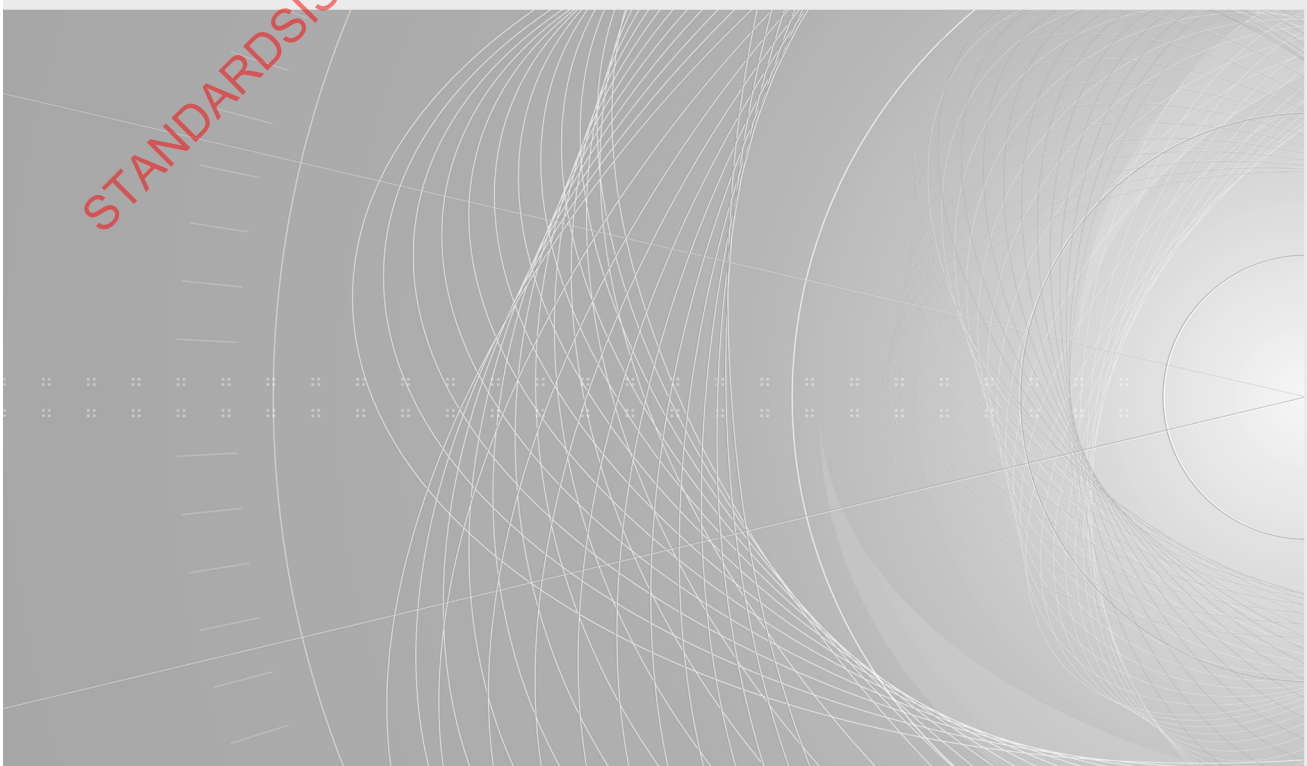
ISO/IEC 11801-5

Edition 1.0 2017-11

INTERNATIONAL STANDARD

Information technology – Generic cabling for customer premises – Part 5: Data centres



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ISO/IEC 11801-5

Edition 1.0 2017-11

INTERNATIONAL STANDARD

Information technology – Generic cabling for customer premises – Part 5: Data centres

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INFORMATION TECHNOLOGY – GENERIC CABLING FOR CUSTOMER PREMISES –

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FOREWORD

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International Standard ISO/IEC 11801-5 was prepared by subcommittee 25: Interconnection of information technology equipment, of ISO/IEC joint technical committee 1: Information technology.

This first edition cancels and replaces ISO/IEC 24764:2010 and Amendment 1:2014. 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 data centres;

b) addition of balanced cabling channels Class I and Class II;

c) addition of examples of structures in accordance with ISO/IEC 11801-5 in Annex C;

d) addition of examples of networking architectures in Annex D.

ISO/IEC 11801-5 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 can 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 to the computer room spaces of data centre premises, or computer room spaces within other types of building.

Additionally those premises can include

- office spaces for which generic cabling is specified in ISO/IEC 11801-2,
- industrial spaces for which generic cabling is specified in ISO/IEC 11801-3.

Generic cabling for distributed building services in data centre 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.

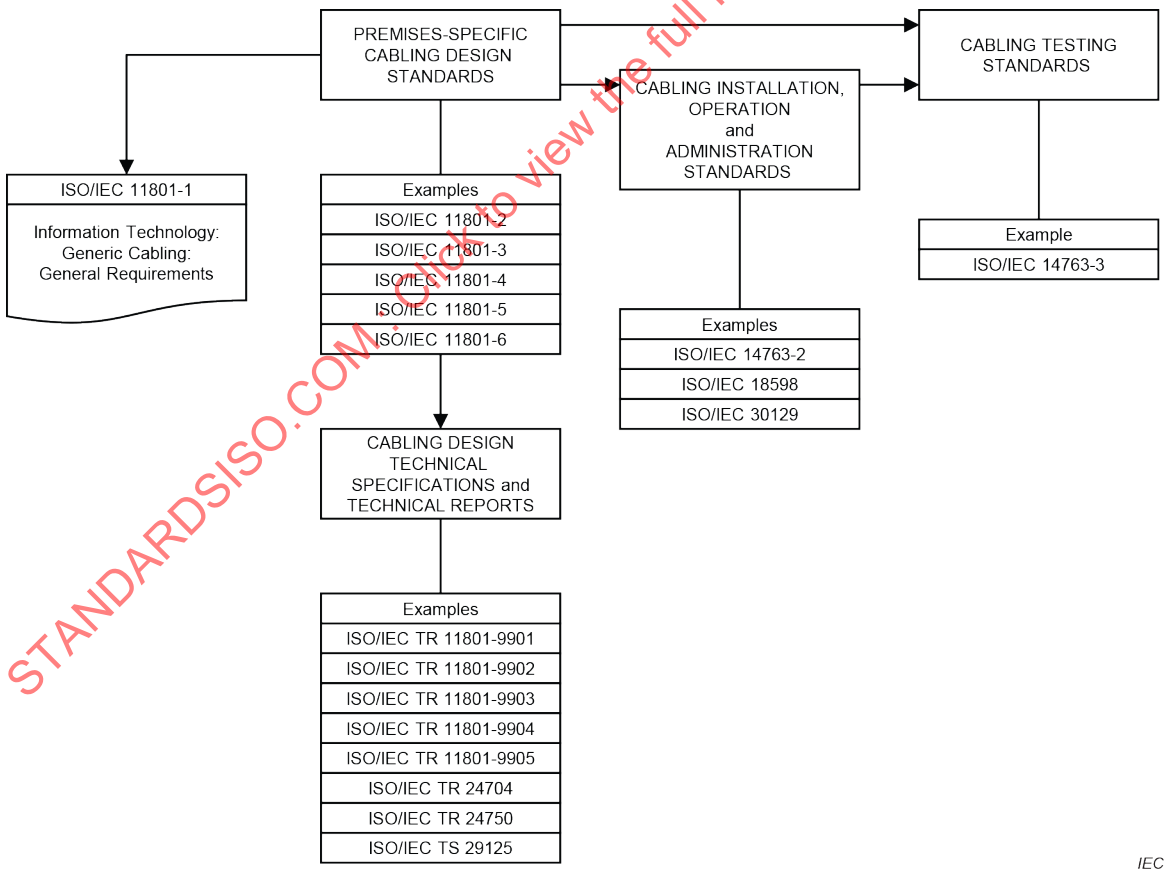


Figure 1 – Relationships between the generic cabling documents produced by ISO/IEC JTC 1/SC 25

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 as used to support high data rate, mission-critical services within the densely connected environment of data centre spaces.

This document has taken into account requirements specified in application standards listed in Annex E of ISO/IEC 11801-1:2017.

This document should be read in conjunction with ISO/IEC 11801-1, which was created to consolidate general requirements for generic cabling into a single standard which allows the other standards in the ISO/IEC 11801 series to have a common reference.

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 International Standard specifies a structure for generic cabling supporting a wide variety of applications, which

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

2) 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,

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

Life expectancy of generic cabling systems can vary depending on environmental conditions, supported 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 5: Data centres

1 Scope

This part of ISO/IEC 11801 specifies generic cabling within and to the computer room spaces of data centre premises, or data centre spaces within other types of buildings. 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 also 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 configurations for generic cabling within data centres,

b) the interfaces at the equipment outlet (EO) and the external network interface (ENI),

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, 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 60603-7-7, *Connectors for electronic equipment – Part 7-7: Detail specification for 8-way, shielded, free and fixed connectors for data transmissions with frequencies up to 600 MHz*

IEC 60603-7-41, *Connectors for electronic equipment – Part 7-41: Detail specification for 8-way, unshielded, free and fixed connectors, for data transmissions with frequencies up to 500 MHz*

IEC 60603-7-51, *Connectors for electronic equipment – Part 7-51: Detail specification for 8-way, shielded, free and fixed connectors, for data transmissions with frequencies up to 500 MHz*

IEC 60603-7-71, *Connectors for electronic equipment – Part 7-71: Detail specification for 8-way, shielded, free and fixed connectors, for data transmission with frequencies up to 1 000 MHz*

IEC 60603-7-81, *Connectors for electronic equipment – Part 7-81: Detail specification for 8-way, shielded, free and fixed connectors, for data transmissions with frequencies up to 2 000 MHz*

IEC 60603-7-82, *Connectors for electronic equipment – Part 7-82: Detail specification for 8-way, 12 contacts, shielded, free and fixed connectors, for data transmissions with frequencies up to 2 000 MHz*

IEC 61754-7-1, *Fibre optic interconnecting devices and passive components – Fibre optic connector interfaces – Part 7-1: Type MPO connector family – One fibre row*

IEC 61754-7-2, *Fibre optic interconnecting devices and passive components – Fibre optic connector interfaces – Part 7-2: Type MPO connector family – Two fibre rows*

IEC 61754-20, *Fibre optic connector interfaces – Part 20: Type LC connector family*

IEC 61755-3-2, *Fibre optic connector optical interfaces – Part 3-2: Optical interface, 2,5 mm and 1,25 mm diameter cylindrical full zirconia ferrules for 8 degrees angled-PC single mode fibres*

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 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
computer room
one or more spaces primarily dedicated to housing cabling and equipment used for electronics data storage, processing and networking

3.1.2
computer room space
area within the data centre that accommodates the data processing, data storage and telecommunications equipment that provides the primary function of the data centre

3.1.3
equipment outlet
fixed connecting device for terminating the zone distribution cabling and providing the interface to the equipment cord

3.1.4
fixed zone distribution cable
cable connecting the zone distributor to either the equipment outlet or, if present, the local distribution point

3.1.5
intermediate distribution cable
cable connecting the intermediate distributor to the zone distributor

3.1.6
intermediate distributor
distributor used to make connections between the main distribution cabling subsystem, intermediate distribution cabling subsystem, network access cabling subsystem and cabling subsystems specified in ISO/IEC 11801-1 and active equipment

3.1.7
local distribution point
connection point in the zone distribution cabling subsystem between a zone distributor and an equipment outlet

3.1.8
local distribution point cable
cable connecting a local distribution point to an equipment outlet

3.1.9
local distribution point link
transmission path between a local distribution point and the interface at the other end of the fixed zone distribution cable including the connecting hardware at each end

3.1.10
main distribution cable
cable connecting the main distributor to the intermediate distributor or the zone distributor

3.1.11
main distributor
distributor used to make connections between the main distribution cabling subsystem, network access cabling subsystem and cabling subsystems as specified in ISO/IEC 11801-1 and active equipment

3.1.12
network access cable
cable connecting the external network interface (or other distributors of the ISO/IEC 11801 series) to the main distributor, intermediate distributor or zone distributor

3.1.13
transition assembly
assembly of cabled optical fibres and connectors, with an MPO connector on one end and simplex or duplex connectors on the other end

3.1.14
zone distribution cable
cable connecting the zone distributor to the equipment outlet(s) or local distribution point(s), where present

3.1.15
zone distributor
distributor used to make connections between the main distribution cabling subsystem, intermediate distribution cabling subsystem, zone distribution cabling subsystem, network

access cabling subsystem, cabling subsystems specified in ISO/IEC 11801-1 and active equipment

3.2 Abbreviated terms

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

CuC	copper cabling
ENI	external network interface
ID	intermediate distributor
LDP	local distribution point
MD	main distributor
OFC	optical fibre cabling
SAN	storage area network
ZD	zone distributor

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 E1 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 EO 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 30129 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 installation 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 with ISO/IEC 11801-5.

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, 6.2.2, 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 for data centres, describes how they are connected together to form subsystems and identifies the interfaces at which application-specific components are connected to the generic cabling. Examples of structures in accordance with Clause 5 can be found in Annex C.

Applications listed in ISO/IEC 11801-1:2017, Annex E are supported by connecting active equipment at the external network interfaces, equipment outlets and the distributors.

Examples of network architectures in accordance with Clause 5 can be found in Annex D.

5.2 Functional elements

The functional elements of generic cabling are as follows:

a) external network interface (ENI) – not defined in ISO/IEC 11801-1;
b) network access cable – not defined in ISO/IEC 11801-1;
c) main distributor (MD) – equivalent to distributor 3 in ISO/IEC 11801-1;
d) main distribution cable – equivalent to subsystem cable 3 in ISO/IEC 11801-1;
e) intermediate distributor (ID) – equivalent to distributor 2 in ISO/IEC 11801-1;
f) intermediate distribution cable – equivalent to subsystem cable 2 in ISO/IEC 11801-1;
g) zone distributor (ZD) – equivalent to distributor 1 in ISO/IEC 11801-1;
h) zone distribution cable – equivalent to subsystem cable 1 in ISO/IEC 11801-1;
i) local distribution point (LDP) – equivalent to consolidation point in ISO/IEC 11801-1;
j) local distribution point cable (LDP cable) – equivalent to cable Y in ISO/IEC 11801-1;
k) equipment outlet (EO) – 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 applications to the telecommunications equipment and terminal equipment.

5.3 General structure and hierarchy

Generic cabling systems in data centres contain up to four cabling subsystems: network access cabling, main distribution cabling, intermediate distribution cabling and zone distribution cabling. Where present within the premises, distributors of other parts of the ISO/IEC 11801 series are connected to the generic cabling within the data centre using the network access cabling.

The cabling subsystems are connected together to create a generic cabling system with a structure as shown in Figure 2. The composition of the cabling subsystems is described in 5.4.2, 5.4.3, 5.4.4 and 5.4.5. The functional elements of the cabling subsystems are interconnected to form a hierarchical star topology as shown in Figure 3.

The functions of multiple distributors can be combined, see 5.7.1.

Connections between cabling subsystems are either indirect, requiring application-specific equipment, or direct. Connection to application-specific equipment at an MD, ID or a ZD adopts either an interconnect or a cross-connect approach (see ISO/IEC 11801-1). Connection to application-specific equipment at an ENI and EO adopts an interconnect approach (see ISO/IEC 11801-1). Direct connections between cabling subsystems adopt either a cross-connect approach, by way of either patch cords or jumpers, or an interconnect approach.

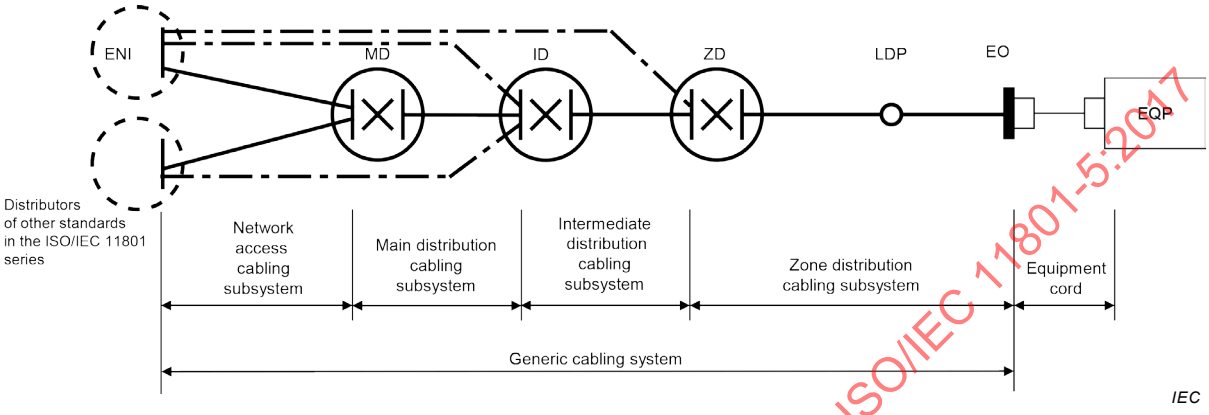
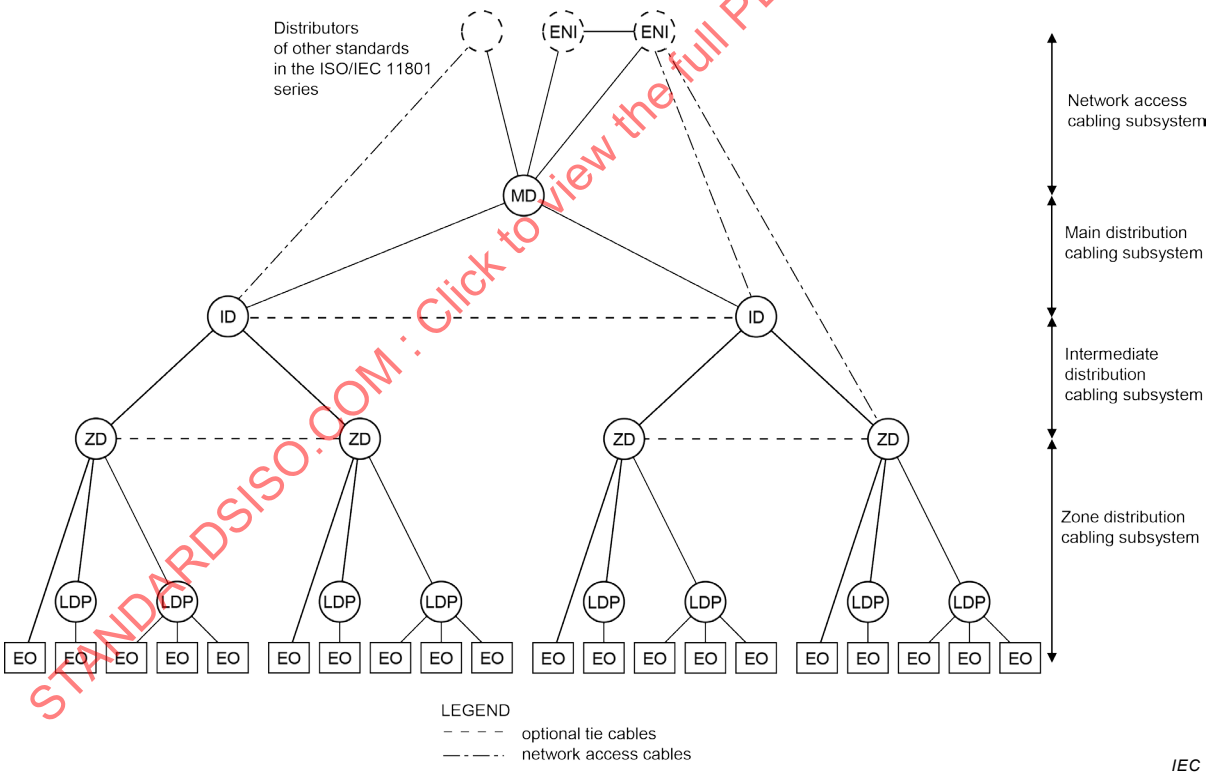


Figure 2 – Structure of generic cabling within a data centre



NOTE Network access cabling is also used to connect ENI to ID or ZD.

Figure 3 – Hierarchical structure of generic cabling within a data centre

5.4 Cabling subsystems

5.4.1 General

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.

The optional redundancy between distributors as shown in Figure 3 shall be provided by the use of tie cabling.

Tie cabling is not considered as a part of the hierarchical structure within this document. If provided, it shall include

a) the tie cable,

b) the mechanical termination of the tie cable at the peer distributors.

5.4.2 Network access cabling subsystem

The network access cabling subsystem extends from an MD (or ID, or ZD) to the ENIs or to the ISO/IEC 11801 series distributors (see Figure 2).

The subsystem includes

a) the network access cables,

b) the mechanical termination of the network access cables at the ENI(s),

c) the mechanical termination of the network access cables at the MD, ID(s), ZD(s) or other distributors in accordance with ISO/IEC 11801-1.

5.4.3 Main distribution cabling subsystem

The main distribution cabling subsystem extends from an MD to the ID(s) (or ZD(s)) connected to it. The subsystem includes

a) the main distribution cables,

b) the mechanical termination of the main distribution cables at the MD together with associated patch cords and/or jumpers at the MD,

c) the mechanical termination of the main distribution cables at the ID(s) or ZD(s).

5.4.4 Intermediate distribution cabling subsystem

The intermediate distribution cabling subsystem extends from an ID to the ZD(s) connected to it.

The subsystem includes

a) the intermediate distribution cables,

b) the mechanical termination of the intermediate distribution cables at the ID together with associated patch cords and/or jumpers at the ID,

c) the mechanical termination of the intermediate distribution cables at the ZD(s).

5.4.5 Zone distribution cabling subsystem

The zone distribution cabling subsystem extends from a ZD to the EO(s) connected to it. The subsystem includes

a) the zone distribution cables,

b) the mechanical termination of the zone distribution cables at the EO(s) and the ZD together with associated patch cords and/or jumpers at the ZD,

c) LDP(s) (optional),

d) LDP cable(s) (optional),

e) the EO(s).

A zone distribution cable shall be continuous from the ZD to the EO(s) unless an LDP is installed (see 5.7.8).

5.4.6 Design objectives

In order to provide the longest operational life while minimizing the disruption and cost associated with re-cabling, the fixed installed cabling should be designed to

a) support the broadest set of existing and emerging applications,

b) accommodate the anticipated growth in volume of supported applications throughout the predicted lifetime of the installation.

In addition, the provision of redundancy within a cabling design should be considered (see also 5.7.2).

5.5 Accommodation of functional elements

Figure 4 shows an example of how the functional elements are accommodated in a building (only a single floor of the building is shown for simplicity).

The MD, ID, ZD and LDP shall be housed in permanent and accessible locations within the data centre.

The ENI shall be housed in permanent and accessible location either internal or external to the data centre.

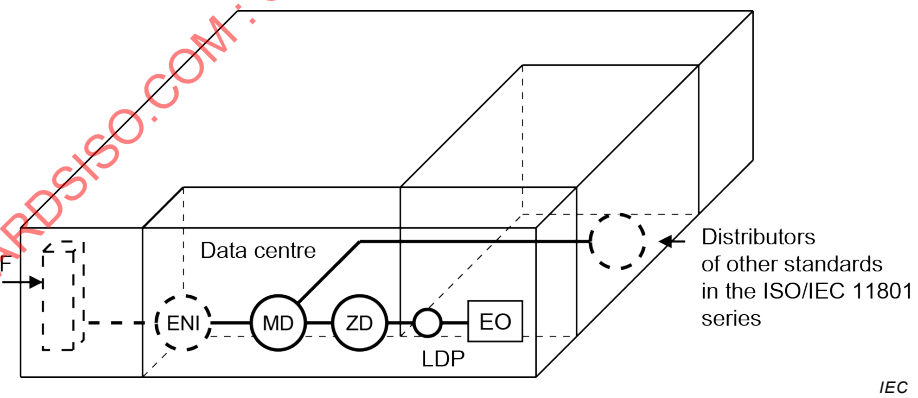


Figure 4 – Example of accommodation of functional elements

5.6 Interfaces

5.6.1 Equipment interfaces and test interfaces

Potential equipment interfaces for data centres are located at the ends of the cabling subsystems (as shown in Figure 5). An LDP does not provide an equipment interface to the generic cabling system.

Potential test interfaces for data centres are located at the ends of the cabling subsystems and at the LDP, if present (as shown in Figure 5).

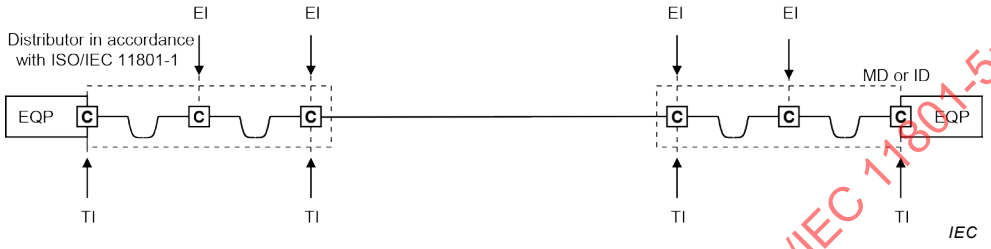
5.6.2 Channels and links

The transmission performance of generic cabling is detailed in Clause 6 for channels and Clause 7 for links.

The channel is the transmission path between data centre equipment such as switches and servers (EQP in Figure 5). A typical channel in a data centre would consist of the zone distribution cabling subsystem together with an equipment cord at each end. For longer reach services, the channel would be formed by the connection of two or more subsystems (including patch cords and equipment cords), see Annex A. The performance of the channel excludes the connections at the application-specific equipment.

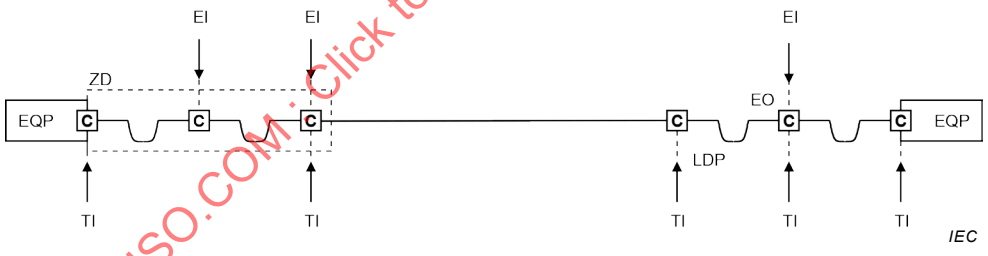
The permanent link is the transmission path of the fixed cabling subsystem, including the connecting hardware at the ends of the installed cable. In a data centre zone distribution cabling subsystem, the permanent link consists of the EO, an optional LDP cable, an optional LDP, the zone distribution cable and the termination of the zone distribution cable at the zone distributor.

a) Network access cabling from ENI to MD, ID or ZD



b) Network access cabling from distributor in accordance with ISO/IEC 11801-1 to MD or ID

c) Main distribution cabling and intermediate distribution cabling



d) Zone distribution cabling

NOTE Where the EQP connected to the ENI lies outside the premises containing the data centre, the function of the interconnecting cord will typically be provided by a combination of fixed cabling and cords that are outside the scope of this document. In such cases the connection to the EQP cannot provide a TI.

Figure 5 – Test and equipment interfaces

5.7 Dimensioning and configuring

5.7.1 Distributors

The number and type of subsystems that are included in a generic cabling implementation depends upon the layout and size of the data centre and upon the strategy of the user.

The design of distributors shall ensure that the length of patch cords, jumpers and equipment cords are minimized, and administration should ensure that the design lengths are maintained during operation. Administration should ensure that the requirements of ISO/IEC 11801-1 are observed regarding the mixing of optical fibre types at the distributors. Distributors should be located in such a way that the resulting cable lengths are consistent with the channel performance requirements of Clause 6.

Where the components of Clauses 9, 10 and 11 are used, the distributors shall be located in accordance with the reference implementations of Clause 8. Where other components are used, the distributors shall be located so that the desired performance Class of Clause 6 is delivered.

The functions of multiple distributors can be combined into a single distributor. For example, an MD can serve the function of a ZD. However, every data centre shall have at least one MD.

5.7.2 Redundancy

Consideration should be given to the resilience of the data centre with respect to the cabling infrastructure. Measures that can be taken to improve the resiliency include

a) redundant and physically separated building entrance facilities (see 5.7.9),

b) redundant and physically separated ENIs with service provisioned in the ENIs by multiple service providers,

c) provision of redundant and physically separated distributors (MDs, IDs, ZDs),

d) provision of tie cables between peer level distributors (i.e. MD-to-MD, ID-to-ID, ZD-to-ZD),

e) diversely routed cabling between distributors (preferably with different coloured jackets or labels).

In certain circumstances, for example for security or reliability reasons, redundancy can be built into a cabling design. Figure 6 shows one of many possible examples of the connection of functional elements within the structured framework to provide such protection against failure in one or more parts of the cabling infrastructure. This might form the basis for the design of generic cabling for a data centre providing some protection against such hazards as fire damage or the failure of an external network.

NOTE 1 Redundancy cabling, shown in Figure 6, is an example of data centres with high availability.

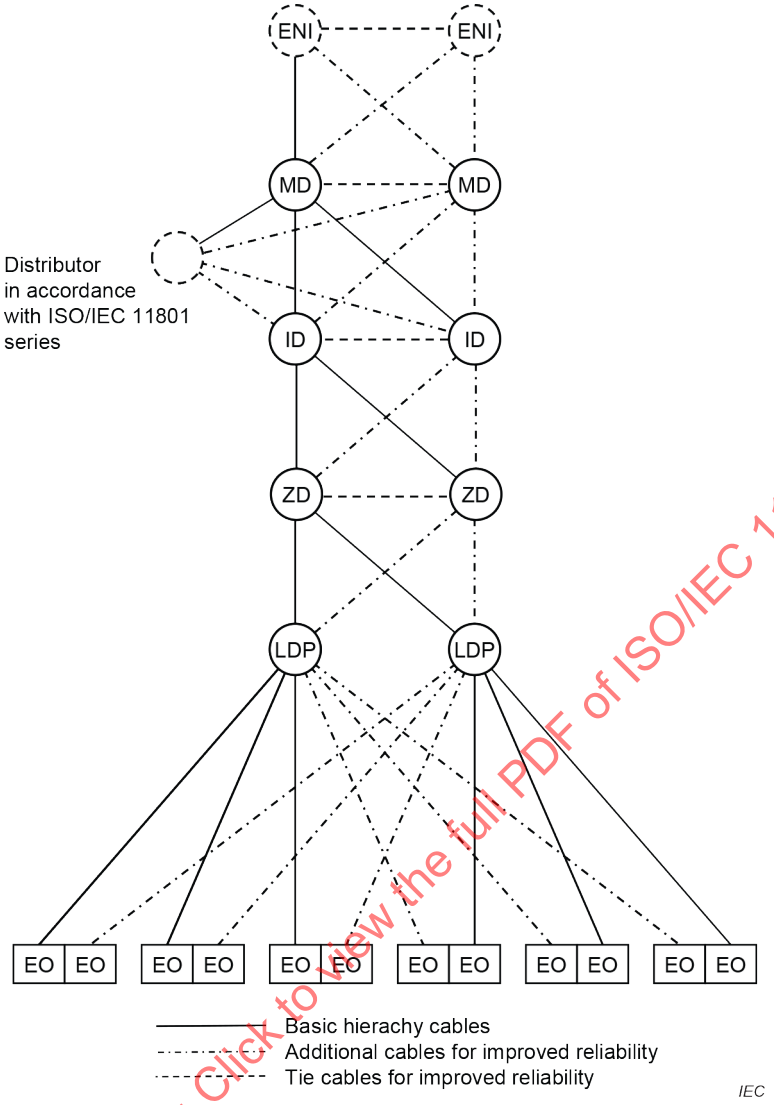


Figure 6 – Connection of functional elements providing redundancy

Additionally, redundancy can be provided by utilizing multiple cables between distributors, with cables following different routes.

NOTE 2 Connections between ZD and ZD are in addition to the connection between MD/ID and ZD and not a replacement for the MD/ID to ZD connection.

5.7.3 External network interface

The ENI provides a termination of the network access cabling that allows connection of external services to the network access cabling as shown in Figure 7.

The multiple service providers should have diverse routes to each of the multiple ENIs.

The ENI shall be in accordance with Clause 10.

Where the components of Clauses 9, 10 and 11 are used, the ENIs shall be located in accordance with the reference implementations of Clause 8.

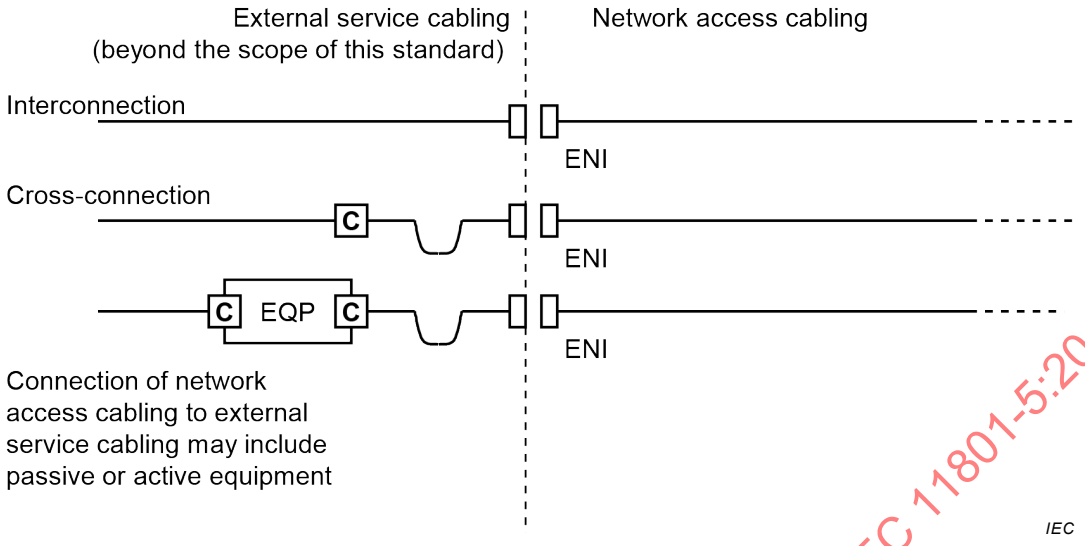


Figure 7 – Examples of external service cabling connections to the ENI

5.7.4 Cables

Cable types used in the reference implementations of Clause 8 are specified in Clause 9.

5.7.5 Equipment cords

Equipment cords connect the generic cabling to transmission equipment at distributors and to terminal equipment at the EO. Equipment cords 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.

The structured cabling system specified by this document restricts the use of direct-attach cords

a) within a distributor,

b) within a single cabinet, frame, or rack,

c) between adjacent cabinets, frames, or racks in the same row.

5.7.6 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.

5.7.7 Equipment outlets

The design of generic cabling should provide for EOs to be installed with a high density and located in close proximity to the application-specific equipment to which they are to be connected. A group of EOs can be served directly by multiple ZDs, or by multiple ZDs via multiple LDPs.

The EO interface presented shall be in accordance with Clause 10.

5.7.8 LDP

The installation of an LDP in the zone distribution cabling between the ZD and the EO can be useful where frequent additions or movements of equipment are required. One LDP is permitted between a ZD and any EO. The LDP shall be an interconnect, not a cross-connect, because the LDP adds one connection per channel or link. There shall be no active equipment in the LDP area.

Where an LDP is used, it shall have sufficient capacity to support the area of the data centre which it is designed to serve during its intended operational life. The area served can be defined in terms of number of frames/cabinets/closures to be supported and should include allowance for growth.

Provided that the requirements of 5.5 are met, LDP(s) can be located in ceiling voids or under floors.

For balanced cabling, the effect of multiple connections in close proximity on transmission performance should be taken into consideration when planning the cable lengths between the ZD and the LDP.

5.7.9 Building entrance facilities

Building entrance facilities are required whenever campus backbone, public and private network cables enter buildings and a transition is made to internal cables. It comprises an entrance point from the exterior of the building and the pathway leading to the main or intermediate distributor. Local regulations can require special facilities where the external cables are terminated. At this termination point, a change from external to internal cable can take place.

When using cables that are suited for both internal and external use, a termination point or transition point are not needed.

5.8 Earthing and equipotential bonding

See ISO/IEC 30129.

6 Channel performance requirements

6.1 General

Clause 6 specifies the minimum channel 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 minimum requirements for the transmission of 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.

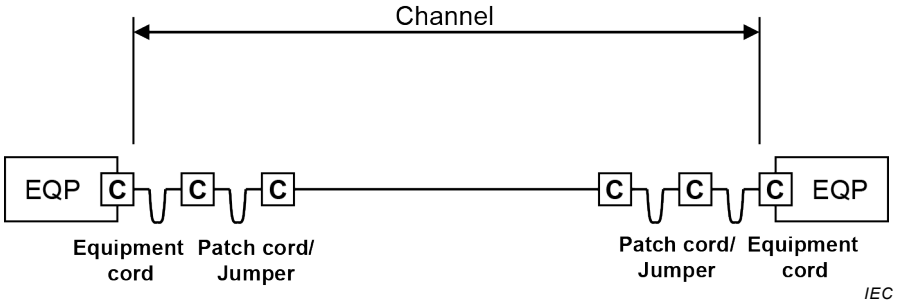


Figure 8 – Example of a channel with four connections

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.

Channels are implemented using either

a) network access cabling only,

b) main distribution cabling only,

c) intermediate distribution cabling only,

d) zone distribution cabling only,

e) a combination of the above, see Annex A.

Figure 9 shows an example of equipment at the MD or ID connected to equipment at the EO using two channels, an optical fibre cabling channel and a balanced cabling channel. The optical fibre and balanced cabling channels are connected together using an optical fibre to balanced cable converter. There are four channel interfaces: one at each end of the balanced cabling channel, and one at each end of the optical fibre cabling channel.

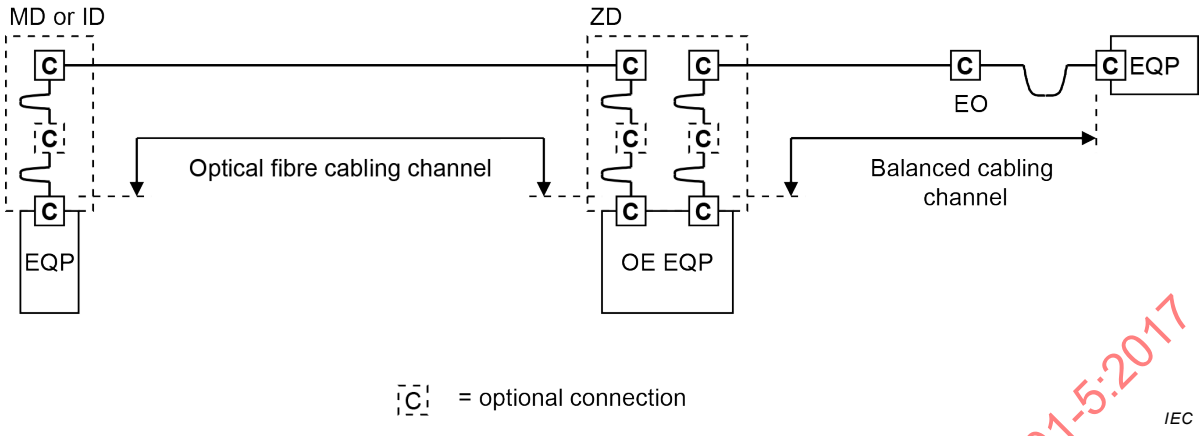


Figure 9 – Example of a system showing the location of cabling interfaces

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 shall be used for the design and can be used for verification of any implementation of this document, using the test methods defined, or referred to, in 6.3. In addition, these requirements can be used for application development and troubleshooting.

Consideration should be given to measuring performance at worst case temperatures, or calculating worst case performance based on measurements made at other temperatures.

6.3.2 Balanced cabling

The channel 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 transmission performance than those of Clauses 9, 10 and 11.

The main distribution, intermediate distribution and zone distribution cabling shall be designed to provide a minimum of Class E_A channel performance as specified in ISO/IEC 11801-1:2017, 6.3.

Some applications listed in ISO/IEC 11801-1:2017, Annex E require channels of Class I or Class II as specified in ISO/IEC 11801-1:2017, 6.3.

NOTE Class I and Class II specify a maximum of two connections in a channel and is designed as an interconnect to EO implementation.

6.3.3 Optical fibre cabling

The selection of optical fibre components shall take into account the initial 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 and optical connecting hardware as specified in 10.3 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

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.

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 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.

The reference implementations described in Clause 8 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 8.2.2, 8.2.3 and 8.2.4, or

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

8.2 Balanced cabling

8.2.1 Assumptions

Balanced cabling components referenced in Clauses 9, 10 and 11 are defined in terms of Category. In the reference implementations of 8.2, the components used in each cabling channel shall have the same nominal characteristic impedance in accordance with ISO/IEC 11801-1:2017, 6.3.2.

Cables and connections of different Categories should not be mixed within a channel. If different Categories are mixed, the resultant cabling performance will be determined by the Category of the lowest performing component.

The implementations are based on component performance at 20 °C. The effect of temperature on the performance of cables shall be taken into account as shown in Table 3.

8.2.2 Zone distribution cabling

8.2.2.1 Component choice

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

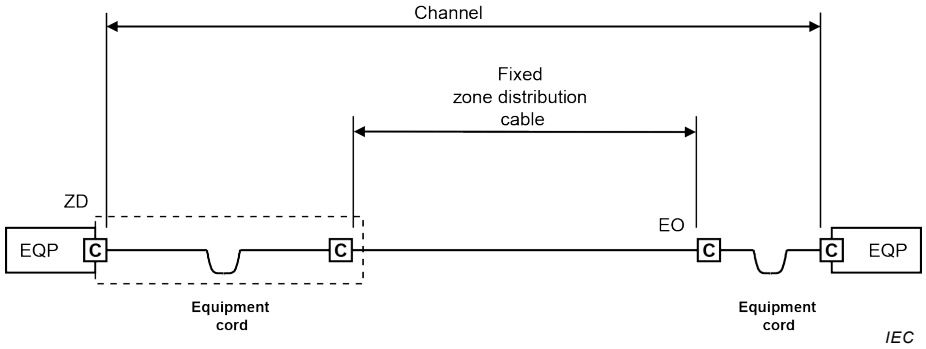
Using the models of 8.2.2.2,

a) Category 6_A or Category 8.1 components provide Class E_A balanced cabling performance,
b) Category 7 components provide Class F balanced cabling performance,
c) Category 7_A or Category 8.2 components provide Class F_A balanced cabling performance,
d) Category 8.1 components provide Class I balanced cabling performance for interconnect–EO implementation,
e) Category 8.2 components provide Class II balanced cabling performance for interconnect–EO implementation.

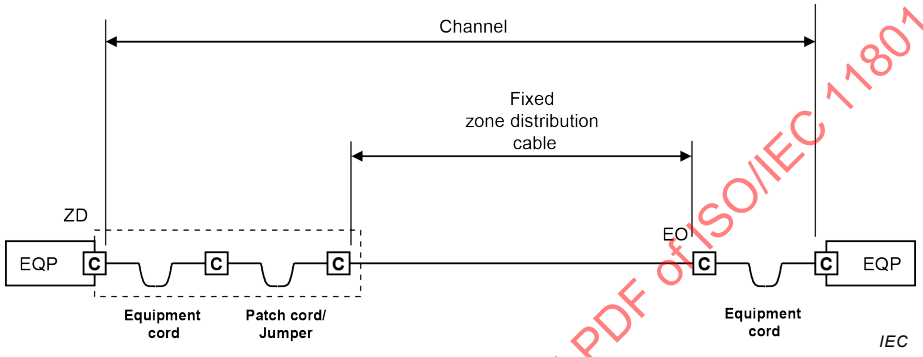
Category 8.1 components cannot be used to provide a Class F, F_A or II balanced cabling performance.

8.2.2.2 Dimensions

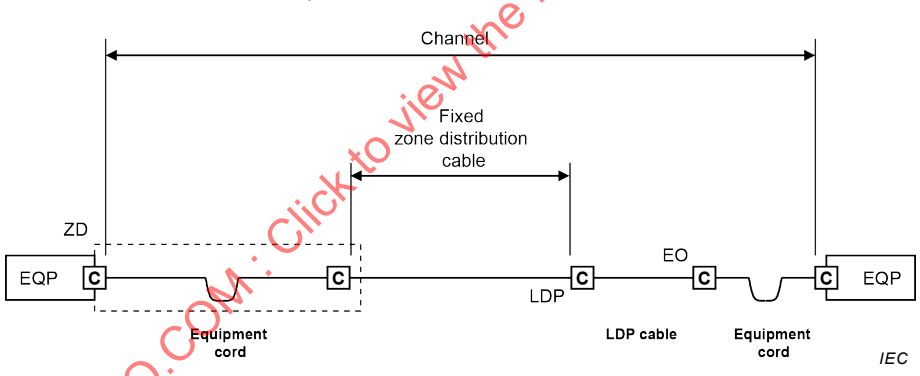
Figure 10 shows the models used to correlate zone distribution cabling dimensions specified in Clause 8 with the channel specifications in Clause 6.



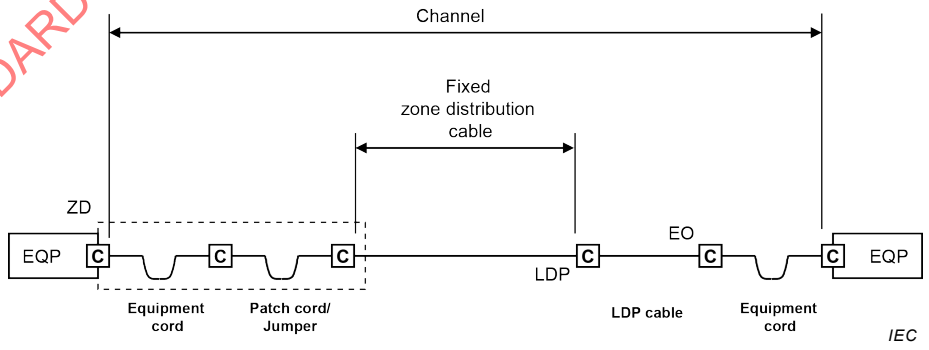
a) Interconnect–EO model



b) Cross-connect–EO model



c) Interconnect–LDP–EO model



d) Cross-connect–LDP–EO model

Figure 10 – Zone distribution cabling models

Figure 10a) shows a channel containing only an interconnect and an EO. Figure 10b) contains an additional connection as a cross-connect. In both cases the fixed horizontal cable connects

the ZD to the EO. The channel includes patch cords and equipment cords. For the purposes of 8.2.2.2, jumpers used in place of patch cords are treated as cords.

Figure 10c) shows a channel containing an interconnect, an LDP and an EO. Figure 10d) contains an additional connection as a cross-connect. In both cases the fixed zone distribution cable connects the ZD to the LDP. The channel includes patch cords and equipment cords. For the purposes of 8.2.2.2, jumpers used in place of patch cords are treated as cords.

In addition to the cords, the channels shown in Figure 10c) and Figure 10d) contain an LDP cable. The insertion loss specification for the LDP cable can differ from that of both the fixed zone distribution cable and the flexible cables. The channel of Figure 10d) is recognized as the maximum implementation used to define the channel performance limits of Clause 6.

In order to accommodate cables used for LDP cables, patch cords, jumpers and equipment cords with different insertion loss specifications, the maximum cable length used within a channel shall be determined by the equations shown in Table 3.

In Table 3 it is assumed that

a) the flexible cable within these cords has a higher insertion loss specification than that used in the fixed zone distribution cable (see Clause 11),

b) the cables within these cords in the channel have a common insertion loss specification.

The following general restrictions apply:

1) for Class E_A, F and F_A the physical length of the channel shall not exceed 100 m,

2) for Class I and II the physical length of the channel shall not exceed 30 m,

3) for Class E_A, F and F_A the physical length of the fixed zone distribution cable shall not exceed 90 m and can be less depending on the length of LDP cables and cords used and the number of connections.

Table 1 and Table 2 contain the length assumptions of the mathematical model used to validate channel performance using components specified in Clauses 9, 10 and 11. They do not represent absolute restrictions on the implementation of channels and permanent links, but can be used for guidance in reference implementations. Table 1 and Table 2 give the length assumptions used in the mathematical modelling of balanced zone distribution cabling.

Table 1 – Zone distribution cabling – length assumptions for balanced cabling using Classes E_A to F_A

Segment	Length m	
	Minimum	Maximum
ZD–LDP	15	85
LDP–EO	5	–
ZD–EO (no LDP)	15	90
Equipment cord at the EO	2[a]	5
Patch cord	2	–
Equipment cord at the ZD	2[b]	5
All cords	–	10

[a] If there is no LDP, the minimum length of the equipment cord is 1 m.

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

Table 2 – Zone distribution cabling – length assumptions for balanced cabling using Classes I and II

Segment	Length m	
	Minimum	Maximum
ZD–EO	5	26
Equipment cord at the EO	1	2
Equipment cord at the ZD	1	2
All cords	–	4

Table 3 – Zone distribution channel length equations for Classes

Model	Figure	Implementation equations		
		Class E_A	Class F and Class F_A	Class I and II
Interconnect–EO	10a)	$l_z = 104 - l_a X$	$l_z = 105 - l_a X$	$l_z = 32 - l_a X$
Cross-connect–EO	10b)	$l_z = 103 - l_a X$	$l_z = 103 - l_a X$	-
Interconnect–LDP–EO	10c)	$l_z = 103 - l_a X - l_l Y$	$l_z = 103 - l_a X - l_l Y$	-
Cross-connect–LDP–EO	10d)	$l_z = 102 - l_a X - l_l Y$	$l_z = 102 - l_a X - l_l Y$	-
For operating temperatures above 20 °C, l_z should be reduced by 0,2 % per °C for screened cables and 0,4 % per °C (20 °C to 40 °C) and 0,6 % per °C (40 °C to 60 °C) for unscreened cables.				
l_z is the maximum length of the fixed zone distribution cable (m) l_a is the combined length of patch cords, jumpers and equipment cords (m) l_l is the length of the LDP cable (m) X is the ratio of flexible cable insertion loss (dB/m) to fixed zone distribution cable insertion loss (dB/m) Y is the ratio of LDP cable insertion loss (dB/m) to fixed zone distribution cable insertion loss (dB/m)				

8.2.3 Cabling between distributors

8.2.3.1 Component choice

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

Using the models of 8.2.2.2,

a) Category 6_A or Category 8.1 components provide Class E_A balanced cabling performance,

b) Category 7 components provide Class F balanced cabling performance,

c) Category 7_A or Category 8.2 components provide Class F_A balanced cabling performance,

d) Category 8.1 components provide Class I balanced cabling performance for interconnect to interconnect implementation,

e) Category 8.2 components provide Class II balanced cabling performance for interconnect to interconnect implementation.

Category 8.1 components cannot be used to provide a Class F, F_A or II balanced cabling performance.

8.2.3.2 Dimensions

The connection of application-specific equipment to the cabling between distributors at the MD, IDs and ZDs adopts either an interconnect or cross-connect approach (see

ISO/IEC 11801-1). The channel includes patch cords and equipment cords. For the purposes of 8.2.3.2, jumpers used in place of patch cords are treated as cords.

Figure 11 and Figure 12 show the models used to correlate main distribution cabling and intermediate distribution cabling dimensions specified in 8.2.3 with the channel specifications in Clause 6. These figures represent the full configuration for the main distribution channel.

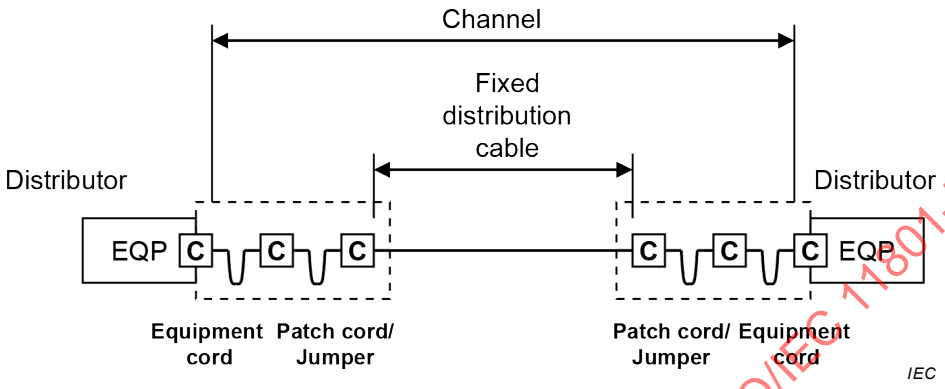


Figure 11 – Cabling model between distributors using Class E_A to F_A

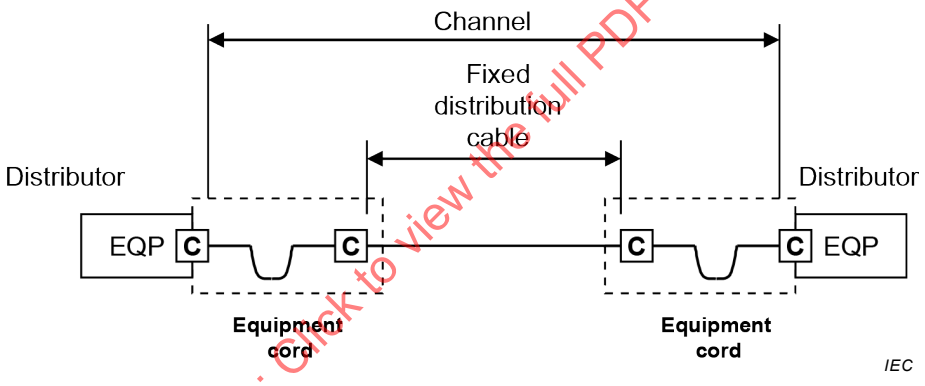


Figure 12 – Cabling model between distributors using Class I and II

Table 4 and Table 5 contain the length assumptions of the mathematical model used to validate channel performance using components specified in Clauses 9, 10 and 11. They do not represent absolute restrictions on the implementation of channels and permanent links, but can be used for guidance in reference implementations.

Table 4 – Cabling between distributors – length assumptions for balanced cabling using Classes E_A to F_A

Segment	Length m	
	Minimum	Maximum
MD-ID or ZD	15	90
Equipment cord at the MD	2[a]	5
Equipment cord at the ID	2[b]	5
Patch cord	2	–
All cords	–	10

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

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

Table 5 – Cabling between distributors – length assumptions for balanced cabling using Classes I and II

Segment	Length m	
	Minimum	Maximum
ZD-EO	5	26
Equipment cord at the EO	1	2
Equipment cord at the ZD	1	2
All cords	–	4

The maximum length of the fixed distribution cable will depend on the total length of cords to be supported within a channel. During the operation of the installed cabling, an administration system in accordance with ISO/IEC 14763-2 shall be implemented to ensure that the length of cords used to create the channel conform to the design rules of this document.

In order to accommodate the higher insertion loss of flexible cables used for cords, the length of the cables used within a channel of a given Class (see Clause 6) shall be determined by the equations shown in Table 6.

In Table 6 it is assumed that

a) the flexible cable within these cords has a higher insertion loss specification than that used in the fixed distribution cable (see Clause 11);

b) the cables within these cords in the channel have a common insertion loss specification.

The following general restrictions apply:

1) for Class E_A, F and F_A the physical length of the channel shall not exceed 100 m;
2) for Class I and II the physical length of the channel shall not exceed 30 m;
3) for Class E_A, F and F_A the physical length of the fixed distribution cable shall not exceed 90 m and can be less depending on the length of LDP cables and cords used and the number of connections.

Table 6 – Length equations for cabling between distributors

Model	Implementation equations		
	Class E_A	Class F and Class F_A	Class I and II
Interconnect–interconnect	$l_m = 104 - l_a X$	$l_m = 105 - l_a X$	$l_m = 32 - l_a X$
Interconnect–cross-connect	$l_m = 103 - l_a X$	$l_m = 103 - l_a X$	-
Cross-connect–cross-connect	$l_m = 102 - l_a X$	$l_m = 102 - l_a X$	-
For operating temperatures above 20 °C, l_m should be reduced by 0,2 % per °C for screened cables and 0,4 % per °C (20 °C to 40 °C) and 0,6 % per °C (40 °C to 60 °C) for unscreened cables.			
l_m is the maximum length of the fixed main distribution cable (m) l_a is the combined length of patch cords, jumpers and equipment cords (m) X is the ratio of flexible cable insertion loss (dB/m) to fixed main distribution cable insertion loss (dB/m)			

8.2.4 Network access cabling

8.2.4.1 Component choice

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

Using the models of 8.2.2.2,

a) Category 5 components provide Class D balanced cabling performance,

b) Category 6 components provide Class E balanced cabling performance,

c) Category 6_A or Category 8.1 components provide Class E_A balanced cabling performance,

d) Category 7 components provide Class F balanced cabling performance,

e) Category 7_A or Category 8.2 components provide Class F_A balanced cabling performance,

f) Category 8.1 components provide Class I balanced cabling performance for interconnect–EO implementation,

g) Category 8.2 components provide Class II balanced cabling performance for interconnect–EO implementation.

Category 8.1 components cannot be used to provide a Class F, F_A or II balanced cabling performance.

8.2.4.2 Dimensions

Figure 13 shows the model used to correlate cabling dimensions specified in 8.2.4 with the channel specifications in Clause 6. The network access channel shown contains a cross-connect at both ends and represents the worst-case configuration for a network access cabling channel between an MD or ID and a distributor in accordance with ISO/IEC 11801-1. A channel between an ENI and an MD, ID or ZD contains an interconnect at the ENI.

The channel includes patch cords and equipment cords. For the purposes of 8.2.4.2, jumpers used in place of patch cords are treated as cords.

In Table 7 it is assumed that

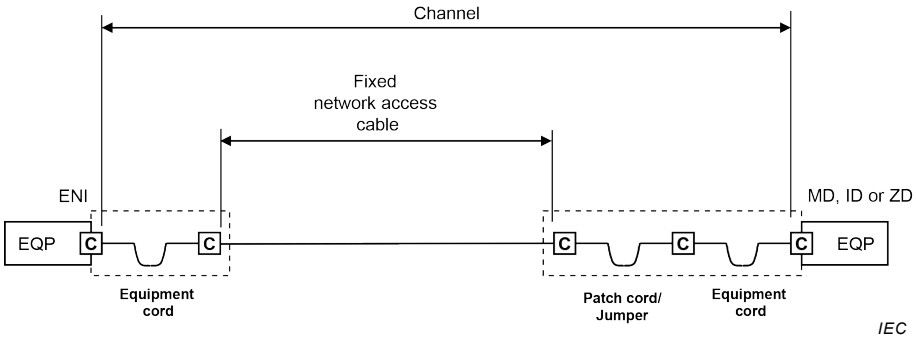
a) the flexible cable within these cords has a higher insertion loss specification than that used in the fixed network access cable,

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

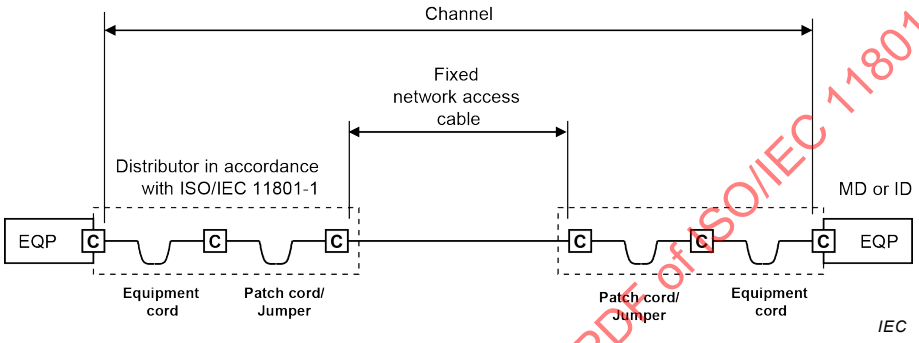
In order to accommodate the higher insertion loss of flexible cables used for cords, the length of the cables used within a channel of a given Class (see Clause 6) shall be determined by the equations shown in Table 7.

When four connections are used in a channel, the physical length of the network access cable should be at least 15 m.

The maximum length of the fixed network access cable will depend on the total length of cords to be supported within a channel. The maximum lengths of cords shall be fixed for ENIs and distributors.



a) Network access cabling from ENI to MD, ID or ZD



b) Network access cabling from distributor in accordance with ISO/IEC 11801-1 to MD or ID

NOTE Where the EQP connected to the ENI lies outside the premises containing the data centres, the function of the interconnecting cord will typically be provided by a combination of fixed cabling and cords that are outside the scope of this document. In such cases the connection to the EQP cannot provide a TI.

Figure 13 – Network access cabling models

Table 7 – Network access cabling channel equations

Component	Implementation equations [a]							
Category	**Class A**	**Class B**	**Class C**	**Class D**	**Class E**	**Class E_A**	**Class F**	**Class F_A**
5	2 000	l_n = 250 − $l_a X$	l_n = 170 − $l_a X$	l_n = 105 − $l_a X$	–	–	–	–
6	2 000	l_n = 260 − $l_a X$	l_n = 185 − $l_a X$	l_n = 111 − $l_a X$	l_n = 102 − $l_a X$	–	–	–
6_A or 8.1	2 000	l_n = 260 − $l_a X$	l_n = 189 − $l_a X$	l_n = 114 − $l_a X$	l_n = 105 − $l_a X$	l_n = 102 − $l_a X$	–	–
7	2 000	l_n = 260 − $l_a X$	l_n = 190 − $l_a X$	l_n = 115 − $l_a X$	l_n = 106 − $l_a X$	l_n = 104 − $l_a X$	l_n = 102 − $l_a X$	–
7_A or 8.2	2 000	l_n = 260 − $l_a X$	l_n = 192 − $l_a X$	l_n = 117 − $l_a X$	l_n = 108 − $l_a X$	l_n = 107 − $l_a X$	l_n = 102 − $l_a X$	l_n = 107 − $l_a X$
l_n is the length of the fixed network access cable (m) l_a is the combined length of patch cords, jumpers and equipment cords (m) X is the ratio of flexible cable insertion loss (dB/m) to fixed network access cable insertion loss (dB/m)								
Where channels contain a different number of connections than in the model shown in Figure 13, the equation is met when the fixed cable length is reduced (where more connections exist) and/or increased (where fewer connections exist) by 2 m per connection for Category 5 connections and 1 m per connection for Category 6 and above connections. Additionally, the NEXT, Return Loss (RL) and ACR-F performance should be verified. Category 5 and Category 6 components and Class A through Class E channels can only be used for network access cabling. For operating temperatures above 20 °C, l_n should be reduced by 0,2 % per °C for screened cables and 0,4 % per °C (20 °C to 40 °C) and 0,6 % per °C (40 °C to 60 °C) for unscreened cables.								
[a] Applications limited by propagation delay or skew are likely not to be supported if channel lengths exceed 100 m.								

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.

Use of transition assemblies, combining optical fibre connecting hardware, as described in 10.3 are described in Annex B.

8.3.2 Component choice

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 Figures 10, 11, 12 and 13 are applicable to optical fibre cabling for zone distribution cabling, cabling between distributors and network access cabling. The channel length is limited by channel length restrictions of the cabled optical fibre Category used, see ISO/IEC 11801-1:2017, Annex E. It should be noted that the connection systems used to terminate fixed optical fibre cabling can contain mated connections and splices (permanent or re-usable) and that cross-connects can comprise re-usable splices.

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 can 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).

9 Cable requirements

9.1 General

Clause 9 defines the minimum requirements for

a) cables installed in cabling between distributors, zone distribution and network access cabling subsystems specified in Clause 5 and used in the reference implementations of Clause 8,

b) flexible balanced cables to be assembled as cords as specified in Clause 11 and used in the reference implementations of Clause 8,

c) balanced cables or cable elements to be used as jumpers.

9.2 Balanced cables

The electrical performance of balanced cables, other than for network access cabling, shall meet a minimum of Category 6_A requirements according to ISO/IEC 11801-1:2017, 9.3.1 and 9.3.2.

9.3 Optical fibre cables

The optical performance of cabled optical fibres shall meet the requirements of ISO/IEC 11801-1:2017, 9.5.

10 Connecting hardware requirements

10.1 General requirements

10.1.1 Overview

See ISO/IEC 11801-1:2017, 10.1.1.

10.1.2 Location

Connecting hardware is installed at the

a) ENI,

b) MD, ID and ZD,

c) LDP (if provided),

d) EO.

10.1.3 Design

See ISO/IEC 11801-1:2017, 10.1.3.

10.1.4 Operating environment

See ISO/IEC 11801-1:2017, 10.1.4.

10.1.5 Mounting

See ISO/IEC 11801-1:2017, 10.1.5.

10.1.6 Installation practices

See ISO/IEC 11801-1:2017, 10.1.6.

10.1.7 Marking and colour coding

See ISO/IEC 11801-1:2017, 10.1.7.

10.2 Connecting hardware for balanced cabling

10.2.1 General requirements

See ISO/IEC 11801-1:2017, 10.2.1.

10.2.2 Performance marking

See ISO/IEC 11801-1:2017, 10.2.2.

10.2.3 Mechanical characteristics

10.2.3.1 Connecting hardware of the type used at the ENI

Balanced cabling connecting hardware shall be in accordance with ISO/IEC 11801-1:2017, 10.6 and 10.7.

10.2.3.2 Connecting hardware of the type used at the EO

Balanced cabling connecting hardware shall be in accordance with ISO/IEC 11801-1:2017, 10.6, as amended by the requirements of Table 8.

Table 8 – Connecting hardware of the type used at the EO

Category	Standard
Category 6_A unscreened	IEC 60603-7-41
Category 6_A screened	IEC 60603-7-51
Category 7 screened	IEC 60603-7-7[a]
Category 7_A screened	IEC 60603-7-71[a]
Category 8.1 screened	IEC 60603-7-81
Category 8.2 screened	IEC 60603-7-82[a]

[a] In installations where other factors such as cable sharing take preference over backwards compatibility offered by the IEC 60603-7-7 and IEC 60603-7-71 interface, the interface specified in IEC 61076-3-104 can be used.

10.2.3.3 Pin and pair assignments at the EO

See ISO/IEC 11801-1:2017, 10.6 and 10.7.

Pair rearrangement should not involve modification of the cable terminations. If pair rearrangement is used, the configuration of the terminations shall be clearly identified.

When two physically similar cabling links are used in the same installation (for example, different performance categories and cables with different nominal impedance), special precautions are required to ensure that they are identified.

If the connecting hardware types at a distributor, LDP or EO in the same link or channel are different from each other, the cabling connections shall be configured with consistent pin/pair assignments to ensure end-to-end connectivity. Pair rearrangement at the equipment outlet should not involve modification of the horizontal cable terminations.

10.2.3.4 Electrical characteristics

10.2.3.4.1 ENI and EO requirements

See ISO/IEC 11801-1:2017, 10.6.

Free and fixed connectors (plugs and jacks) that are intermateable shall be backwards compatible with those of different performance categories. Backwards compatibility means that mated connections with free and fixed connectors (plugs and jacks) from different categories shall meet all of the requirements for the lower Category component. See ISO/IEC 11801-1:2017, Clause 10.

10.2.3.4.2 Other connecting hardware

Connecting hardware for use in distributors and LDPs of a given Category shall meet the corresponding performance requirements specified in ISO/IEC 11801-1:2017, 10.2.4.

When creating a Class F_A configuration PL3 link, see ISO/IEC 11801-1:2017, 10.2.5.1.

10.3 Connecting hardware for optical fibre cabling

10.3.1 General requirements

See ISO/IEC 11801-1:2017, 10.5.

10.3.2 ENI requirements

For single-mode optical fibre, the interface shall be IEC 61754-20 (the LC interface). It shall have a minimum return loss performance of 55 dB provided by an angled face connection, in accordance with IEC 61755-3-2.

The interface at the other end of the network access cabling permanent link should have a minimum return loss performance of 55 dB.

For the termination of one or two multimode optical fibres, the interface shall be IEC 61754-20 (the LC interface). It shall have a minimum return loss performance of 20 dB.

10.3.3 EO requirements

For the termination of one or two single-mode optical fibres, the interface shall be IEC 61754-20 (the LC interface).

For the termination of one or two multimode optical fibres, the interface shall be IEC 61754-20 (the LC interface).

For the termination of more than two optical fibres in rows of up to twelve optical fibres, the interface shall be of an MPO type in accordance with IEC 61754-7-1 (one row) or IEC 61754-7-2 (two rows of twelve fibres).

10.3.4 Optical fibre assignments at the EO

For the optical fibre connecting hardware in 10.3.3, the optical fibre assignments shall be as shown in ISO/IEC 11801-1:2017, Figure 15 (duplex adapter) and Figure 16.

Polarity of optical fibres should be identified at the EO by means of any combination of latching, keying or labelling.

10.3.5 Connecting hardware at other locations

See ISO/IEC 11801-1:2017, 10.5.

11 Requirements for cords and jumpers

11.1 Jumpers

See Clause 9.

11.2 Balanced cords

See ISO/IEC 11801-1:2017, 11.1, 11.2 and 11.3.

Factory terminated balanced cords should be used.

11.3 Optical fibre cords

See ISO/IEC 11801-1:2017, 11.5.

Annex A
(normative)

Combination of balanced cabling links

A.1 General

Typical lengths of balanced links within the data centre allow for combination of two or more links to form one transmission channel conforming to the channel requirements, as specified in 6.3. Examples of link combinations are shown in Figure A.1.

A.2 Requirements

The length of the combined links, including its patch cords and equipment cords at both ends, shall not exceed

a) 100 m for Classes E_A, F and F_A constructed using Category 6_A, 7 and 7_A, respectively,

b) 30 m for Classes I and II constructed using Category 8.1 and 8.2, respectively.

Channel lengths for Classes A through E can be based upon the backbone implementations of ISO/IEC 11801-1:2017, Table 84.

Channel performance in accordance with Clause 6 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.

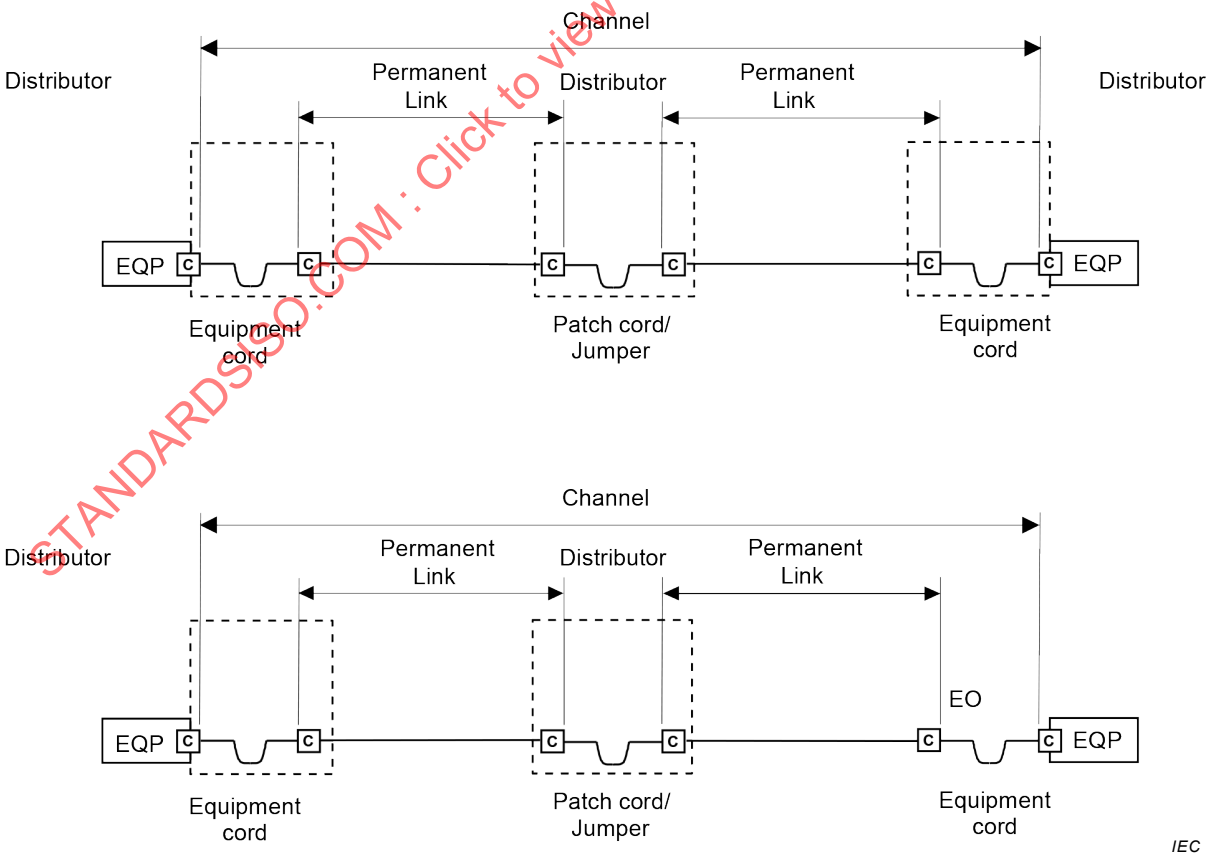


Figure A.1 – Examples of combination of different links

Annex B
(informative)

Usage of high density connecting hardware within optical fibre cabling

B.1 General

For the purposes of Annex B, the term “high density connecting hardware” refers to optical fibre connecting hardware that provides interconnection

a) of multi-element cabling (more than two optical fibres),

b) at a greater density than is possible using groups of the duplex optical fibre interface as specified at the EO (see Clause 10),

c) through a transition assembly, or a fan-out cord.

High density connecting hardware can be required in the following locations:

1) interfaces to switch blades for high density switches,

2) interfaces to equipment using parallel optical sources and detectors,

3) one or both ends of equipment cords at distributors,

4) one or both ends of patch cords at distributors,

5) LDPs,

6) interfaces that replace duplex EO connectors.

High density connecting hardware can be used as replacement or in combination with the duplex interface specified in Clause 10. Information regarding polarity maintenance is provided in ISO/IEC 14763-2.

Using connecting hardware that is minimally compliant with the performance specified in ISO/IEC 11801-1 limits the number of connections within the channel to two where the channels are of maximum length. The use of connecting hardware having attenuation performance that exceeds the requirements of ISO/IEC 11801-1 and/or the implementation of shorter channels can allow the required channel performance to be achieved using additional connections and splices. Figure B.1 and Figure B.2 show a number of implementations that include more than two connections.

B.2 Use cases for high density connecting hardware

Examples of high density connecting hardware within cabling subsystems in accordance with Clause 5 are shown in Figure B.1 and Figure B.2.

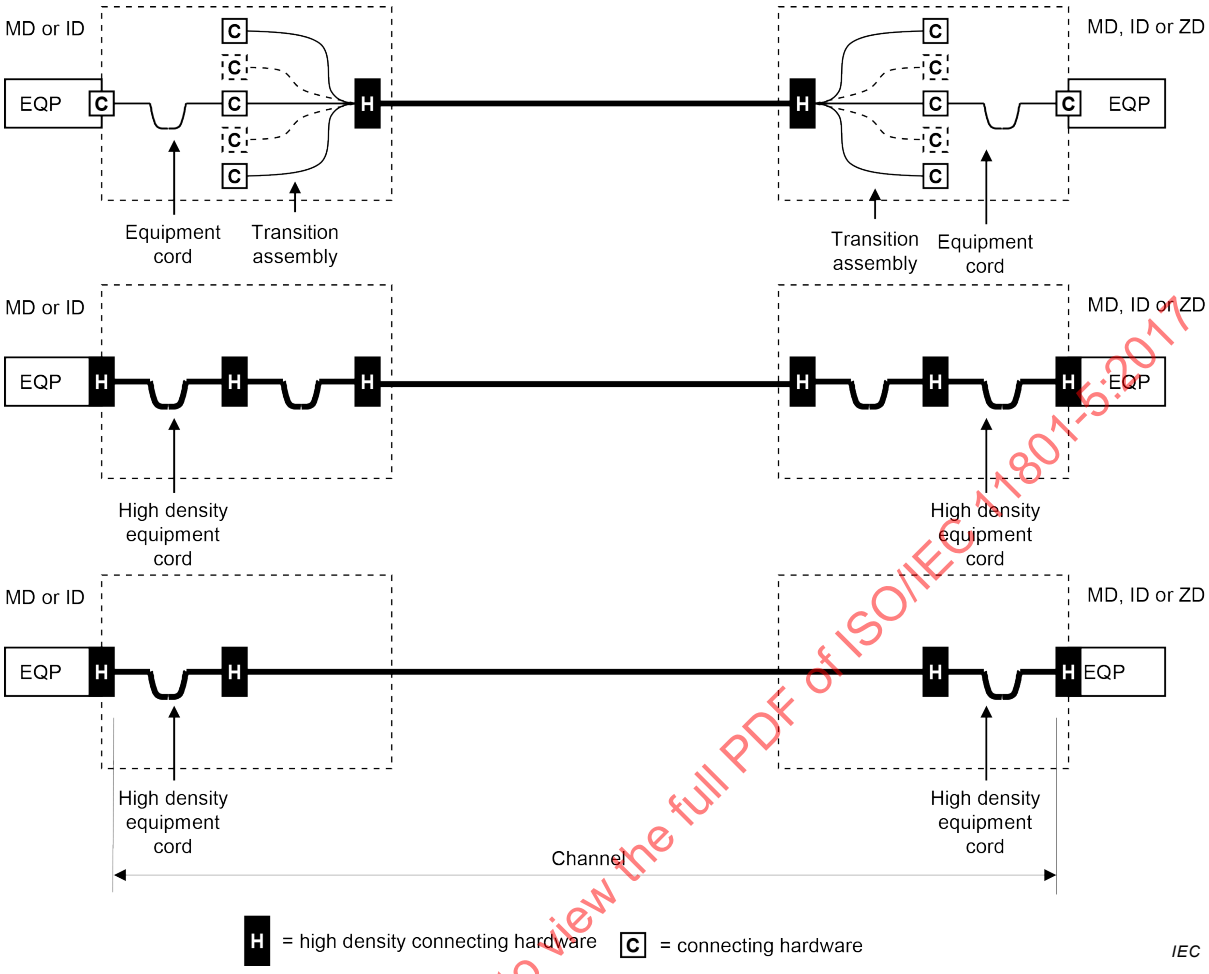
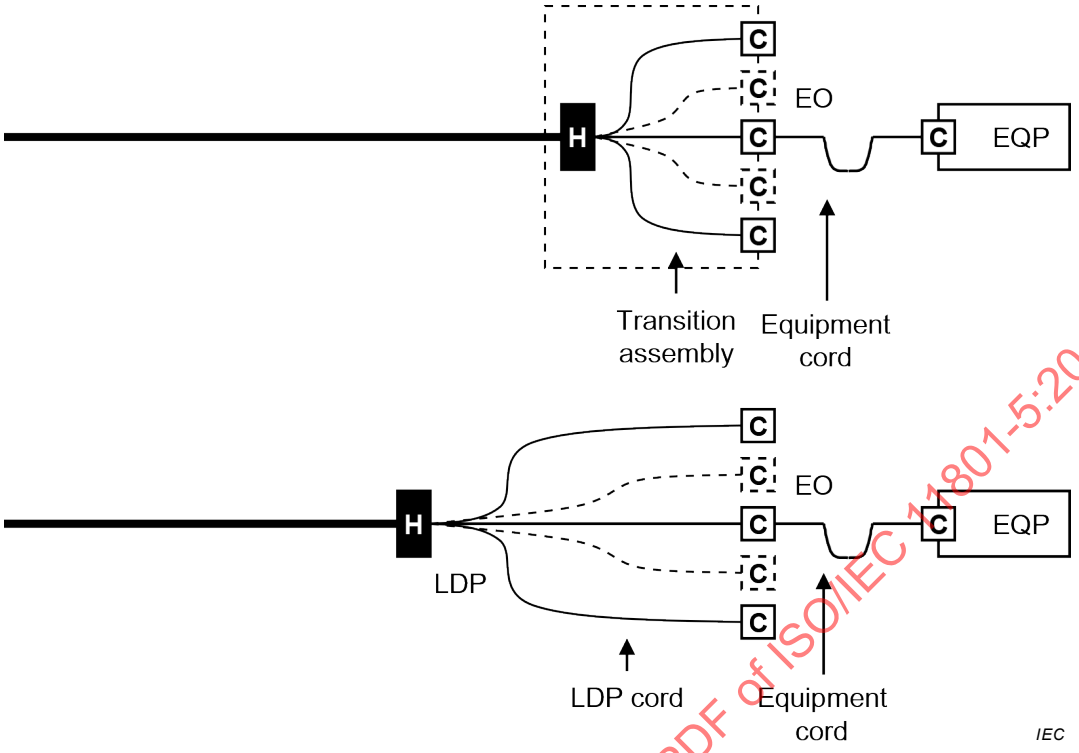


Figure B.1 – Examples of high density connecting hardware within main distribution cabling and intermediate distribution cabling



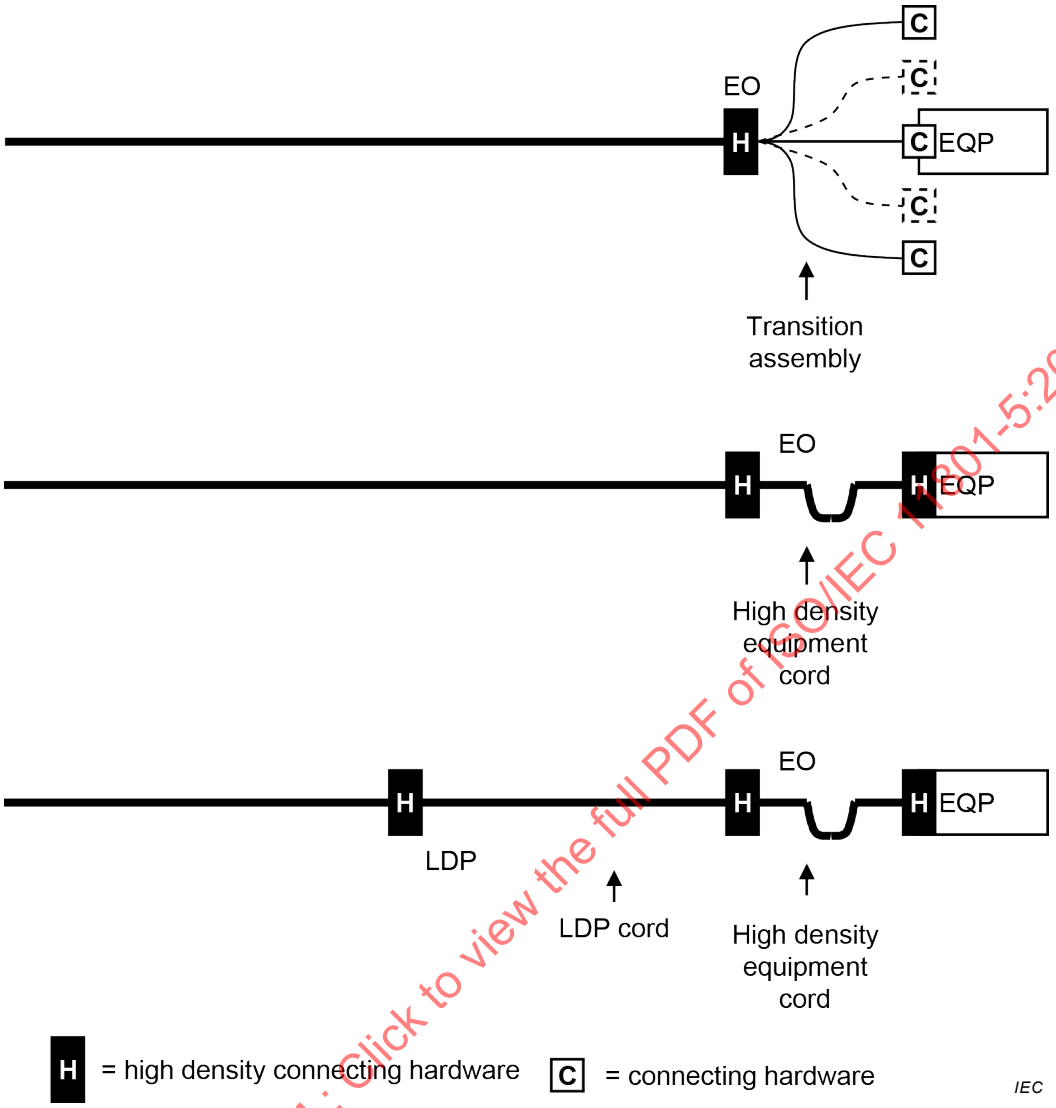


Figure B.2 – Examples of high density connecting hardware at the LDP and EO within zone distribution cabling

Annex C
(informative)

Examples of structures in accordance with ISO/IEC 11801-5

C.1 General

Typical data centre designs involve different design concepts, which might be difficult to relate to the structures within this document. Annex C describes cabling design concepts and uses terms which are often used in descriptions of functions.

Within Annex C, a series of concepts are described mainly by the use of figures. Figure C.1 provides a key to aid the understanding of these figures.

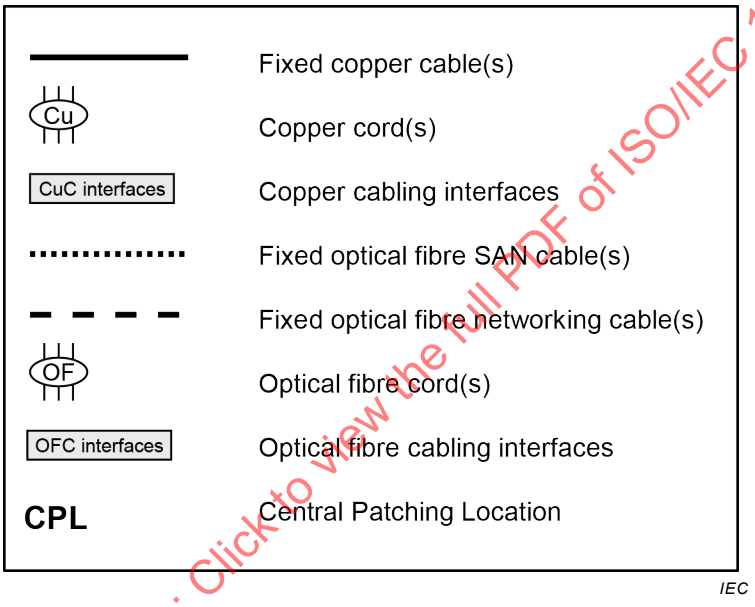


Figure C.1 – Key for Figures C.2 through C.9

C.2 Data centre minimum configuration

A data centre consisting of one distributor serving one rack of servers and one rack of storage would often utilize direct connect patch cords, although this is not recommended by this document. The structure contains no structured cabling, but a portion of marked patch cords or direct-attach cables, which serves as the telecommunications cabling.

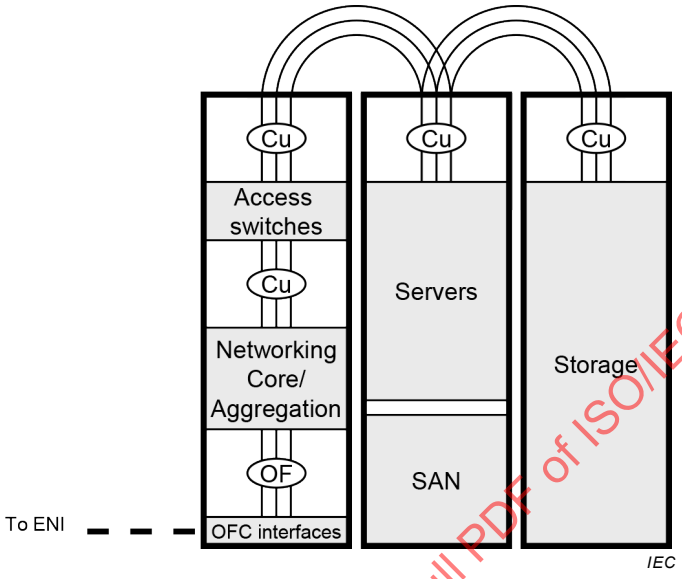


Figure C.2 – Example of a minimum configuration

C.3 End of Row concept

An End of Row (EoR) topology is a cabling concept where cabling is distributed from the main distributor or intermediate distributor to the zone distributor which is located at the end of a row of equipment cabinets. Equipment outlets are located in patch panels typically either at the top or bottom of server or storage cabinets. The example in Figure C.3 shows balanced copper cabling EOs placed in the top of cabinets and optical fibre EO placed in the bottom of the cabinets.

Balanced copper cabling is used from the zone distributor to the EOs and optical fibre cabling is used from the main distributor or the intermediate distributor to the zone distributor and the EOs.

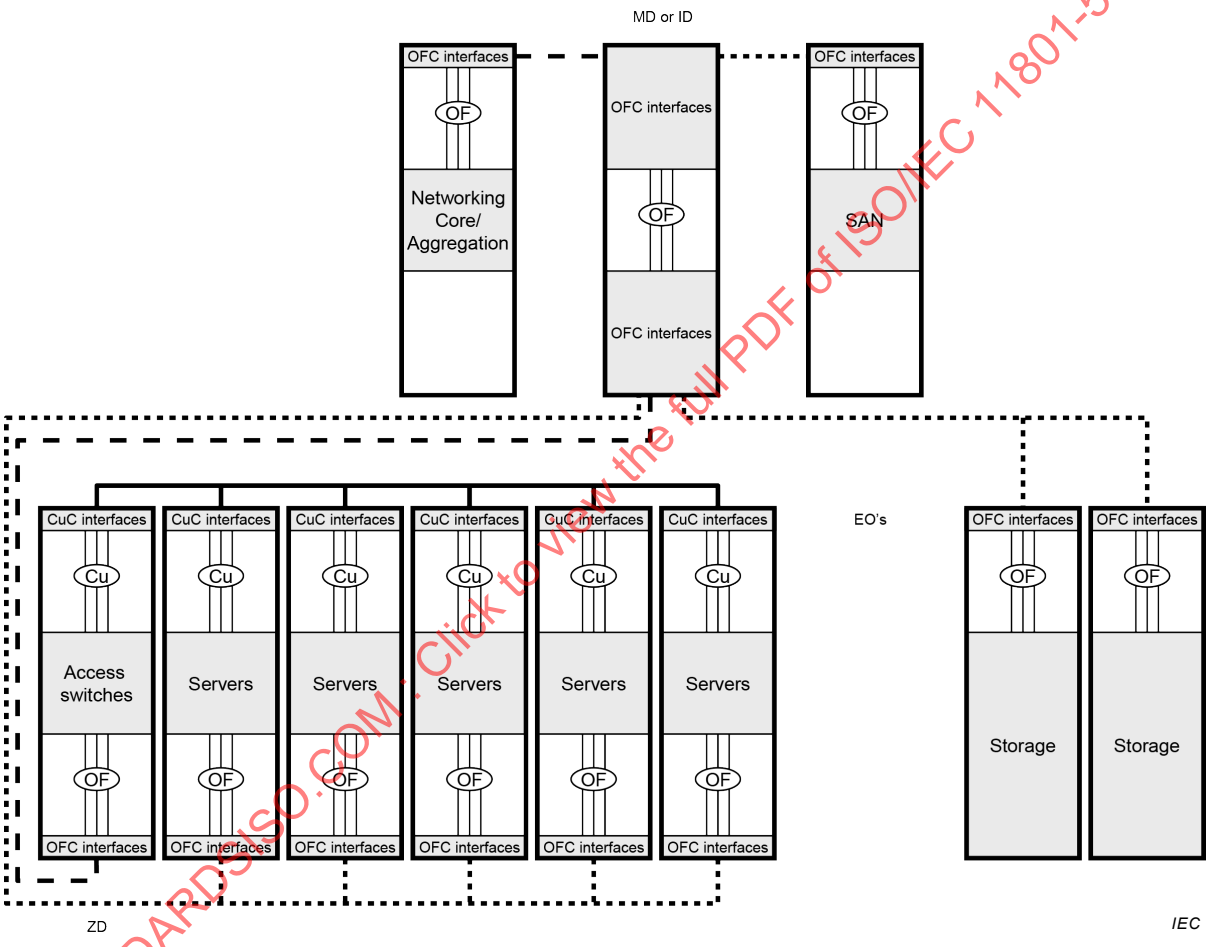


Figure C.3 – Example of End of Row configuration

C.4 Middle of Row concept

A Middle of Row (MoR) topology is a cabling concept where cabling is distributed from the main distributor or intermediate distributor to the zone distributor which is located in the middle of a row of equipment cabinets. Equipment outlets are located in patch panels either in the top or bottom of server or storage cabinets. The example in Figure C.4 shows balanced copper cabling EOs placed in the top of cabinets and optical fibre EO placed in the bottom of the cabinets.

Balanced copper cabling is used from the zone distributor to the EOs and optical fibre cabling is used from the main distributor or the intermediate distributor to the zone distributor and the EOs.

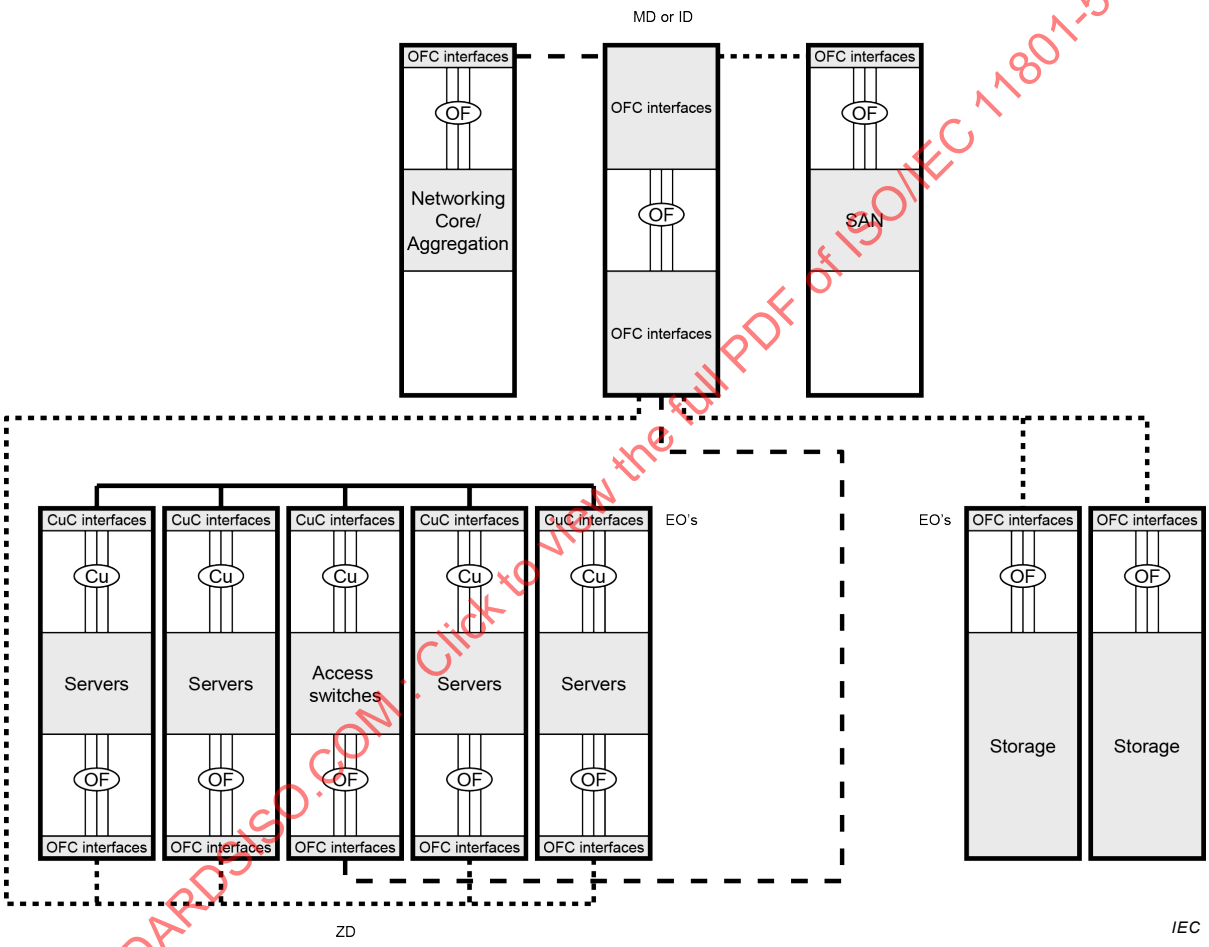


Figure C.4 – Example of Middle of Row configuration

C.5 Top of Rack concept

A Top of Rack (ToR) topology is a cabling concept where cabling is distributed from the main distributor or intermediate distributor to equipment cabinets containing EOs which are located in patch panels typically either at the top or bottom of server or storage cabinets. The example in Figure C.5 shows networking optical fibre cabling EOs placed in the top of cabinets and SAN optical fibre EOs placed in the bottom of the cabinets.

Balanced copper cabling is used from EOs to the equipment and optical fibre cabling is used from the main distributor or the intermediate distributor to the EOs.

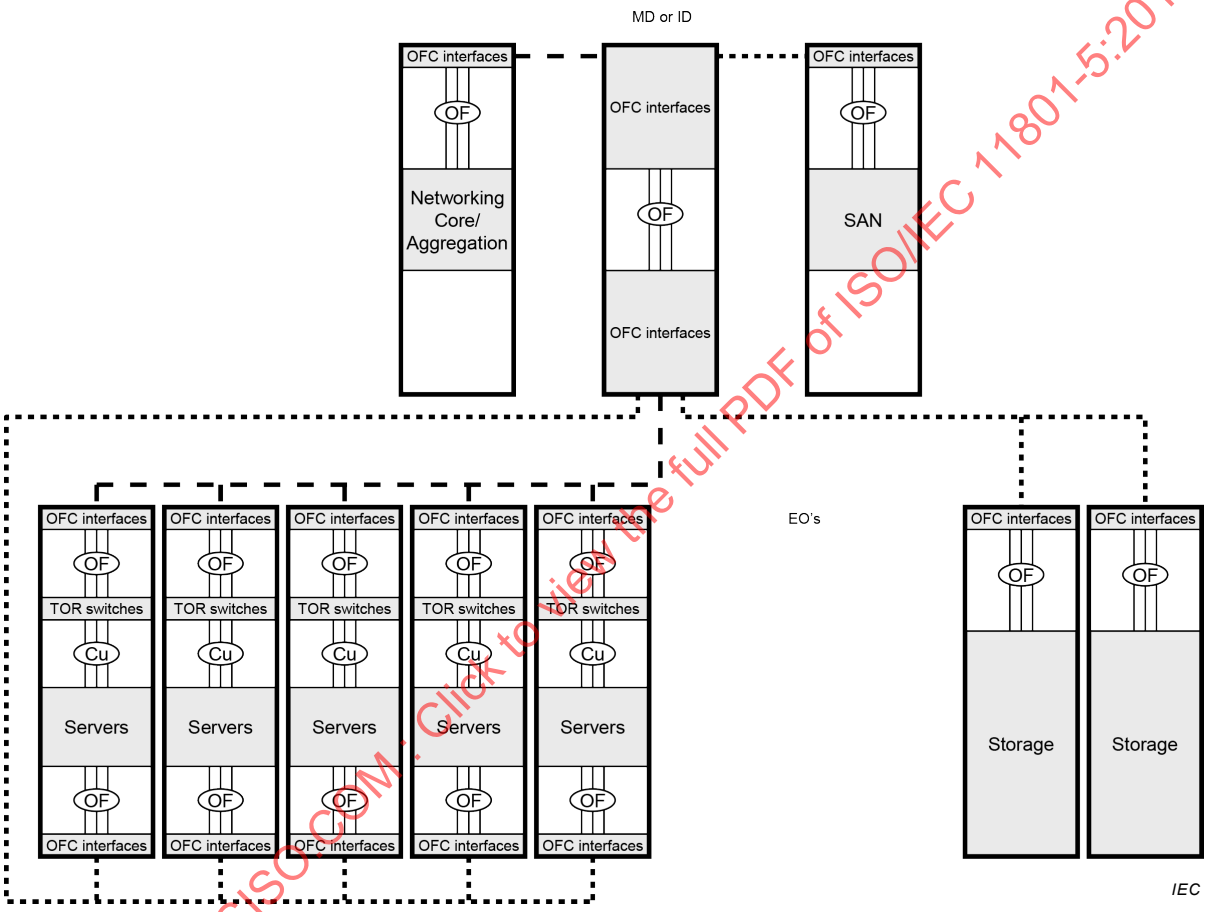


Figure C.5 – Example of Top of Rack configuration