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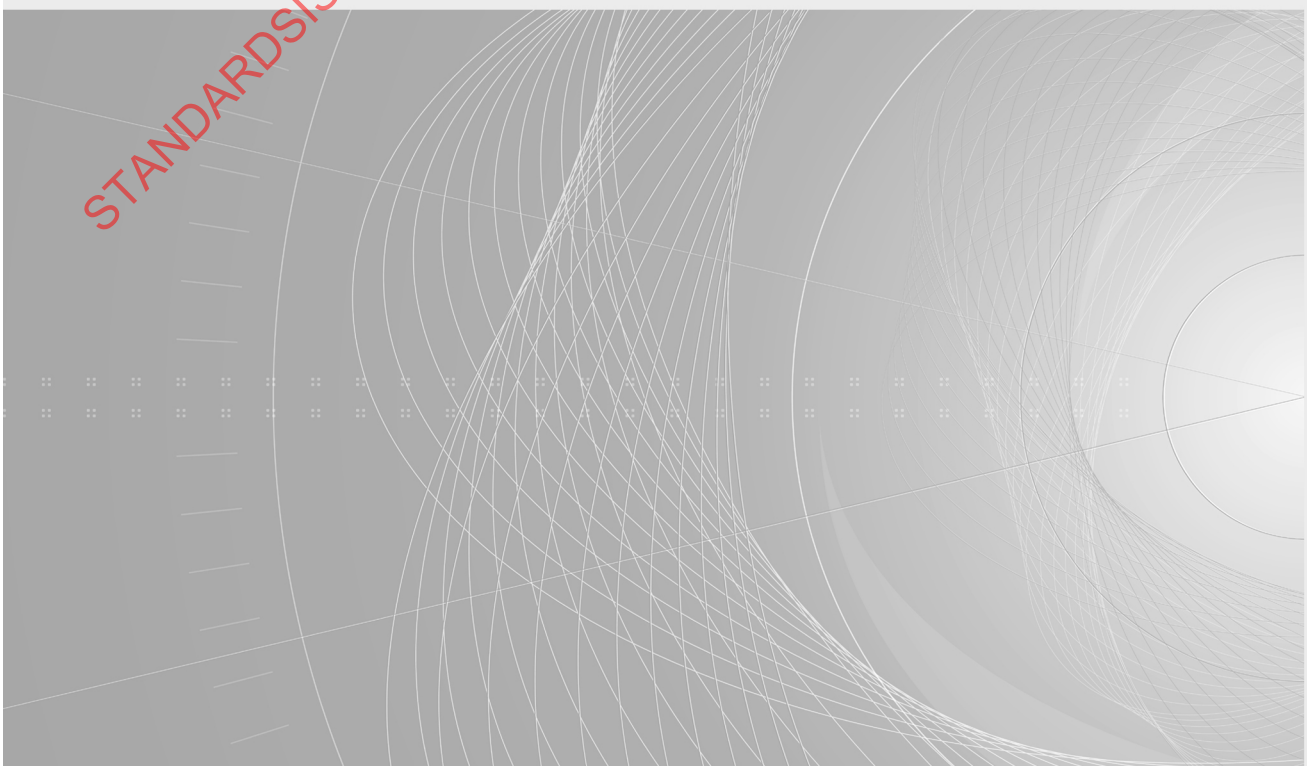
INTERNATIONAL STANDARD

Information technology – Generic cabling for customer premises – Part 2: Office premises



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ISO/IEC 11801-2

Edition 1.0 2017-11

INTERNATIONAL STANDARD

Information technology – Generic cabling for customer premises – Part 2: Office premises

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FOREWORD

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International Standard ISO/IEC 11801-2 was prepared by subcommittee 25: Interconnection of information technology equipment, of ISO/IEC joint technical committee 1: Information technology.

This first edition, together with ISO/IEC 11801-1, cancels and replaces ISO/IEC 11801:2002, Amendment 1:2008 and Amendment 2:2010. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) standard re-structured to contain only those requirements that are specific for generic cabling systems installed in offices,

b) alignment of functional element designations with the generic terminology of ISO/IEC 11801-1,

c) reference to the campus and building backbone cabling system specification of ISO/IEC 11801-1,

d) reference to the channel and link specifications of ISO/IEC 11801-1.

ISO/IEC 11801-2 is to be read in conjunction with ISO/IEC 11801-1.

This International Standard has been approved by vote of the member bodies, and the voting results may be obtained from the address given on the second title page.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the ISO/IEC 11801 series, published under the general title *Information technology – Generic cabling for customer premises*, can be found on the IEC website.

The contents of the corrigendum of April 2018 have been included in this copy.

INTRODUCTION

The importance of cabling infrastructure is similar to that of other fundamental utilities such as water and energy supply and interruptions to the services provided over that infrastructure can have a serious impact. A lack of design foresight, the use of inappropriate components, incorrect installation, poor administration or inadequate support can threaten quality of service and have commercial consequence for all types of users.

This document specifies generic cabling within and between the buildings of office premises, or office spaces within other types of building.

Additionally those premises can include

- industrial spaces for which generic cabling is specified in ISO/IEC 11801-3,
- data centre spaces for which generic cabling is specified in ISO/IEC 11801-5.

Generic cabling for distributed building services in office spaces is specified in ISO/IEC 11801-6, which addresses all of the above premises and spaces within them.

Figure 1 shows the schematic and contextual relationships between the standards relating to information technology cabling produced by ISO/IEC JTC 1/SC 25, namely the ISO/IEC 11801 series of standards for generic cabling design, standards for the installation, operation and administration of generic cabling and for testing of installed generic cabling.

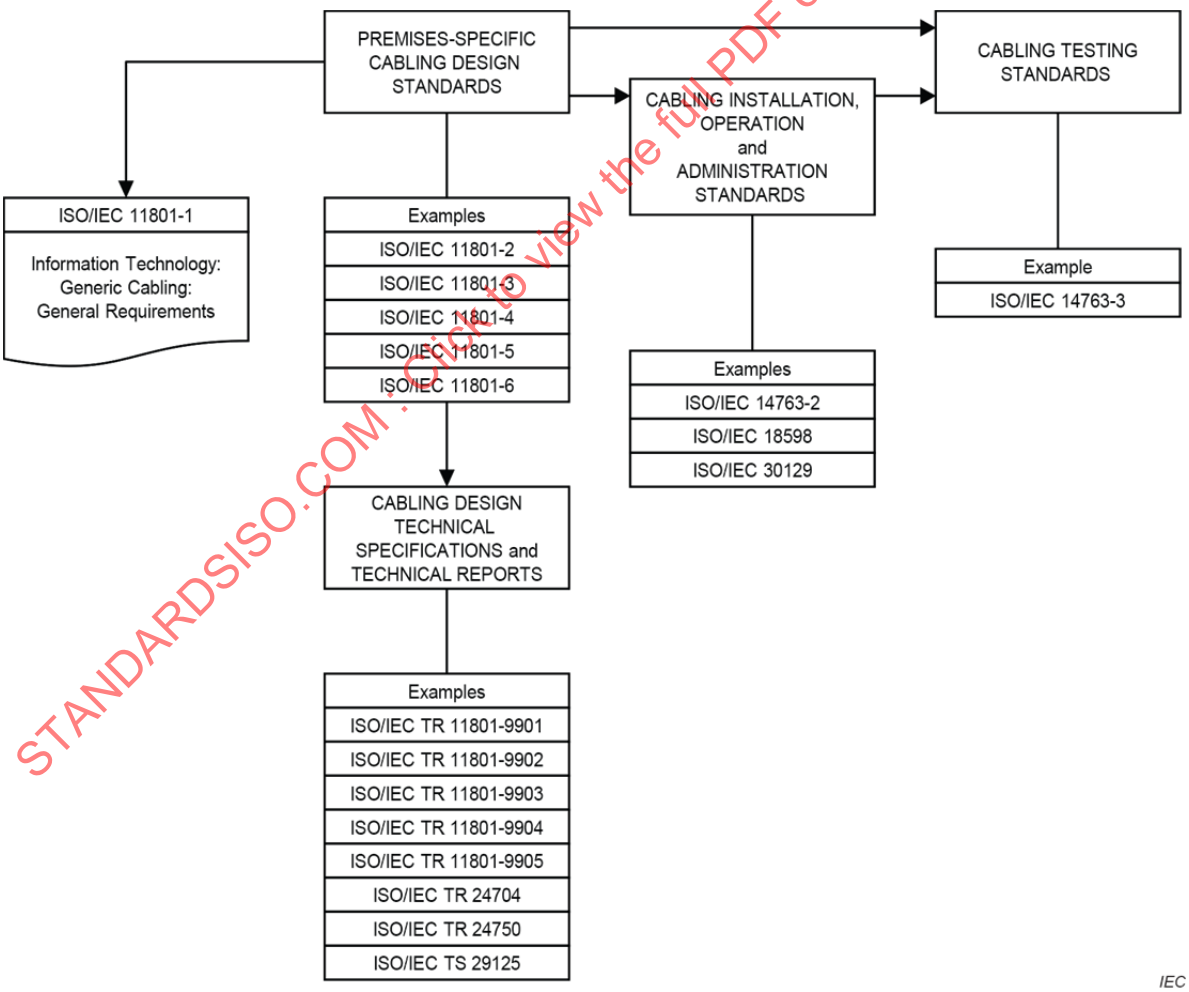


Figure 1 – Relationships between the generic cabling documents produced by ISO/IEC JTC 1/SC 25

The generic cabling specified by this document provides users with

a) an application independent system capable of supporting a wide range of applications in a range of installation and operating environments,

b) a flexible scheme such that modifications are both easy and economical,

c) a multi-vendor supply chain within an open market for cabling components.

In addition, this document provides

d) relevant industry professionals with guidance allowing the accommodation of cabling before specific requirements are known, i.e. in the initial planning either for construction or refurbishment and for further deployment as the requirements of areas are defined,

e) industry and standardization bodies with a cabling system which supports current products and provides a basis for future product development and applications standardization.

Applications addressed in this document include those developed by the technical committees of IEC (including the subcommittees of ISO/IEC JTC 1) and study groups of ITU-T.

Physical layer requirements for the applications listed in Annex E of ISO/IEC 11801-1:2017 have been analysed to determine their compatibility with the cabling performance specified in this document and, together with statistics concerning premises geography from different countries and the models described in Clause 6, have been used to develop the requirements for cabling components and to stipulate their arrangement into cabling systems.

As a result, this document

1) specifies a structure for generic cabling supporting a wide variety of applications,

2) adopts balanced cabling channel and link Classes E, E_A, F, and F_A specified in ISO/IEC 11801-1,

3) adopts optical fibre cabling channel and link requirements specified in ISO/IEC 11801-1,

4) adopts component requirements, specified in ISO/IEC 11801-1, and specifies cabling implementations that ensure performance of permanent links and of channels that meet or exceed the requirements of a specified group (e.g. Class) of applications.

Life expectancy of generic cabling systems can vary depending on environmental conditions, supporting applications, aging of materials used in cables, and other factors, such as access to pathways (campus pathways are more difficult to access than building pathways). With appropriate choice of components, generic cabling systems meeting the requirements of this document are expected to have a life expectancy of at least ten years.

This document has taken into account requirements specified in application standards listed in ISO/IEC 11801-1:2017, Annex E. It refers to International Standards for components and test methods whenever appropriate International Standards are available.

INFORMATION TECHNOLOGY – GENERIC CABLING FOR CUSTOMER PREMISES –

Part 2: Office premises

1 Scope

This part of ISO/IEC 11801 specifies generic cabling for use within office premises, which can comprise single or multiple buildings on a campus. It covers balanced cabling and optical fibre cabling.

This document is optimized for premises in which the maximum distance over which telecommunications services can be distributed is 2 000 m. The principles of this document can be applied to larger installations.

Cabling specified by this document supports a wide range of services including voice, data, and video that can also incorporate the supply of power.

This document specifies directly or via reference to ISO/IEC 11801-1

a) the structure and minimum configuration for generic cabling within office premises,

b) the interfaces at the telecommunications outlet (TO),

c) the performance requirements for cabling links and channels,

d) the implementation requirements and options,

e) the performance requirements for cabling components,

f) the conformance requirements and verification procedures.

Safety (e.g. electrical safety and protection and fire) and electromagnetic compatibility (EMC) requirements are outside the scope of this document, and are covered by other standards and by regulations. However, information given by this document can be of assistance.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61754-20 (all parts), *Fibre optic interconnecting devices and passive components – Fibre optic connector interfaces – Part 20: Type LC connector family*

ISO/IEC 11801-1:2017, *Information technology – Generic cabling for customer premises – Part 1: General requirements*

ISO/IEC 14763-2, *Information technology – Implementation and operation of customer premises cabling – Part 2: Planning and installation*

ISO/IEC 30129, *Information technology – Telecommunications bonding networks for buildings and other structures*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 11801-1, ISO/IEC 14763-2 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1.1
equipment room
room dedicated to housing distributors and application specific equipment

3.1.2
floor distributor
distributor used to connect between the horizontal cable and other cabling subsystems or equipment

Note 1 to entry: See also telecommunications room.

3.1.3
horizontal cable
cable connecting the floor distributor to the consolidation point (CP) if a CP is present, or to the telecommunications outlet if no CP is present

3.1.4
individual work area
minimum building space that would be reserved for an occupant

3.1.5
multi-user telecommunications outlet assembly
grouping in one location of several telecommunications outlets

3.1.6
telecommunications room
enclosed space for housing telecommunications equipment, cable terminations, interconnect and cross-connect

3.1.7
work area
building space where the occupants interact with telecommunications terminal equipment

3.1.8
work area cord
cord connecting the telecommunications outlet to the terminal equipment

3.2 Abbreviated terms

For the purposes of this document, the abbreviated terms given in ISO/IEC 11801-1 and the following apply.

FD floor distributor

MUTO multi-user telecommunications outlet

PBX private branch exchange

4 Conformance

For a cabling installation to conform to this document the following applies.

a) The configuration and structure shall conform to the requirements outlined in Clause 5.

b) Channels shall meet the requirements specified in Clause 6 when subjected to environment conditions, local to the channels (see NOTE below), as defined by the applicable environmental Class(es) of Clause 6.

This shall be achieved by one of the following:

1) a channel design and implementation ensuring that the prescribed channel performance of Clause 6 is met;
2) attachment of appropriate components to a permanent link or CP link design meeting the prescribed performance class of Clause 7. Channel performance shall be ensured where a channel is created by adding more than one cord to either end of a link meeting the requirements of Clause 7;
3) for E_1 environments, using the reference implementations of Clause 8 and compatible cabling components conforming to the requirements of Clauses 9, 10, and 11, that is based upon a statistical approach of performance modelling.

c) The interfaces to the cabling at the TO shall conform to the requirements of Clause 10 with respect to mating interfaces and performance when subjected to environment conditions, local to the connecting hardware (see NOTE below), as defined by the applicable environmental Class(es) of Clause 6.

d) Connecting hardware at other places in the cabling structure shall meet the performance requirements specified in Clause 10 when subjected to environment conditions, local to the connecting hardware (see NOTE below), as defined by the applicable environmental Class(es) of Clause 6.

e) The requirements of ISO/IEC 14763-2 and ISO/IEC 30219 shall be met.

This document does not specify which tests and sampling levels should be adopted. Test methods to assess conformance with the channel and link requirements of Clause 6 and Clause 7, respectively, are specified in ISO/IEC 11801-1. The test parameters to be measured, the sampling levels and the treatment of measured results to be applied for particular installations shall be defined in the installation specification and quality plan for that installation, prepared in accordance with ISO/IEC 14763-2.

In the absence of the channel, the conformance of the link shall be used to verify conformance to this document.

Specifications marked "ffs" are preliminary specifications, and are not required for conformance to this document.

NOTE The applicable environmental classification of ISO/IEC 11801-1:2017, 6.2, local to the cabling or cabling component(s), is that of the environment immediately adjacent to the cabling or cabling component(s).

5 Structure of the generic cabling system

5.1 General

Clause 5 identifies the functional elements of generic cabling, describes how they are connected together to form subsystems and identifies the interfaces at which application-specific components are connected to the generic cabling.

Applications are supported by connecting equipment to the telecommunications outlets and distributors.

5.2 Functional elements

In addition to the functional elements of ISO/IEC 11801-1, cabling in accordance with this document specifies the following functional elements:

a) floor distributor (FD) – equivalent to distributor 1 in ISO/IEC 11801-1;

b) horizontal cable – equivalent to fixed cable (cable Z) within cabling subsystem 1 in ISO/IEC 11801-1;

c) consolidation point (CP) – equivalent to consolidation point in ISO/IEC 11801-1;

d) consolidation point cable (CP cable) – equivalent to cable Y in ISO/IEC 11801-1;

e) telecommunications outlet (TO) or multi-user telecommunications outlet (MUTO) – equivalent to TE outlet in ISO/IEC 11801-1.

Groups of these functional elements are connected together to form cabling subsystems to provide the required connectivity to the terminal equipment.

5.3 General structure and hierarchy

5.3.1 General

Generic cabling systems contain up to three cabling subsystems: campus backbone, building backbone and horizontal cabling. The composition of the subsystems is described in 5.3.2 and 5.3.3. The cabling subsystems are connected together to create a generic cabling system with a structure as shown in Figure 2. The distributors provide the means to configure the cabling to support different topologies like bus, star and ring.

In generic cabling, the functional elements of the cabling subsystems are interconnected to form a hierarchical structure as shown in Figure 3.

It is possible to combine multiple functional elements into a single element (see 5.6.1).

Connections between cabling subsystems are either active, requiring application-specific equipment, or passive. Connection to application-specific equipment adopts either an interconnect or a cross-connect approach (see ISO/IEC 11801-1). Passive connections between cabling subsystems adopt a cross-connect approach, by way of either patch cords or jumpers.

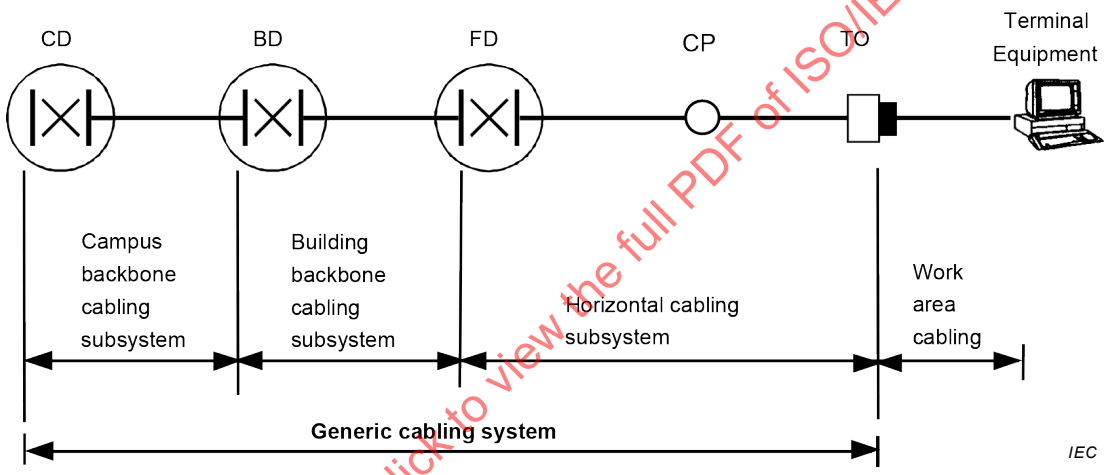


Figure 2 – Structure of generic cabling

5.3.2 Campus and building backbone cabling subsystem

See ISO/IEC 11801-1:2017, 5.3.3.

5.3.3 Horizontal cabling subsystem

The horizontal cabling subsystem (equivalent to the cabling subsystem 1 of ISO/IEC 11801-1) extends from a floor distributor to the telecommunications outlet(s) connected to it. Although work area cords (equivalent to the TE cords of ISO/IEC 11801-1) and equipment cords are used to connect terminal and transmission equipment, respectively, to the cabling subsystem, they are not considered part of the cabling subsystem because they can be application specific. Horizontal cables shall be continuous from the floor distributor to the telecommunications outlets unless a consolidation point is installed (see 5.6.6).

5.3.4 Design objectives

Horizontal cabling should be designed to support the broadest 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 good physical access to pathways. The selection of campus backbone cabling can require a longer-term approach than that adopted for the building backbone, particularly if access to pathways is more limited.

5.4 Interconnection of subsystems

5.4.1 General

The hierarchical structure of generic cabling is shown in Figure 3.

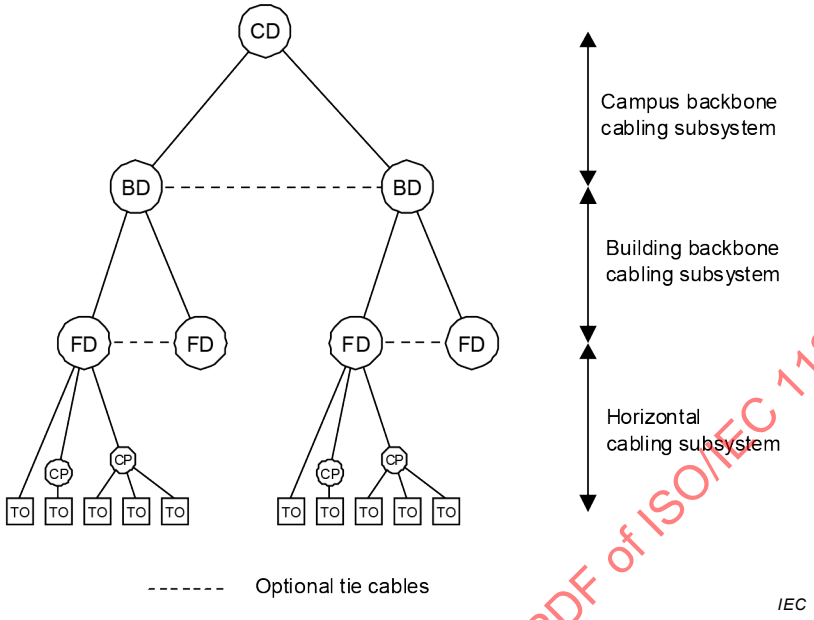


Figure 3 – Hierarchical structure of generic cabling

5.4.2 Centralized cabling architecture

Centralized cabling structures, as shown in Figure 4 create combined backbone/horizontal channels. The channels are provided by passive connections in the distributors. The connections are achieved by using either cross-connections or interconnections. In addition, for centralized optical fibre cabling, it is possible to create connections at the distributors using splices although this reduces the ability of the cabling to support re-configuration.

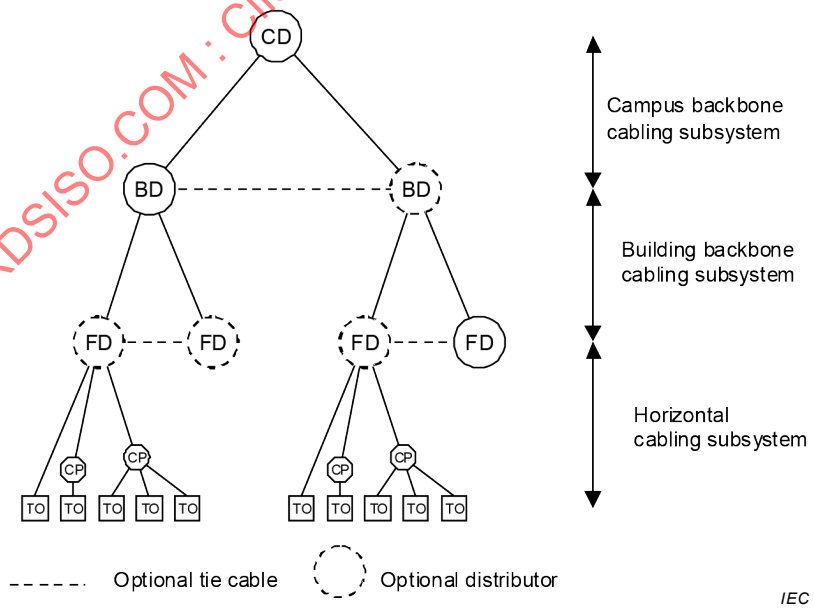


Figure 4 – Structures for centralized generic cabling

5.5 Accommodation of functional elements

Figure 5 shows an example of how the functional elements are accommodated in a building.

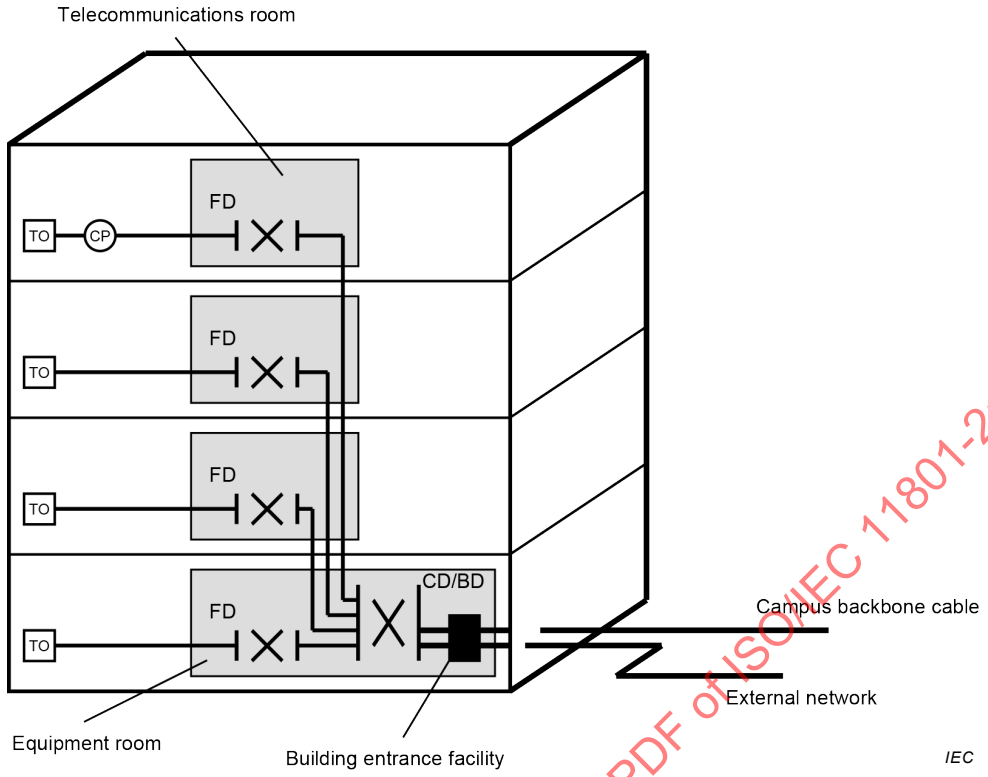


Figure 5 – Accommodation of functional elements

Distributors can be located in equipment rooms or telecommunications rooms. Requirements for the accommodation of distributors are given in ISO/IEC 14763-2.

Cables are routed using pathways. A variety of cable management systems can be used to support the cables within the pathways including ducts, conduits and trays. Requirements for pathways and the cable management systems are provided in ISO/IEC 14763-2.

Telecommunications outlets are typically located in the work area.

5.6 Dimensioning and configuring

5.6.1 Distributors

The number and type of subsystems that are included in a generic cabling implementation depends upon the geography and size of the campus or building, and upon the strategy of the user. Usually there would be one campus distributor per campus, one building distributor per building, and one floor distributor per floor. If the premises comprise only a single building which is small enough to be served by a single building distributor, there is no need for a campus backbone cabling subsystem. Similarly larger buildings can be served by multiple building distributors interconnected via a campus distributor.

The design of the floor distributor should ensure that the lengths of patch cords/jumpers and equipment cords are minimized and administration should ensure that the design lengths are maintained during operation.

Distributors shall be located in such a way that the resulting cable lengths are consistent with the channel performance requirements of Clause 6.

In the case of the reference implementations described in Clause 8, distributors shall be located to ensure that the channel lengths in Table 1 are not exceeded. However, not all applications are supported over the maximum lengths shown in Table 1 using a single cable type.

Table 2 and Table 3 indicate that the support of specific applications over installed channels can require a mix of cabling media and performance specifications.

Table 1 – Maximum channel lengths

Channel	Length m
Horizontal	100
Horizontal + building backbone + campus backbone	2 000
NOTE In some implementations of the horizontal cabling subsystem in Clause 8, the FD might not support TOs up to the maximum distance shown.	

A minimum of one floor distributor shall be provided for every floor; for floor spaces exceeding 1 000 m^2, a minimum of one floor distributor should be provided for every 1 000 m^2 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. The functions of multiple distributors can be combined. Figure 6 shows an example of generic cabling. The building in the foreground shows an example with each distributor housed separately. The building in the background shows an example where the functions of a floor distributor and the building distributor have been combined into a single distributor.

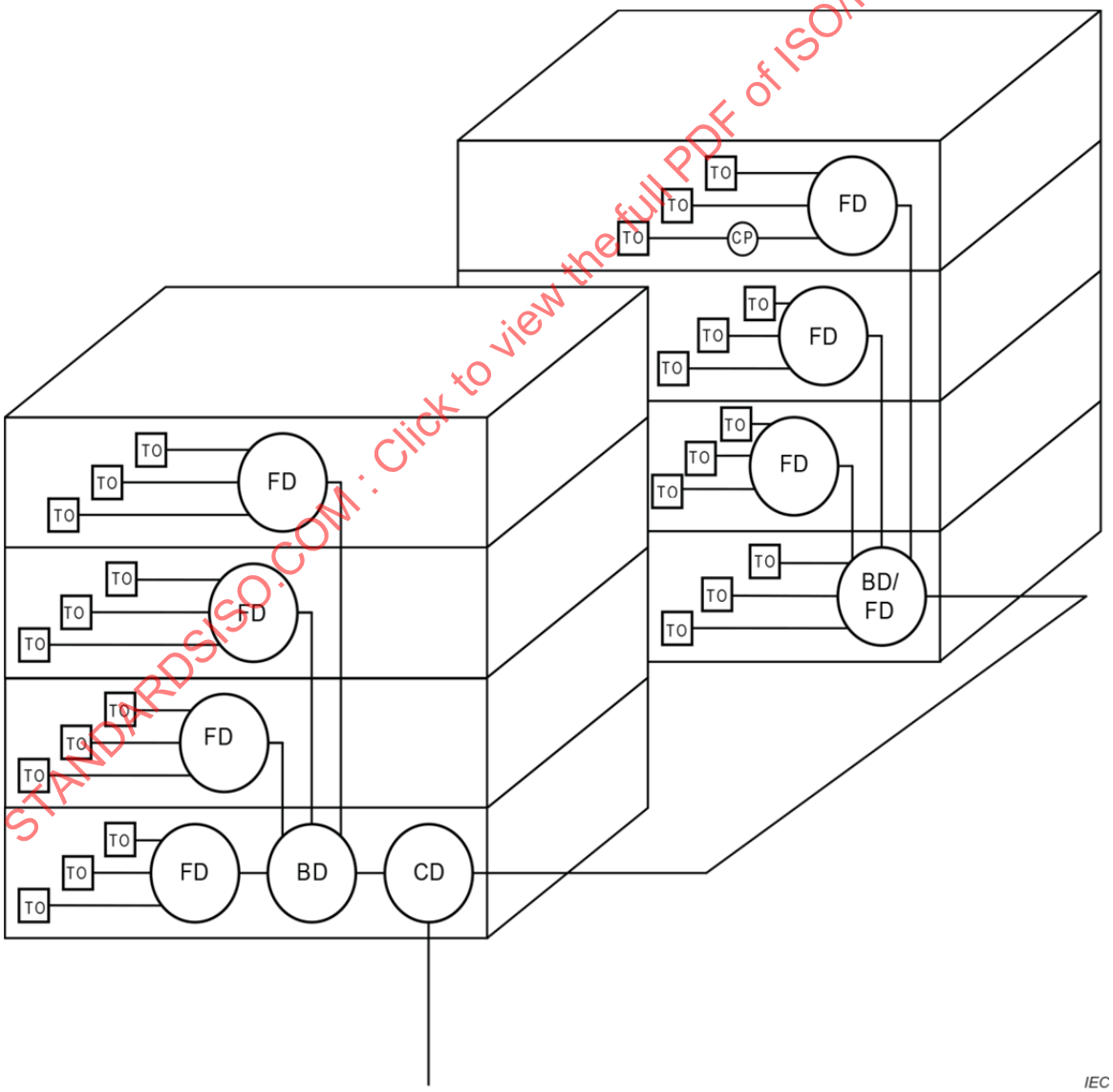


Figure 6 – Example of a generic cabling system with combined BD and FD

In certain circumstances, for example for reasons of security or reliability, redundancy can be built into a cabling design. Figure 7 gives one of many possible examples of the connection of functional elements within the structured framework in order to provide protection against failure within one or more parts of the cabling infrastructure. This might form the basis for the design of generic cabling for a building, providing some protection against such hazards as fire damage or the failure of the cables providing connection to external service provision.

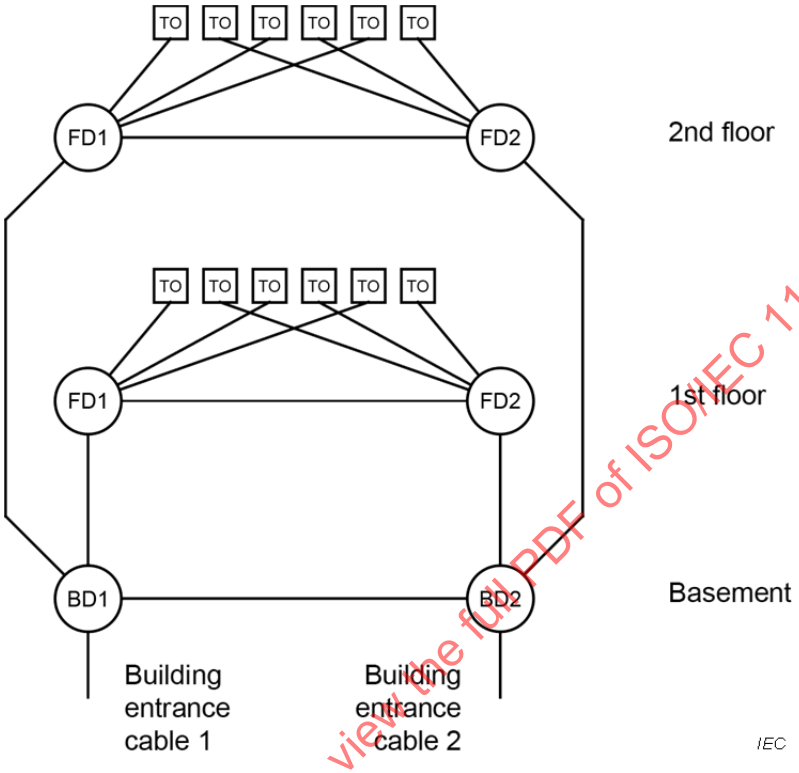


Figure 7 – Inter-relationship of functional elements in an installation with redundancy

5.6.2 Connecting hardware

Connecting hardware shall only provide direct onward attachment for each conductor and shall not provide contact between more than one incoming or outgoing conductor (for example, bridge taps shall not be used).

5.6.3 Work area cords and equipment cords

The work area cord connects the telecommunications outlet to the terminal equipment. Equipment cords connect equipment to the generic cabling at distributors. Both are non-permanent and can be application specific. Assumptions have been made concerning the length and the transmission performance of these cords; the assumptions are identified when relevant. The performance contribution of these cords shall be taken into account in the design of the channel. Clause 8 provides guidance on cord length for reference implementations of generic cabling.

5.6.4 Patch cords and jumpers

Patch cords and jumpers are used within cross-connect implementations at distributors. The performance contribution of these cords shall be taken into account in the design of the channel. Clause 8 provides guidance on cord/jumper lengths for reference implementations of generic cabling.

5.6.5 Telecommunications outlet

5.6.5.1 General requirements

The design of generic cabling should ensure that telecommunications outlets are installed throughout the usable floor space. A high density of telecommunications outlets will enhance the ability of the cabling to accommodate changes. Telecommunications outlets may be presented individually or in groups according to the requirements as follows.

a) Each individual work area shall be served by a minimum of two TOs. Requirements on work area size are given in ISO/IEC 14763-2.

b) The first outlet should be for four-pair balanced cable terminated in accordance with 10.2.2.1.

c) The second outlet may be for

   1) optical fibre terminated in accordance with 10.3.2.1,

   2) four-pair balanced cable terminated in accordance with 10.2.2.1.

d) Each telecommunications outlet shall have a permanent means of identification that is visible to the user.

e) Devices such as baluns and impedance matching adapters, if used, shall be external to the outlet.

f) The performance contribution of work area cords, equipment cords, patch cords and jumpers shall be taken into account to ensure that the channel requirements of Clause 6 (for balanced cabling) and 8.3 (for optical fibre cabling) are met.

For balanced cables, two pairs per TO may be used as an alternative to four pairs. However, four pairs per TO is recommended to support common applications. (see ISO/IEC 11801-1:2017, Annex E). Care should be taken that the initial pair assignment, and all subsequent changes, are recorded (see ISO/IEC 14763-2 for details of administration requirements). Pair reassignment by means of inserts is allowed.

5.6.5.2 Single user TO assembly

In a general implementation of generic cabling, one assembly of TOs serves a single work area. The length of work area cords should be minimized. The implementation topology shall be selected from the options described in 8.2.2.2 (for balanced cabling) and in 8.3 (for optical fibre cabling). The assembly of TOs shall be known as a single user TO assembly.

In addition, where the single user TO assembly is used, it should be located in user-accessible locations.

5.6.5.3 Multi-user TO assembly

In an open office environment, a single assembly of TOs may be used to serve more than one work area. The implementation topology shall be selected from the options described in 8.2.2.2 (for balanced cabling) and in 8.3 (for optical fibre cabling), and the assembly of TOs shall be known as a multi-user TO assembly.

In addition, where the multi-user TO assembly is used

a) a multi-user TO assembly shall be located in an open work area so that each work area group is served by at least one multi-user TO assembly,

b) a multi-user TO assembly should be limited to serving a maximum of twelve work areas,

c) a multi-user TO assembly should be located in user-accessible, permanent locations such as on building columns and permanent walls,

d) a multi-user TO assembly shall not be installed in obstructed areas,

e) the length of the work area cord should be limited to ensure cable management in the work area.

5.6.6 Consolidation point

The installation of a consolidation point in the horizontal cabling between the FD and the TO can be useful in an open office space where the flexibility of relocating TOs is required. One consolidation point is permitted between an FD and any TO. 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) a consolidation point shall be part of the administration system.

5.6.7 Telecommunications rooms and equipment rooms

A telecommunications room should provide all the facilities (e.g. space, power and environmental control) for passive components, active devices, and external network interfaces housed within it. Each telecommunications room should have direct access to the backbone cabling subsystem.

An equipment room is an area within a building where equipment is housed. Equipment rooms are treated differently from telecommunications rooms because of the nature or complexity of the equipment (for example, PBXs or extensive computer installations). More than one distributor may be located in an equipment room. If a telecommunications room serves more than one building distributor, it should be considered an equipment room.

5.6.8 External services cabling

The distance from external services to a distributor can be significant. The performance of the cable between these points should be considered as part of the initial design and implementation of customer applications.

6 Channel performance requirements

6.1 General

Clause 6 specifies the minimum performance of generic cabling at and between the connections to active equipment as shown in Figure 8 and comprises only passive sections of cable, connecting hardware, cords and jumpers.

The channel performance is specified as a combination of environmental performance and transmission performance.

The environmental classification of spaces served by generic cabling is described in 6.2. The environmental classification of office premises is typically $M_1I_1C_1E_1$ as specified in ISO/IEC 11801-1.

The minimum requirements for the transmission performance of cabling channels are specified in 6.3. The required transmission performance Class shall be met for all environmental performance Classes specified for the channel.

Compatibility between the structures and materials at the interfaces between these components and assemblies shall ensure that the required mechanical, environmental and transmission performance is maintained for the intended life of the cabling.

Where applications listed in ISO/IEC 11801-1:2017, Annex E, are to be supported, the performance of the connections at the active equipment are the responsibility of the equipment supplier.

Application support depends on channel performance, which in turn depends on cable length, number of connections and performance of the components within the environments to which the channel is subjected.

Transmission and environmental performance shall be assured by the selection of cabling components suitable for the environmental Class(es) or by the use of pathway systems and installation practices that provide the required protection to the installed cabling.

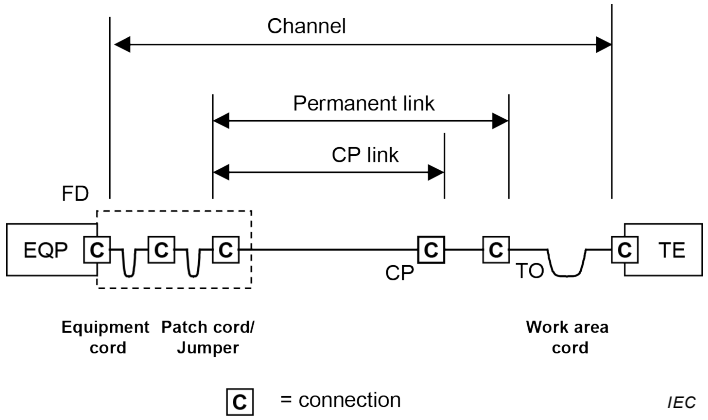


Figure 8 –Channel, permanent link and CP link

Channels are implemented using

a) horizontal cabling only,

b) building backbone cabling only,

c) campus backbone cabling only,

d) combinations of the above.

Figure 9 shows an example of terminal equipment in the work area connected to transmission equipment using two different media channels which are cascaded. In fact, there is an optical fibre cabling channel (see 8.3) connected via an active component in the FD to a balanced cabling channel. There are four channel interfaces: one at each end of the balanced channel and one at each end of the optical fibre cabling channel.

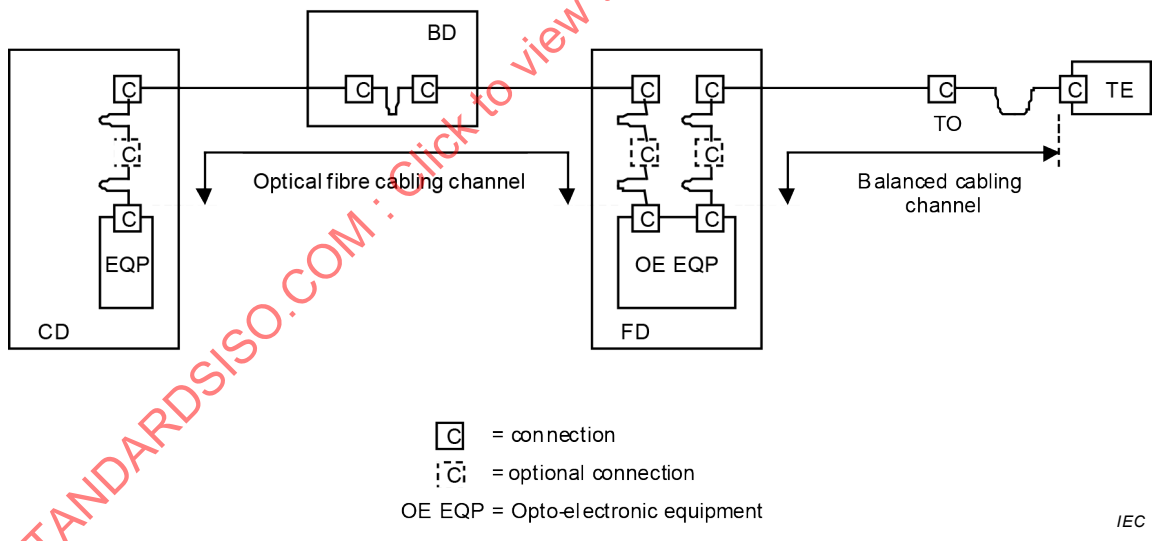


Figure 9 – Example of a system showing the location of cabling interfaces and extent of associated channels

6.2 Environmental performance

See ISO/IEC 11801-1:2017, 6.2.

6.3 Transmission performance

6.3.1 General

The channel performance requirements described in 6.3 may be used for the design and verification of any implementation of this document. Where required, the test methods defined or referred to by 6.3 shall apply. In addition, these requirements can be used for application development and troubleshooting.

6.3.2 Balanced cabling

6.3.2.1 General

The specifications in 6.3.2 allow for the transmission of defined Classes of applications over distances other than those of Clause 8, and/or using media and components with different performances than those specified in Clauses 9, 10 and 11.

For applications requiring remote power delivery, see ISO/IEC TS 29125 for the DC resistance and DC resistance unbalance (within, and between pairs) component specifications.

6.3.2.2 Requirements

6.3.2.2.1 Backbone cabling

Backbone balanced cabling shall provide channel performance as required from Classes A to F_A as specified in ISO/IEC 11801-1:2017, 6.3.

6.3.2.2.2 Horizontal cabling

Horizontal balanced cabling shall provide Class E or better channel performance as specified in ISO/IEC 11801-1:2017, 6.3. Class E_A or better performance is recommended for support of applications with data rates exceeding one gigabit per second.

6.3.2.2.3 Cable sharing

In the case of cable sharing, additional requirements shall be taken into account for balanced cabling. The additional crosstalk requirements are specified in ISO/IEC 11801-1:2017, 9.3.2.5.1.

6.3.3 Optical fibre cabling

The selection of optical fibre components shall take into account the applications to be supported, and the required channel lengths, and should take into account any predicted changes to the applications to be supported during the expected life of the cabling.

Cabling shall be designed using the cabled optical fibres referenced in 9.3 to provide channel performance as required to support the relevant applications of ISO/IEC 11801-1:2017, Annex E, for the following parameters:

a) channel attenuation,

b) channel length.

Channel performance shall meet the requirements of ISO/IEC 11801-1:2017, 6.5.

7 Link performance requirements

7.1 General

Clause 7 specifies the minimum performance of permanent links and CP links as shown in Figure 8.

A link comprises only passive sections of cable and connections. Compatibility between the structures and materials at the interfaces between these components shall ensure that the required mechanical, environmental and transmission performance is maintained for the intended life of the cabling.

The permanent link and CP link performance requirements described in Clause 7 may be used for acceptance testing of any implementation of this document. Where required, the test methods defined or referred to by Clause 7 shall apply.

7.2 Balanced cabling

Link performance shall meet the requirements of ISO/IEC 11801-1:2017, 7.2.

7.3 Optical fibre cabling

Link performance shall meet the requirements of ISO/IEC 11801-1:2017, 7.4.

8 Reference implementations

8.1 General

Clause 8 describes implementations of generic cabling that utilize components and assemblies referenced in Clauses 9, 10 and 11. These reference implementations meet the requirements of Clause 5 and, when installed in accordance with ISO/IEC 14763-2, comply with the channel performance requirements of Clause 6.

8.2 Balanced cabling

8.2.1 General

Balanced components referenced in Clauses 9, 10 and 11 are defined in terms of impedance and Category. In the reference implementations of 8.2, the components used in each cabling channel shall have the same nominal impedance.

The implementations are based on component performance at 20 °C. The effect of temperature on the performance of cables shall be accommodated by derating length as shown in Table 3.

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.

8.2.2 Horizontal cabling

8.2.2.1 Component choice

The selection of balanced cabling components will be determined by the Class to be met. Refer to ISO/IEC 11801-1:2017, Annex E for applications supported by cabling Classes.

The balanced cabling reference implementations described in 8.2.2 contain reductions in channel length where operating temperatures are in excess of 20 °C. In order to maintain specific channel lengths under such conditions (due to the effect of ambient temperature and/or the impact of applications supported by the cabling),

a) cables can be specified with lower insertion loss specifications than those detailed in 8.2, or

b) appropriate protection can be provided to reduce the operating temperature of the channel.

Using the configurations of 8.2.2.2,

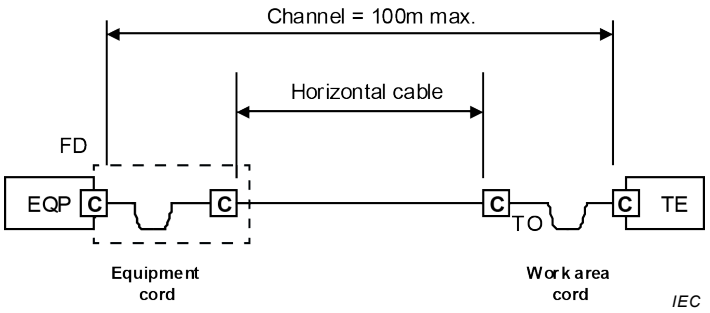
1) Category 6 components provide Class E balanced cabling performance,
2) Category 6_A components or Category 8.1 components provide Class E_A balanced cabling performance,
3) Category 7 components provide Class F balanced cabling performance,
4) Category 7_A components or Category 8.2 components provide Class F_A balanced cabling performance.

8.2.2.2 Dimensions

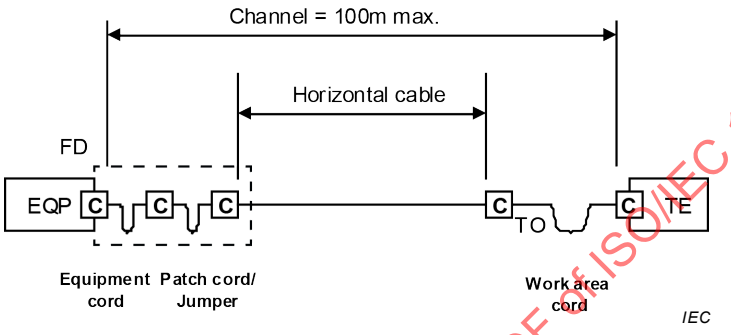
Figure 10 shows the models used to correlate horizontal cabling dimensions specified in 8.2.2.2 with the channel specifications in Clause 6.

Figure 10a shows a channel containing only an interconnect and a TO. Figure 10b contains an additional connection as a cross-connect. In both cases the horizontal cable connects the FD to the TO or MUTO. The channel includes cords comprising patch cords/jumpers, equipment and work area cords.

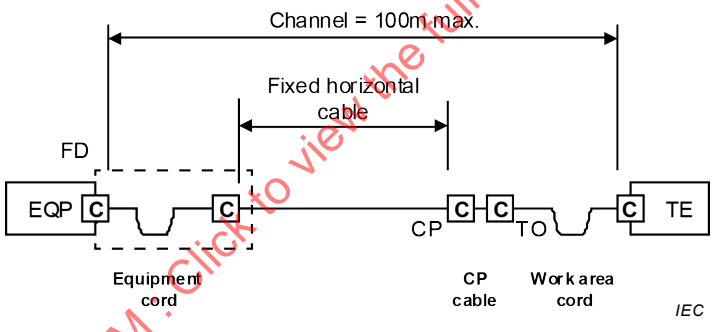
Figure 10c shows a channel containing an interconnect, a CP and a telecommunications outlet. Figure 10d contains an additional connection as a cross-connect. In both cases the horizontal cable connects the FD to the CP. The channel includes cords comprising patch cords/jumpers, equipment and work area cords.



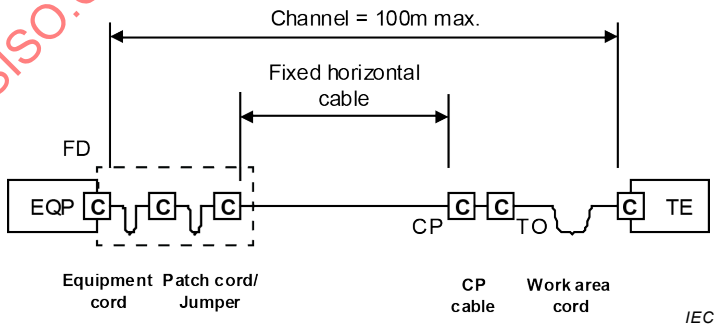
a) Interconnect - TO model



b) Cross-connect - TO model



c) Interconnect - CP - TO model



d) Cross-connect - CP - TO model

Figure 10 – Horizontal cabling models

Table 2 contains the length assumptions of the mathematical model used to validate channel performance using components of Clauses 9, 10 and 11. They do not represent absolute restrictions on the implementation of channels and permanent links, but may be used for guidance in reference implementations.

Table 2 – Length assumptions used in the mathematical modelling of balanced horizontal cabling

Segment	Minimum m	Maximum m
FD-CP	15	85
CP-TO	5	-
FD-TO (no CP)	15	90
Work area cord [a]	2	5
Patch cord	2	-
Equipment cord [b]	2	5
All cords	-	10

[a] If there is no CP, the minimum length of the work area cord is 1 m.

[b] If there is no cross-connect, the minimum length of the equipment cord is 1 m.

In addition to the cords, the channels shown in Figure 10c and Figure 10d contain a CP cable. The insertion loss specification for the CP cable may differ from that of both the horizontal cable and the cords. In order to accommodate cables used for work area cords, CP cables, patch cords, jumpers and equipment cords with different insertion loss, the length of the cables used within a channel shall be determined by the equations shown in Table 3.

Table 3 – Horizontal link length equations

Model	Figure	Implementation equation	
		Class E and E_A	Class F and F_A
Interconnect - TO	10a	$l_h = 104 - l_a \times X$	$l_h = 105 - l_a \times X$
Cross-connect - TO	10b	$l_h = 103 - l_a \times X$	$l_h = 103 - l_a \times X$
Interconnect - CP -TO	10c	$l_h = 103 - l_a \times X - l_c \times Y$	$l_h = 103 - l_a \times X - l_c \times Y$
Cross-connect - CP - TO	10d	$l_h = 102 - l_a \times X - l_c \times Y$	$l_h = 102 - l_a \times X - l_c \times Y$

l_h is the maximum length of the horizontal cable (m)

l_a is the combined length of patch cords/jumpers and equipment cords (m)

l_c is the length of the CP cable (m)

X is the ratio of cord cable insertion loss (dB/m) to horizontal cable insertion loss (dB/m)

Y is the ratio of CP cable insertion loss (dB/m) to horizontal cable insertion loss (dB/m)

For operating temperatures above 20 °C, l_h should be reduced by

1) 0,2 % per °C for screened balanced cables up to 60 °C,
2) 0,4 % per °C for unscreened balanced cables up to 40 °C,
3) 0,6 % per °C for unscreened balanced cables between 40 °C and 60 °C.

These are default values and should be used where the actual characteristic of the cable is not known.

Manufacturer's or supplier's information shall be consulted where the intended operating temperature exceeds 60 °C.

For the purpose of calculation in Table 3 it is assumed that

a) the flexible cable within these cords has a higher insertion loss than that used in the horizontal cable (see Clause 9),

b) all the cords in the channel have a common insertion loss specification.

The following general restrictions apply.

1) The physical length of the channel shall not exceed 100 m.
2) The physical length of the horizontal cable shall not exceed 90 m. When the total length of patch, equipment and work area cords exceeds 10 m, the allowed physical length of the horizontal cable shall be reduced according to Table 3.
3) A consolidation point shall be located so that there is at least 15 m from it to the floor distributor.
4) Where a multi-user TO assembly is used, the length of the work area cord should not exceed 20 m.
5) The length of patch cords/jumper cables should not exceed 5 m.

The maximum length of the horizontal cable will depend on the total length of cords to be supported within a channel. During the operation of the installed cabling, a management system should be implemented to ensure that the cords, jumper cables and, where appropriate, the CP cables used to create the channel conform to the design rules for the floor, building or installation.

8.2.3 Campus and building backbone cabling system

See ISO/IEC 11801-1:2017, 8.2.

8.3 Optical fibre cabling

8.3.1 General

Optical fibre components are referenced in Clauses 9, 10 and 11. The optical fibres are defined in terms of physical construction (core/cladding diameter) and their transmission performance Category within a cable.

Within the reference implementations of 8.3, the optical fibres used in each cabling channel shall have the same physical construction specification and the cabled optical fibres shall be of the same Category.

When more than one physical construction or cabled optical fibre Category is used in a cabling subsystem, the cabling shall be marked to allow each cabling type to be clearly identified.

8.3.2 Component selection

The selection of optical fibre components shall be determined by the channel lengths required and the existing and anticipated applications to be supported. Refer to ISO/IEC 11801-1:2017, Annex E for guidance.

8.3.3 Dimensions

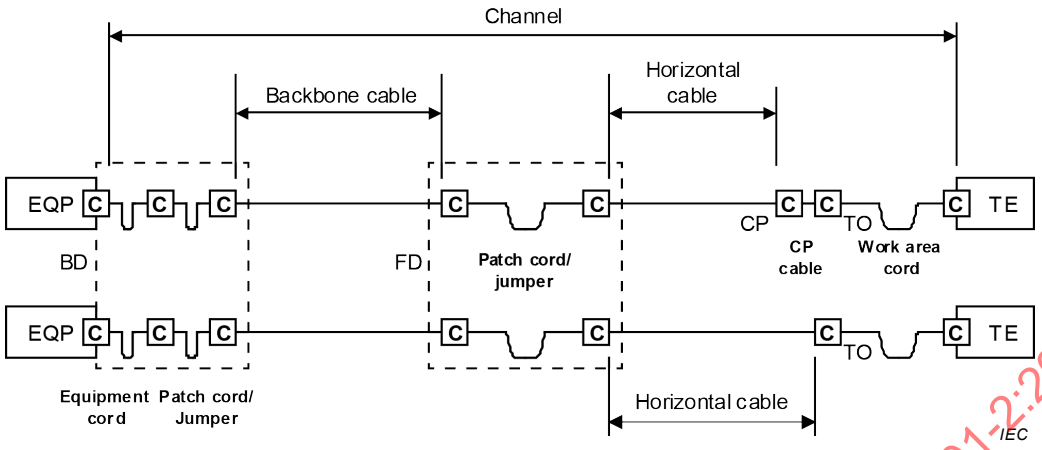
The models of Figure 10 are applicable to optical fibre cabling for horizontal cabling. The channel length is limited by channel length restrictions of the cabled optical fibre Category used, see Annex E of ISO/IEC 11801-1:2017. It should be noted that the connection system, used to terminate optical cabling, can contain mated connecting hardware and splices (permanent or re-useable) and that cross-connects can comprise re-useable splices.

The delivery of cabled optical fibre to the TO would not generally require transmission equipment at the FD (unless the design of optical fibre in the backbone cabling subsystem differs from that in the horizontal cabling subsystem). This allows the creation of a combined backbone/horizontal channel as shown in Figure 11. The three diagrams show a patched channel, a spliced channel and a direct channel (which does not require the use of an FD). Patched and spliced channel designs are also applicable to combined campus/building backbone channels and it is possible to consider a combined campus/building/horizontal channel.

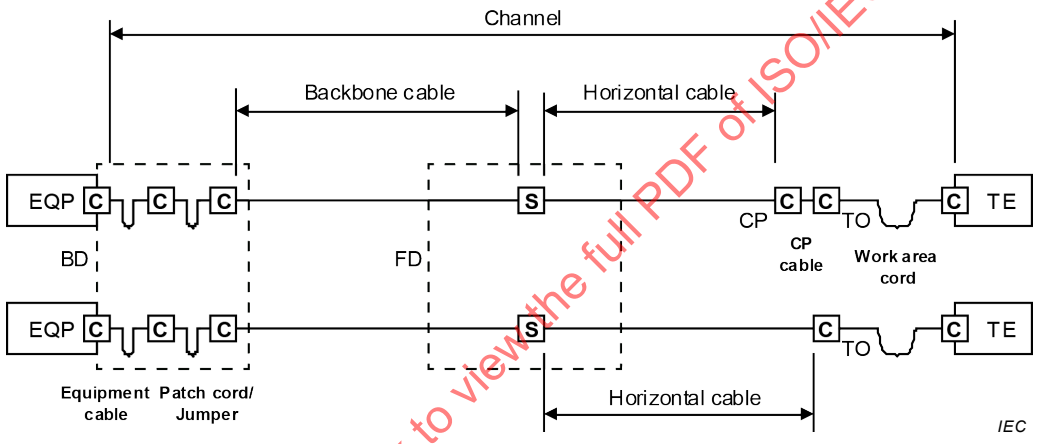
The use of permanently spliced and direct channels can be used as a means of reducing channel attenuation and centralizing the distribution of applications. However, centralizing the distribution can also result in a reduction in the overall flexibility in generic cabling.

In order to accommodate increased quantities of mated connections and splices used within a channel, the total length of the channel is typically reduced to accommodate the additional attenuation.

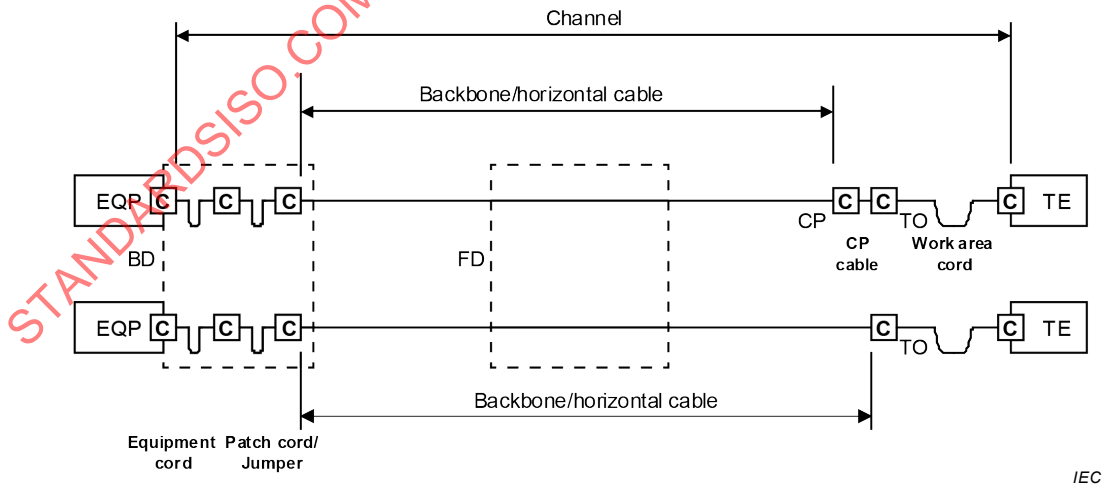
Additional connections may be used if the maximum channel insertion loss (or optical power budget, as applicable) of the application allows (see ISO/IEC 11801-1:2017, Annex E).



a) "Patched" combined channel



b) "Spliced" combined channel



c) "Direct" combined channel

Figure 11 – Combined backbone/horizontal channels

9 Cable requirements

9.1 General

Clause 9 defines the minimum requirements for