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SERIES L: CONSTRUCTION, INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT

Copper loop requirements for various technologies including indoor and structured cabling

Recommendation ITU-T L.76

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Copper loop requirements for various technologies including indoor and structured cabling

Summary

Old indoor installations, designed for voice transmission, are responsible for intermittent faults and performance degradation, in terms of throughput, when they are used for broadband applications. Very often, the use of older cabling becomes impractical for today's needs. Structured cabling is a solution that allows reliable broadband transmission and accommodates the increasingly varied information and communication services, such as super-high speed internet, video-communication, voice over Internet protocol (VoIP), Video on Demand (VoD), Internet protocol television (IPTV), security, telemetry, etc.

General customer premises and residential buildings cabling architectures are introduced. Pertinent electrical parameters and requirements are referred to in [ISO/IEC 11801] and [ITU-T L.75].

The purposes of Recommendation ITU-T L.76 are:

– to present general indoor network architectures;

– to recommend structured cabling as a solution for indoor network implementations; and

– to define the requirements to indoor copper networks.

Source

Recommendation ITU-T L.76 was approved on 29 May 2008 by ITU-T Study Group 6 (2005-2008) under Recommendation ITU-T A.8 procedure.

Keywords

General customer premises and residential buildings cabling, indoor copper cabling requirements, structured cabling.

FOREWORD

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Copper loop requirements for various technologies including indoor and structured cabling

1 Scope

The purposes of this Recommendation are:

– to present general indoor network architectures;

– to recommend structured cabling as a solution for indoor network implementations; and

– to define the requirements for indoor copper networks.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T L.75] Recommendation ITU-T L.75 (2008), *Test, acceptance and maintenance methods of copper subscriber pairs*.

[ISO/IEC 11801] ISO/IEC 11801:2002, *Information technology – Generic cabling for customer premises*.
<http://www.iso.org/iso/iso_catalogue_tc/catalogue_detail.htm?csnumber=36491>

3 Definitions

This Recommendation defines the following terms (aligned with [ISO/IEC 11801]):

3.1 balanced cable: Cable consisting of one or more metallic symmetrical cable elements (twisted pairs or quads).

3.2 building backbone cabling subsystem: Distribution system connecting the main distribution frame to an intermediate distribution frame, an intermediate distribution box, a floor distribution frame or a floor distribution box in a building and the distribution system interconnecting intermediate distribution frames in a building.

3.3 building distribution frame (or box): Distribution frame (or box) installed in each multi-tenant unit for effective building wire management in case of a configuration of a residential complex of more than two multi-tenant units.

3.4 cabling: System of telecommunication cables, cords and connecting hardware that can support the connection of information technology equipment.

3.5 campus: Premise containing one or more buildings.

3.6 campus backbone cabling subsystem: Distribution system connecting the main distribution frame or the main distribution box in a local area to a building distribution frame or a building distribution box, and the distribution system interconnecting building distribution frames.

3.7 consolidation point (CP): Connection point in the horizontal cabling subsystem between a floor distributor and a telecommunications outlet.

3.8 connecting hardware: Connecting hardware is considered to consist of a device or a combination of devices used to connect cables or cable elements.

3.9 cross-connect: Apparatus enabling the termination of cable elements and their cross-connection, primarily by means of patch cords or jumpers.

3.10 customer device box: Distribution box installed in a private space of a user for effective distribution of telecommunication line or the line for cable television facilities, etc.

3.11 demarcation point: Boundary point between a commercial facility and user facility.

3.12 main distribution box: Network connection facility which interconnects a carrier's facility with a user's facility in a small building which accommodates below 300 office lines, as in a single residential unit, and which is installed at a demarcation point for satisfactory cross-connection and maintenance of the line.

3.13 main distribution frame: Network connection facility which interconnects a carrier's facility with a user's facility in a big building which accommodates over 300 office lines, as in a multi-tenant unit, and which is installed instead of a main distribution box at a demarcation point for satisfactory cross-connection and maintenance of the line.

3.14 patch cord: Cable, cable unit or cable element with connector(s) used to establish connections on a patch panel.

3.15 patch panel: Assembly of multiple connectors designed to accommodate the use of patch cords.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ACR	Attenuation to Crosstalk Ratio
BD	Building Distributor
CD	Campus Distributor
CP	Consolidation Point
DSLAM	Digital Subscriber Line Access Multiplexer
EQP	Equipment
ELFEXT	Equal Level Far-End CrossTalk
FD	Floor Distributor
FEXT	Far-End CrossTalk
IPTV	Internet Protocol Television
NEXT	Near-End CrossTalk
PS ELFEXT	Power Sum Equal Level Far-End CrossTalk
PS NEXT	Power Sum Near-End CrossTalk
TO	Telecommunication Outlet
UTP	Unshielded Twisted Pair
VoD	Video on Demand
VoIP	Voice over Internet Protocol
xDSL	Generic Digital Subscriber Line

5 Conventions

None.

6 Generic cabling system for customer premises

6.1 Structure of generic cabling for building telecommunication facilities

Generic cabling systems contain up to three cabling subsystems: campus backbone, building backbone and horizontal cabling. The cabling subsystems are connected together to create a generic cabling system with a structure as shown in Figure 6-1. The distributors provide the means to configure the cabling to support different topologies such as bus, star and ring. In case of a hierarchical structure of the interconnection of subsystems, refer to [ISO/IEC 11801].

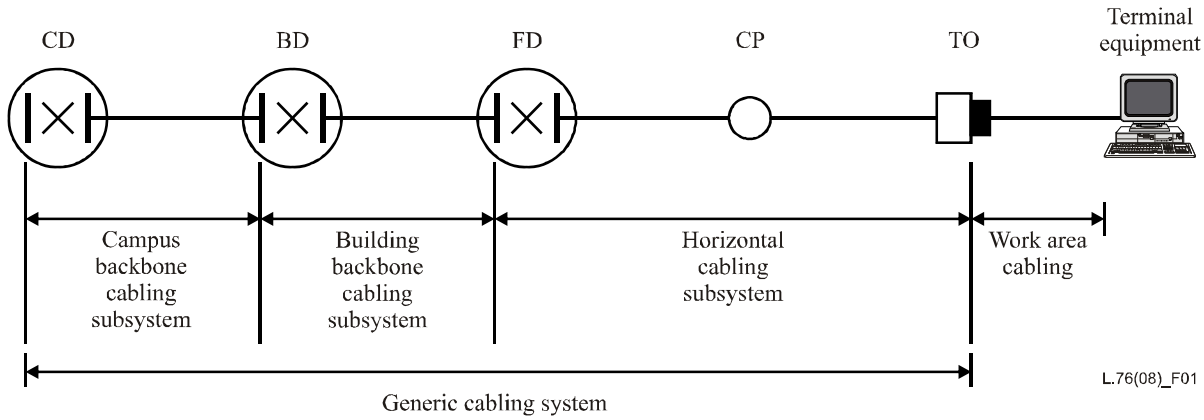

Figure 6-1 – General cabling structure

6.2 Campus backbone cabling subsystem

The campus backbone cabling subsystem extends from the campus distributor (CD) to the building distributor(s) (BD), usually located in separate buildings. When present, the subsystem includes the campus backbone cables, any cabling components within the building entrance facilities, jumpers and patch cords in the campus distributor, and the connecting hardware on which the campus backbone cables are terminated (at both the campus and building distributors).

6.3 Building backbone cabling subsystem

The building backbone cabling subsystem extends from building distributor(s) to the floor distributor(s) (FD). When present, the subsystem includes the building backbone cables, jumpers and patch cords in the building distributor, and the connecting hardware on which the building backbone cables are terminated (at both the building and floor distributors).

6.4 Horizontal cabling subsystem

The horizontal cabling subsystem extends from a floor distributor to the telecommunication outlet(s) connected to it. The subsystem includes the horizontal cables, jumpers and patch cords in the floor distributor, the mechanical termination of the horizontal cables at the telecommunication outlet, the mechanical termination of the horizontal cables at the floor distributor including the connecting hardware, a consolidation point (optional) and the telecommunication outlets.

6.5 Design objectives

Horizontal cabling should be designed to support the broadcast set of existing and emerging applications and therefore provide the longest operational life. This will minimize disruption and the high cost of re-cabling in the work area.

Building backbone cabling should be designed for the entire life of the generic cabling system. However, it is common to adopt short-term approaches that support current and foreseeable application requirements, particularly where there is no good physical access to pathways. The selection of campus backbone cabling may require a longer-term approach than that adopted for the building backbone, particularly if access to pathways is more limited.

7 Residential area telecommunication cabling

7.1 Principles

– In case of a multi-tenant unit, a customer device box for each household or a connection point with the function of a customer device box should be installed in each user's private space.

– In case of a single residential area unit, a customer device box should be installed at a demarcation point instead of a main distribution box.

– At least more than one telecommunication outlet should be installed from a customer device box to each room, and four pairs of UTP cables or equivalent to that or more should be installed in star wiring topology from a customer device box to each telecommunication outlet. However, a voice-only service is an exception and does not follow this principle.

– In lead-in line for each household, UTP cable with at least more than four pairs should be led in, and more than eight pairs is recommended.

– Cabling in a building should be done using the star wiring topology, and careful consideration for installation of building telecommunication facilities should be made when designing so that it can accommodate various information and communication services permanently.

7.2 Multi-tenant unit/apartment cabling system

At a demarcation point, the main distribution box or the main distribution frame is installed as user network connection equipment. The section from the main distribution box or the main distribution frame to a building distribution frame is called the campus backbone cabling subsystem, and the section from a building distribution frame to an intermediate distribution frame is called the building backbone cabling subsystem, and the section from an intermediate distribution frame to a customer device box, or the telecommunication outlet, is called the horizontal cabling subsystem.

In a case where a residential complex of over two multi-tenant units are configured, the main distribution box is installed in any one place within the multi-tenant unit, and then the office line is led in. Backbone cables are distributed to each customer device box of other multi-tenant units through a building distribution frame (a building distribution box) or an intermediate distribution frame. Cabling equipment and material for each building cabling subsystem are selected in consideration of building usage, telecommunication accommodation facilities, application facilities, etc. Figure 7-1 shows the building cabling system of a multi-tenant unit.

Cross connection of a campus backbone cabling subsystem is done in the main telecommunication room and in each building telecommunication room. In a campus backbone cabling subsystem, cables from the telecommunication room are led into each multi-tenant building (apartment block, etc.) through a tray facility of underground conduit located in an underground vault or parking lot facility of the apartment block. In campus backbone cabling subsystems, cables can be isolated from power cables to prevent power induction.

A building cable is classified into a backbone cable (a campus backbone cable, a building backbone cable) and a horizontal cable. Backbone and horizontal cables should not be damaged due to excessive tensile forces being applied during or after installation. The tensile force that is applied to a four-pair cable in order to minimize cable sag should not exceed 10 kg (100 N), nor exceed the manufacturer's specification for the tensile strength of a backbone or horizontal cable. To prevent electrical interference in the case where a long section has to be installed, a cable cannot be installed with a power cable in parallel. An outdoor cable should be used when installing outside, including the campus backbone cable. The stipulated connecting accessories should be used for cable connection. The unconnected insulated conductor should be protected with extra length as a contingency for the future.

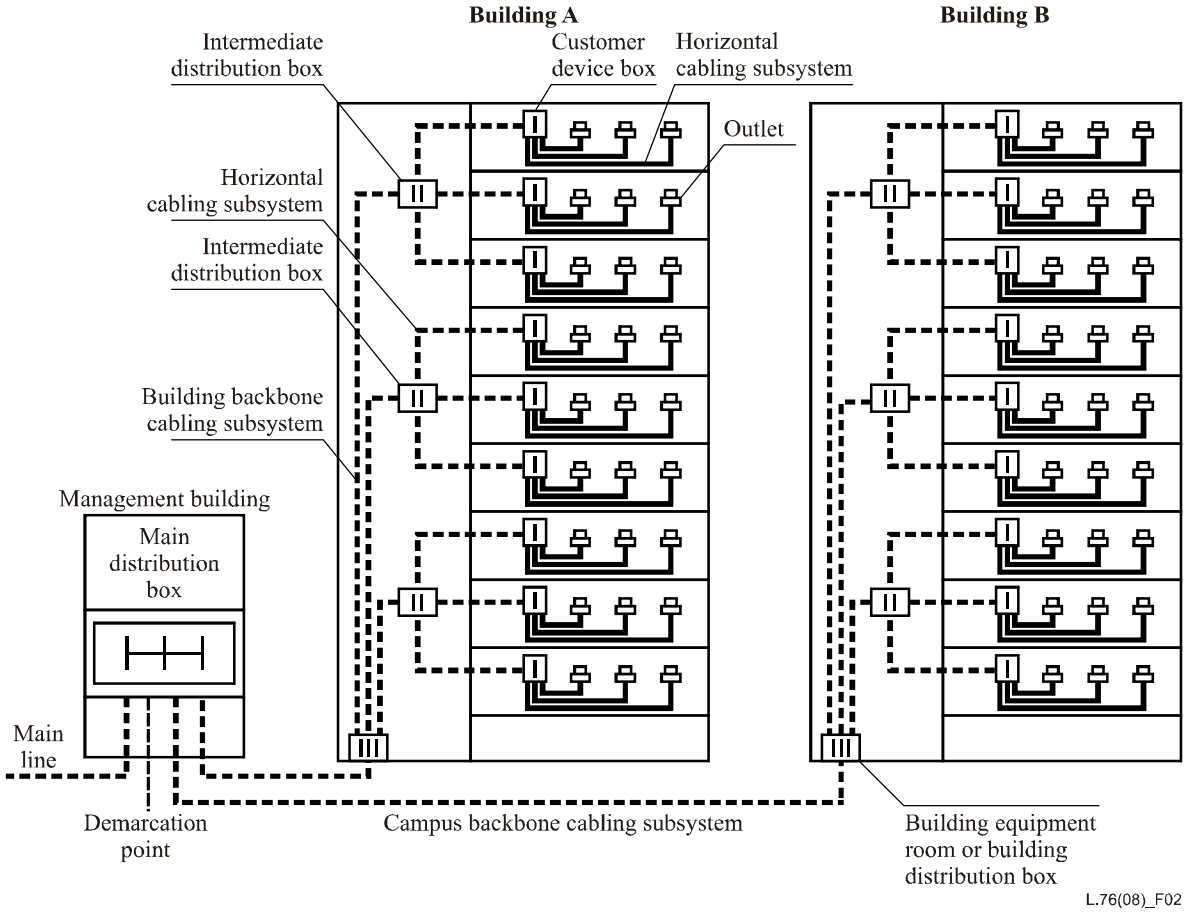

Figure 7-1 – Illustration of the building cabling system for apartments

7.3 Single residential unit cabling system

At the demarcation point of a single residential unit, a customer device box (if necessary, with protector) should be installed. In the case of a building cabling system of a single residential unit, refer to multi-tenant unit. A building cabling of a single residential unit is shown in Figure 7-2.

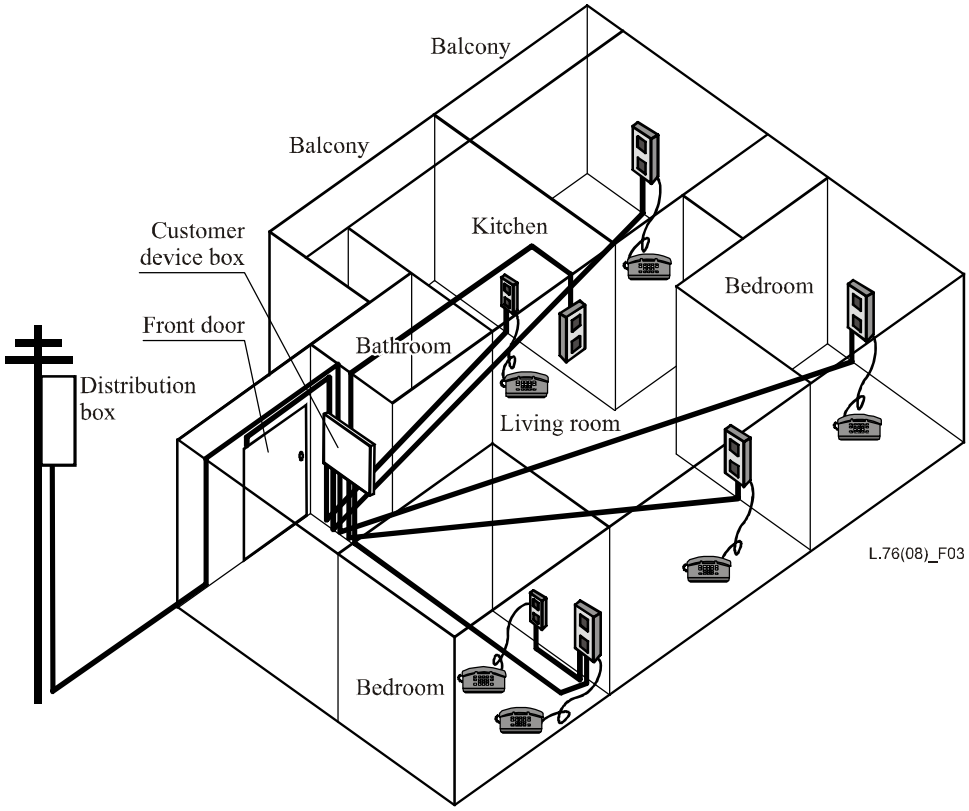

Figure 7-2 – Illustration of the building cabling of a single residential unit

8 Requirements

Indoor installations are, for the purposes of requirement definition, divided in two segments: cabling before the modem input and cabling after the modem output.

For the first segment, test procedures and requirements are recommended to be evaluated in the same way as defined in [ITU-T L.75] because, from the DSLAM up to each modem, signals transmitted and received follow one of the xDSL standards.

For the segment after the modem, field testing for class A to F should be conducted according to clause 6.4 (balanced cabling performance) of [ISO/IEC 11801].

The parameters specified in this clause apply to channels with screened or unscreened cable elements, with or without overall screen, unless explicitly stated otherwise.

The nominal impedance of channels is 100 Ω. This is achieved by suitable design and appropriate choice of cabling components (irrespective of nominal impedance).

8.1 Performance of balanced cabling

8.1.1 General

The performance of balanced cabling, balanced cords and connecting hardware requirements are described in [ISO/IEC 11801]. For convenience, some of the contents are summarized here.

The performance of balanced cabling is specified for channels, permanent links and CP links (see Figure 8-1).

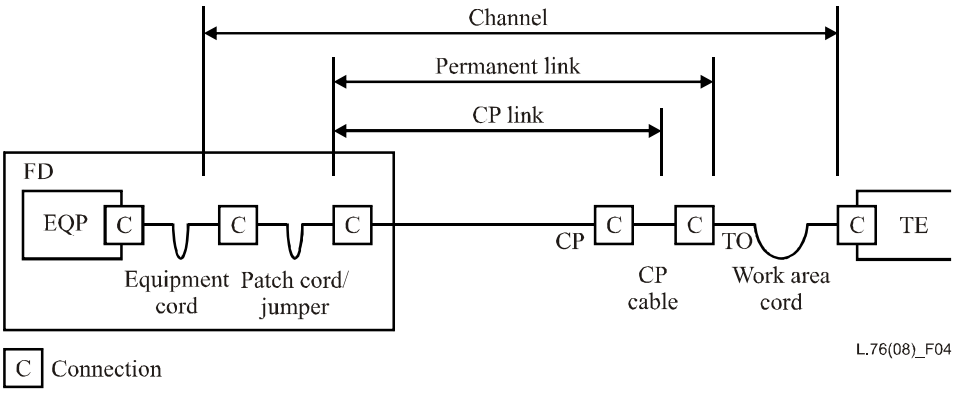

Figure 8-1 – Channel, permanent link and CP link of a balanced cabling

8.1.2 Classification of balanced cabling

The following classes for balanced cabling are defined according to [ISO/IEC 11801].

– Class A is specified up to 100 kHz.

– Class B is specified up to 1 MHz.

– Class C is specified up to 16 MHz.

– Class D is specified up to 100 MHz.

– Class E is specified up to 250 MHz.

– Class F is specified up to 600 MHz.

A class A channel is to provide at least the minimum transmission function to support class A application. Similarly, class B, C, D, E and F channels provide the transmission performance to support class B, C, D, E and F applications, respectively. Links and channels of a given class will support all application of a lower class. Class A is regarded as the lowest class.

Channels, permanent links and CP links in the horizontal cabling shall be installed to provide a minimum of class D performance.

Cables and connecting hardware of different categories may be mixed within a channel. However, the resultant cabling performance will be determined by the category of the lowest performing component.

The selection of balanced cabling component will be determined by the class of applications to be supported. For examples;

– Category 5 components provide class D balanced cabling performance.

– Category 6 and 6A components provide class E balanced cabling performance.

– Category 7 components provide class F balanced cabling performance.

In case of applications by classes, refer to Annex F in [ISO/IEC 11801].

Bibliography

[b-ITU-T G.996.1] Recommendation ITU-T G.996.1 (2001), *Test procedures for digital subscriber line (DSL) transceivers*.

[b-ITU-T L.19] Recommendation ITU-T L.19 (2003), *Multi-pair copper network cable supporting shared multiple services such as POTS, ISDN and xDSL*.

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