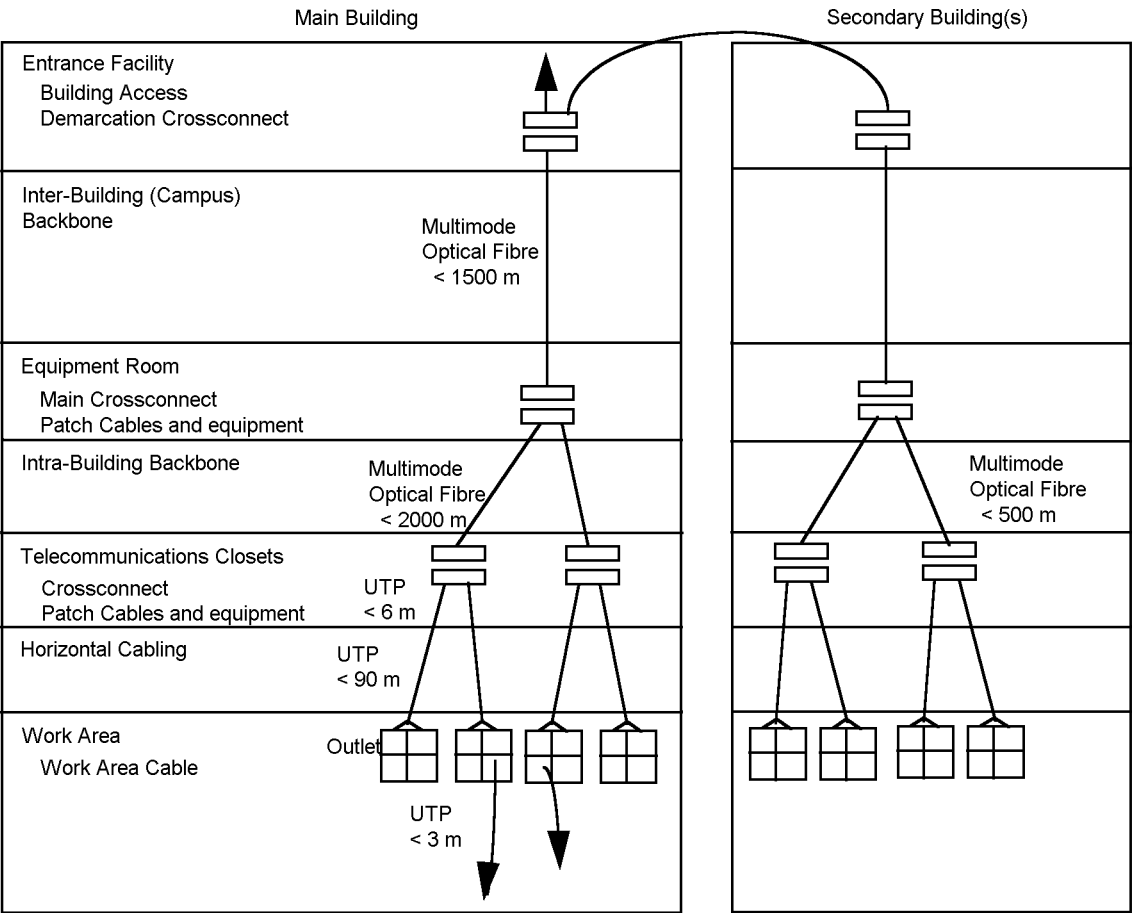


FIGURE 2 HIERARCHICAL STAR TOPOLOGY



2.2 WORK AREA

- Many installations are site-specific. The following shall be specified by the Principal: cable outlet location and mounting methods (such as wall or floor mount), faceplate design, colour and the quantity per office or "zone".
- Three cable outlets per work area shall be provided: two for data and one for voice.
- Wall mount outlets should normally be used. In open office areas utility columns shall be used. Horizontal cables shall not be terminated within furniture, instead only work area cables shall be used.
- Each work area cable outlet shall have a minimum of one associated power outlet. In new buildings and where possible in old buildings, power outlets shall be mounted near to and at the same height as the cable outlet. Electrical power outlets shall not terminate in the same outlet as the communications cable.
- Cable outlet boxes shall be no smaller than 50 mm wide, 75 mm high and 64 mm deep.
- Cable outlet boxes shall be securely mounted. Adhesive fixing is not acceptable.
- Faceplates shall be flush, vertical, and square to the wall panels. Outlet boxes shall be tested with a mock-up to ensure that the cable termination and faceplates can be installed easily within tolerance specifications. Some products do not lend themselves to correction of any box mis-alignments.
- A minimum separation of 5 cm shall be maintained between the faceplate and the floor, corner, or ceiling.
- All UTP cables shall be terminated with ISDN-standard 8-pin modular (RJ45) connectors, Enhanced Category 5 compliant (T568A jacks). The Contractor shall verify that the existing PABX and handsets can be adapted to T568A jacks or with the use of external adapters.
- Punch-down tools designed for the cable and connectors employed shall be used to ensure that all conductors are properly seated in connectors.
- Adapters shall be external to the outlet.
- Unused outlet boxes shall be covered by a faceplate blank, and labelled "For Telecommunications Use".
- Dust covers shall be installed over all edge connector assemblies.
- In harsh environments, cables outlets shall be enclosed in a protective case to protect against impact, spills and the ingress of moisture.

2.3 HORIZONTAL CABLING

Horizontal cabling refers to the cable and pathways between the telecommunications closet and the work area.

2.3.1 Distribution methods

- The floor space shall be divided into coverage areas or zones which are approximately square. The area of each zone shall not exceed 90 m². A distribution system using conduit or cable tray shall carry the horizontal cable from the telecommunications closet to the centre of the zone. Individual cables shall continue to the work area outlets.
- Several distribution methods are possible from the work area to the telecommunications closets. The Principal should state the preferred method from the following alternatives. Zoned conduit method shall be used by default.
 - Zoned conduit. The ceiling space is divided into areas (zones) for the cables. One conduit shall run from the closet to a zone box in the centre of the area. Individual cables shall run to each work area through the zone box.
 - Raceways (open or closed metal trays) shall be suspended in the ceiling area. Large header raceways shall bring cables into the area. Lateral raceways branch off the header raceways to provide services to the work area. Cables shall then run into utility columns or partition walls through short lengths of conduit.
 - Raised floor: a false floor shall be installed above the structure floor. Cables shall be routed below the false floor, and enter the work area through floor mounted outlets.
 - Other methods: floor trench, embedded zoned conduit within the structure and cellular floors.
- The distribution system shall be designed to support future cable density of six outlets per work area. Horizontal conduit sizing and cable trays shall be designed to accommodate twice the initial installation capacity. For planning purposes, assume 10 m² per work area.
- Conduit fill limits shall not be exceeded.
- Where the cable is delivered from the ceiling, conduit shall be used within the wall from each individual outlet box to the top of the wall. The conduit shall be sized to accommodate six outlets per work area and engineered to support both Category 5 UTP as well as multi-mode fibre optic cabling. Conduit or other trunking hardware shall be used where cables run vertically along pillars.
- Conduit shall be electrical metallic tubing, rigid metal conduit or rigid PVC. Conduit attachments to walls shall be mechanical, not adhesive. Flexible metal conduit shall not be used.
- Inaccessible ceiling areas, such as lock-in type ceiling tiles, drywall or plaster shall not be used as distribution pathways. If possible, all cable trays and conduit shall be installed invisibly within wall and ceiling space.
- Cable trays shall be sized according to the number of cables installed and weight loading, with allowance for maximum density. At least 650 mm² cross-sectional area of tray per 10 m² of usable floor space shall be provided.
- Trays and conduit shall take as direct a route as possible within the guidelines of EIA/TIA-569 to minimise cost and distance. Routing shall be along corridors where possible for ease of access.
- Conduit from the telecommunications closet to each zone box shall be designed to support 60 outlets. Allowance shall be provided for pulling future cables within partially full conduit. Installation of two conduits is recommended (one is "spare" and used only when the other is "full"). The diameter of each conduit shall be at least 5 cm.

- Pull boxes are required for long or indirect conduit runs. Any conduit longer than 30 m, or containing more than two 90° bends, or having a reverse bend, shall have a pull box. Pull boxes shall be placed in a straight section of conduit and not used in place of a bend, and the corresponding conduit ends should be aligned with each other.
- A pull string shall be installed and left within each conduit. Used pull strings shall be replaced during the pull.
- All cable trays shall be of an open construction such as ladder construction or U-shaped. All parts of the cable tray shall be joined together. Cable shall not run unsupported. Cable trays shall be supported by metal hangers and bonded to ground. The maximum distance between adjacent hangers on straight runs shall be 1.5 m. Where there are bends within the cable tray, the tray shall be supported by hangers on both sides close to the bends. All junctions shall be supported by hangers. No cable trays shall be permitted to move relative to each other. The inside of a cable tray shall be free of burrs, sharp edges or projections.

2.3.2 Cabling (see Figure 3)

- Each outlet shall terminate one Enhanced Category 5, four-pair UTP cable.
- Voice and data shall not share the same cable concurrently.
- At least 4 m of extra cable should be coiled in the ceiling unless this creates a run longer than 90 m. The coil of extra cable shall be fastened to the under-slab of the floor above. The additional cable is to allow future cable moves, ensure easy termination and minimise cable strain.
- Where building regulations permit, cable in ceiling voids shall be suspended without conduit or trays from the zone box or cable tray to the top of the wall conduit. Cables shall be supported by hanging cable supports no more than 1.5 m apart. Cable shall not be taut.
- Each horizontal run shall be less than 90 m from outlet to termination in the telecommunications closet. All run lengths shall be minimised.