



BSI Standards Publication

Industrial communication networks - Installation of communication networks in industrial premises

National foreword

This British Standard is the UK implementation of EN IEC 61918:2018+A11:2019, incorporating corrigendum March 2019. It is derived from IEC 61918:2018. It supersedes BS EN IEC 61918:2018, which will be withdrawn on 3 April 2022.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to text carry the number of the CENELEC amendment. For example, text altered by CENELEC amendment A11 is indicated by A11 A11.

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A list of organizations represented on this committee can be obtained on request to its secretary.

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Date	Text affected
31 March 2019	Implementation of CENELEC corrigendum March 2019: dop modified in European foreword
30 November 2019	Implementation of CENELEC amendment A11:2019

English Version

**Industrial communication networks - Installation of
communication networks in industrial premises
(IEC 61918:2018)**

Réseaux de communication industriels - Installation de
réseaux de communication dans des locaux industriels
(IEC 61918:2018)

Industrielle Kommunikationsnetze - Installation von
Kommunikationsnetzen in Industrieanlagen
(IEC 61918:2018)

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European foreword

The text of document 65C/928/FDIS, future edition 4 of IEC 61918, prepared by SC 65C "Industrial networks" of IEC/TC 65 "Industrial-process measurement, control and automation" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 61918:2018.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2019-12-25
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2021-10-25

This document supersedes EN 61918:2013.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

A11 EN IEC 61918:2018 includes the following significant technical changes with respect to EN 61918:2013:

- a) the reference to ISO/IEC 24702 has been replaced with reference to the new ISO/IEC 11801-3; this affects Table 2;
- b) some terms and abbreviated terms have been modified in Clause 3;
- c) Subclauses 4.1.2, 4.4.2.5, 4.4.3.4.1 and 5.7 have been updated;
- d) Figure 2 and Figure 3 have been updated; Figure 13, Figure 16, Figure 30 and Figure 49 have been added;
- e) Table 7 has been updated;
- f) Annex D and Annex M have been extended to cover additional communication profile families; Annex H has been extended to cover the M12-8 X-coding connector use;
- g) Annex O has been modified by including references to the new edition of the EN 50173 series, ISO/IEC TR 11801-9902 and ISO/IEC 14763-4;
- h) Annex P has been added.

This standard is to be used in conjunction with the EN 61784-5 series with regard to the installation of communication profiles (CPs).

Those standards of the EN 61784-5 series which are still specified for use in conjunction with EN 61918:2013 can also be used in conjunction with this edition, provided that the user takes into account the fact that the reference to ISO/IEC 24702 has been replaced with a reference to EN 50173-3.

NOTE This solution applies for the Installation profiles that are affected only by this modified reference.

This standard is referenced by EN 50174, in particular by EN 50174-2, which covers installation of generic cabling outside the automation islands in industrial premises. **A11**

Endorsement notice

The text of the International Standard IEC 61918:2018 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60060-1	NOTE	Harmonized as EN 60060-1
IEC 60079-11:2011	NOTE	Harmonized as EN 60079-11:2012 (not modified)
IEC 60079-14	NOTE	Harmonized as EN 60079-14
IEC 60228	NOTE	Harmonized as EN 60228
IEC 60332-1 (series)	NOTE	Harmonised as EN 60332-1 (series)
IEC 60364 (series)	NOTE	Harmonised as HD 60364 (series)
IEC 60512-4 (series)	NOTE	Harmonised as EN 60512-4 (series)
IEC 60529	NOTE	Harmonized as EN 60529
IEC 60664-1	NOTE	Harmonized as EN 60664-1
IEC 60670-1:2015	NOTE	Harmonized as EN IEC 60670-1:— ¹ (not modified)
IEC 60950-21	NOTE	Harmonized as EN 60950-21
IEC 61000-4-4	NOTE	Harmonized as EN 61000-4-4
IEC 61000-6-2	NOTE	Harmonized as EN 61000-6-2
IEC 61000-6-4	NOTE	Harmonized as EN 61000-6-4
IEC 61010-2-201	NOTE	Harmonized as EN IEC 61010-2-201
IEC 61131-2:2017	NOTE	Harmonized as EN 61131-2:— ² (not modified)
IEC 61158-1	NOTE	Harmonized as EN 61158-1
IEC 61508-4	NOTE	Harmonized as EN 61508-4
IEC 61984:2008	NOTE	Harmonized as EN 61984:2009 (not modified)
IEC 62026-3	NOTE	Harmonized as EN 62026-3

¹ Under preparation. Stage at the time of publication: prEN IEC 60670-1

² Under preparation. Stage at the time of publication: FprEN 61131-2:2017

Foreword to amendment A11

This document (EN IEC 61918:2018/A11:2019) has been prepared by CLC/TC 65X “Industrial-process measurement, control and automation”.

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to be implemented at national level by
publication of an identical national
standard or by endorsement
- latest date by which the national (dow) 2022-04-03
standards conflicting with this document
have to be withdrawn

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Annex ZA

(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60364-1 (mod)	2005	Low-voltage electrical installations - Part 1: Fundamental principles, assessment of general characteristics, definitions	HD 60364-1	2008
-	-		+ A11	2017
IEC 60364-4-41	-	Low-voltage electrical installations - Part 4-41: Protection for safety - Protection against electric shock	HD 60364-4-41	-
IEC 60364-4-44	-	Low-voltage electrical installations - Part 4-44: Protection for safety - Protection against voltage disturbances and electromagnetic disturbances	HD 60364-4-442	-
IEC 60364-5-54	-	Low-voltage electrical installations - Part 5-54: Selection and erection of electrical equipment - Earthing arrangements and protective conductors	HD 60364-5-54	-
IEC 60512-29-100	-	Connectors for electronic equipment - Tests and measurements - Part 29-100: Signal integrity tests up to 500 MHz on M12 style connectors - Tests 29a to 29g	EN 60512-29-100	-
IEC 60603	series	Connectors for frequencies below 3 MHz for use with printed boards	-	series
IEC 60603-7	series	Connectors for electronic equipment - Part 7: Detail specification for 8-way, shielded, free and fixed connectors	EN 60603-7	series
IEC 60757	-	Code for designation of colours	HD 457 S1	-
IEC 60793	series	Optical fibres	-	series
IEC 60793-2-10	-	Optical fibres - Part 2-10: Product specifications - Sectional specification for category A1 multimode fibres	EN 60793-2-10	-

IEC 60794	series	Optical fibres cables	EN 60794	series
IEC 60807-2	-	Rectangular connectors for frequencies below 3 MHz - Part 2: Detail specification for a range of connectors, with assessed quality, with trapezoidal shaped metal shells and round contacts - Fixed solder contact types	-	-
IEC 60807-3	-	Rectangular connectors for frequencies below 3 MHz - Part 3: Detail specification for a range of connectors with trapezoidal shaped metal shells and round contacts - Removable crimp contact types with closed crimp barrels, rear insertion/rear extraction	-	-
IEC 60825-2	-	Safety of laser products - Part 2: Safety of optical fibre communication systems (OFCS)	EN 60825-2	-
IEC 60950-1	-	Information technology equipment - Safety - Part 1: General requirements	EN 60950-1	-
IEC 61076-2-101	-	Connectors for electronic equipment - Product requirements - Part 2-101: Circular connectors - Detail specification for M12 connectors with screw-locking	EN 61076-2-101	-
IEC 61076-2-109	-	Connectors for electronic equipment - Product requirements - Part 2-109: Circular connectors - Detail specification for connectors with M 12 x 1 screw-locking, for data transmission frequencies up to 500 MHz	EN 61076-2-109	-
IEC 61076-3-106	-	Connectors for electronic equipment - Product requirements - Part 3-106: Rectangular connectors - Detail specification for protective housings for use with 8-way shielded and unshielded connectors for industrial environments incorporating the IEC 60603-7 series interface	EN 61076-3-106	-
IEC 61076-3-117	-	Connectors for electronic equipment - Product requirements - Part 3-117: Rectangular connectors - Detail specification for protective housings for use with 8-way shielded and unshielded connectors for industrial environments incorporating the IEC 60603-7 series interface - Variant 14 related to IEC 61076-3-106 - Push-pull coupling	EN 61076-3-117	-
IEC 61156	series	Multicore and symmetrical pair/quad cables for digital communications	-	-
IEC 61158	series	Industrial communication networks - Fieldbus specifications	EN 61158	series
IEC 61158-2	2014	Industrial communication networks - Fieldbus specifications - Part 2: Physical layer specification and service definition	EN 61158-2	2014
IEC 61169-8	-	Radio-frequency connectors - Part 8: Sectional specification - RF coaxial connectors with inner diameter of outer conductor 6,5 mm (0,256 in) with bayonet lock - Characteristic impedance 50 ohms (type BNC)	EN 61169-8	-

EN IEC 61918:2018+A11:2019 (E)

IEC 61753	series	Fibre optic interconnecting devices and passive components - Performance standard	EN 61753	series
IEC 61753-1	-	Fibre optic interconnecting devices and passive components - Performance standard - Part 1: General and guidance	EN IEC 61753-1	-
IEC 61753-1-3	-	Fibre optic interconnecting devices and passive components - Performance standard - Part 1-3: General and guidance for single-mode fibre optic connector and cable assembly for industrial environment, Category I	EN 61753-1-3	-
IEC 61754-2	-	Fibre optic connector interfaces - Part 2: Type BFOC/2,5 connector family	EN 61754-2	-
IEC 61754-4	-	Fibre optic interconnecting devices and passive components - Fibre optic connector interfaces - Part 4: Type SC connector family	EN 61754-4	-
IEC 61754-20	-	Fibre optic interconnecting devices and passive components - Fibre optic connector interfaces - Part 20: Type LC connector family	EN 61754-20	-
IEC 61754-22	-	Fibre optic connector interfaces - Part 22: Type F-SMA connector family	EN 61754-22	-
IEC 61754-24	-	Fibre optic interconnecting devices and passive components - Fibre optic connector interfaces - Part 24: Type SC-RJ connector family	EN 61754-24	-
IEC 61784	series	Industrial communication networks - Profiles	EN 61784	series
IEC 61784-1 ³	-	Industrial communication networks - Profiles - Part 1: Fieldbus profiles	-	-
IEC 61784-2 ⁴	-	Industrial communication networks - Profiles - Part 2: Additional fieldbus profiles for real-time networks based on ISO/IEC 8802-3	-	-
IEC 61784-3	series	Industrial communication networks - Profiles - Part 3: Functional safety fieldbuses - General rules and profile definitions	EN 61784-3	series
IEC 61784-5	series	Industrial communication networks - Profiles - Part 5: Installation of fieldbuses	EN 61784-5	series
IEC 61935-1	2015	Specification for the testing of balanced and coaxial information technology cabling - Part 1: Installed balanced cabling as specified in ISO/IEC 11801 and related standards	-	-
IEC 61935-2	-	Specification for the testing of balanced and coaxial information technology cabling - Part 2: Cords as specified in ISO/IEC 11801 and related standards	EN 61935-2	-
IEC 62439	series	Industrial communication networks - High availability automation networks	-	-

³ Under preparation. Stage at the time of publication: IEC/FDIS 61784-1:2018

⁴ Under preparation. Stage at the time of publication: IEC/FDIS 61784-2:2018

IEC 62443	series	Security for industrial automation and control systems	EN IEC 62443	series
IEC 62708	-	Documents kinds for electrical and instrumentation projects in the process industry	EN 62708	-
ISO/IEC 8802-3	-	Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements - Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications	-	-
ISO/IEC 11801	series	Information technology - Generic cabling for customer premises	-	-
ISO/IEC 11801-1	2017	Information technology - Generic cabling for customer premises - Part 1: General requirements	-	-
ISO/IEC 11801-3	2017	Information technology - Generic cabling for customer premises - Part 3: Industrial premises	-	-
ISO/IEC TR 11801-9902	2017	Information technology - Generic cabling for customer premises - Part 9902: Specifications for End-to-end link configurations	-	-
ISO/IEC 14763-2	2012	Information technology - Implementation and operation of customer premises cabling - Part 2: Planning and installation	-	-
+A1	2015		-	-
ISO/IEC 14763-3	2014	Information technology - Implementation and operation of customer premises cabling - Part 3: Testing of optical fibre cabling	-	-
ISO/IEC 14763-4	2018	Information technology - Implementation and operation of customer premises cabling - Part 4: Measurement of end-to-end (E2E)-Links	-	-
ISO/IEC TS 29125	2017	Information Technology - Telecommunications cabling requirements for remote powering of terminal equipment	-	-
EN 50174-2	-	Information technology - Cabling installation - Part 2: Installation planning and practices inside buildings	EN 50174-2	-
EN 50310	-	Application of Equipotential Bonding and Earthing in Buildings with Information Technology Equipment	EN 50310	-
IEEE Std 802.3	2015	IEEE Standard for Ethernet	-	-
ANSI/(NFPA) T3.5.29 R1	2007	Fluid power systems and components - Electrically-controlled industrial valves - Interface dimensions for electrical connectors	-	-

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

INDUSTRIAL COMMUNICATION NETWORKS –**Installation of communication networks in industrial premises****FOREWORD**

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International Standard IEC 61918 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

This fourth edition cancels and replaces the third edition published in 2013. This edition constitutes a technical revision.

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

- a) the reference to ISO/IEC 24702 has been replaced with reference to the new ISO/IEC 11801-3; this affects Table 2;
- b) some terms and abbreviated terms have been modified in Clause 3;
- c) Subclauses 4.1.2, 4.4.2.5, 4.4.3.4.1 and 5.7 have been updated;
- d) Figure 2 and Figure 3 have been updated; Figure 13, Figure 16, Figure 30 and Figure 49 have been added;

- e) Table 7 has been updated;
- f) Annex D and Annex M have been extended to cover additional communication profile families; Annex H has been extended to cover the M12-8 X-coding connector use;
- g) Annex O has been modified by including references to the new edition of the ISO/IEC 11801 series, ISO/IEC TR 11801-9902 and ISO/IEC 14763-4;
- h) Annex P has been added.

This standard is to be used in conjunction with the IEC 61784-5 series with regard to the installation of communication profiles (CPs).

Those standards of the IEC 61784-5 series which are still specified for use in conjunction with IEC 61918:2013 can also be used in conjunction with this edition, provided that the user takes into account the fact that the reference to ISO/IEC 24702 has been replaced with a reference to ISO/IEC 11801-3:2017.

NOTE This solution applies for the installation profiles that are affected only by this modified reference.

This standard is referenced by ISO/IEC 14763-2, which covers installation of generic cabling outside the automation islands in industrial premises.

This standard was developed in cooperation with ISO/IEC JTC1/SC25 which is responsible for the ISO/IEC 11801 series.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
65C/928/FDIS	65C/933/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

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

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

Process and factory automation rely increasingly on communication networks and fieldbuses that are inherently designed to cope with the specific environmental conditions of the industrial premises. The networks and fieldbuses provide for an effective integration of applications among the several functional units of the plant/factory. One of the benefits of integrating field-generated data with higher-level management systems is to reduce production costs. At the same time, integrated data helps to maintain or even increase the quantity and quality of production. A correct network installation is an important prerequisite for communications availability, reliability, and performance. This requires proper consideration of safety and security conditions and environmental aspects such as mechanical, liquid, particulate, climatic, chemicals and electromagnetic interference.

The specifications of these communication networks are provided in the following documents.

ISO/IEC 11801-3 specifies design of generic telecommunications infrastructures within industrial premises and provides the foundations for some of the transmission performance specifications of this document. ISO/IEC 11801-3 specifies only the raw bandwidth capability of a channel; it does not specify useful data transfer rate for a specific network using that channel or expected errors after taking account of interference during the communication process, as is needed for industrial automation.

The IEC 61158 fieldbus standard and IEC 62026-3 and their companion standard IEC 61784-1 and IEC 61784-2 jointly specify several Communication Profiles (CPs) suitable for industrial automation. These CPs specify a raw bandwidth capability and in addition, they specify bit modulation and encoding rules for their fieldbus. Some profiles also specify target levels for useful data transfer rate, and maximum values for errors caused by interference during the communication process.

This document provides a common point of reference for the installation of the media of most used industrial communication networks for most industrial sites.

This document provides a consistent set of installation rules for industrial automation islands where control applications reside. In addition, it offers support for the definition and installation of the interfaces between automation island networks and generic cabling.

One of the problems it seeks to solve is the situation created when different parts of a large automation site are provided by suppliers that use non-homogeneous installation guidelines having different structures and contents. This lack of consistency greatly increases the potential for errors and mismatch situations liable to compromise the communication system.

This document was developed by harmonising the approaches of several user groups and industrial consortia.

The document covers the life cycle of an installation in the following clauses (see the map of the document in Figure 1):

- Clause 4: Installation planning;
- Clause 5: Installation implementation;
- Clause 6: Installation verification and acceptance test;
- Clause 7: Installation administration;
- Clause 8: Installation maintenance and installation troubleshooting.

The methods described in these clauses are written in such a way as to provide installation guidance for a wide range of technician skills.

IEC 61918 Installation lifecycle

V2.0 /REL

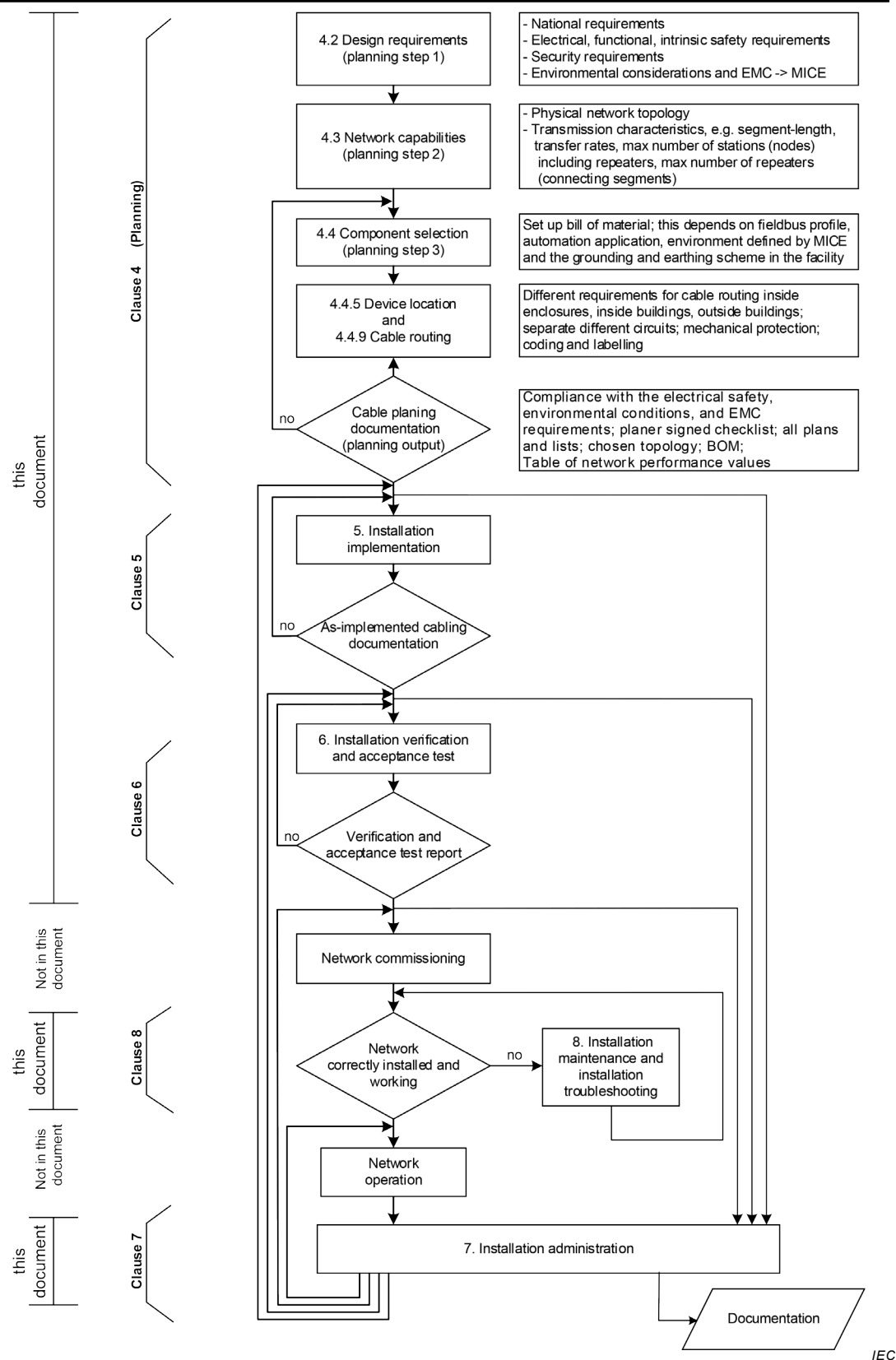


Figure 1 – Industrial network installation life cycle

The installation of a communication system is supported by this document used in conjunction with the relevant installation profile. The installation profile establishes the technology specific

requirements in terms of which requirements apply as they are in this document, or which have been extended, modified, or replaced.

For the fieldbuses that are defined in the IEC 61784 (all parts) as communication profiles (CPs) of the communication profile families (CPF), the installation is specified in the installation profiles that are available in the IEC 61784-5-n documents, where n is the CPF number.

IEC 61158-1 describes the relationship between the fieldbus and the CPs and the relevant installation profiles (see Figure 2).

Those documents of IEC 61784-5 (all parts) that are still specified for use in conjunction with IEC 61918:2013 can also be used in conjunction with this edition 2018, provided that the user takes into account the fact that the reference to ISO/IEC 24702 has been replaced with a reference to ISO/IEC 11801-3:2017.

NOTE This solution applies for the Installation profiles that are affected only by this modified reference

A11 For the installation of generic cabling in industrial premises, EN IEC 61918 is to be used in conjunction with EN 50174 series, in particular by EN 50174-2 (see Figure 2). **A11**

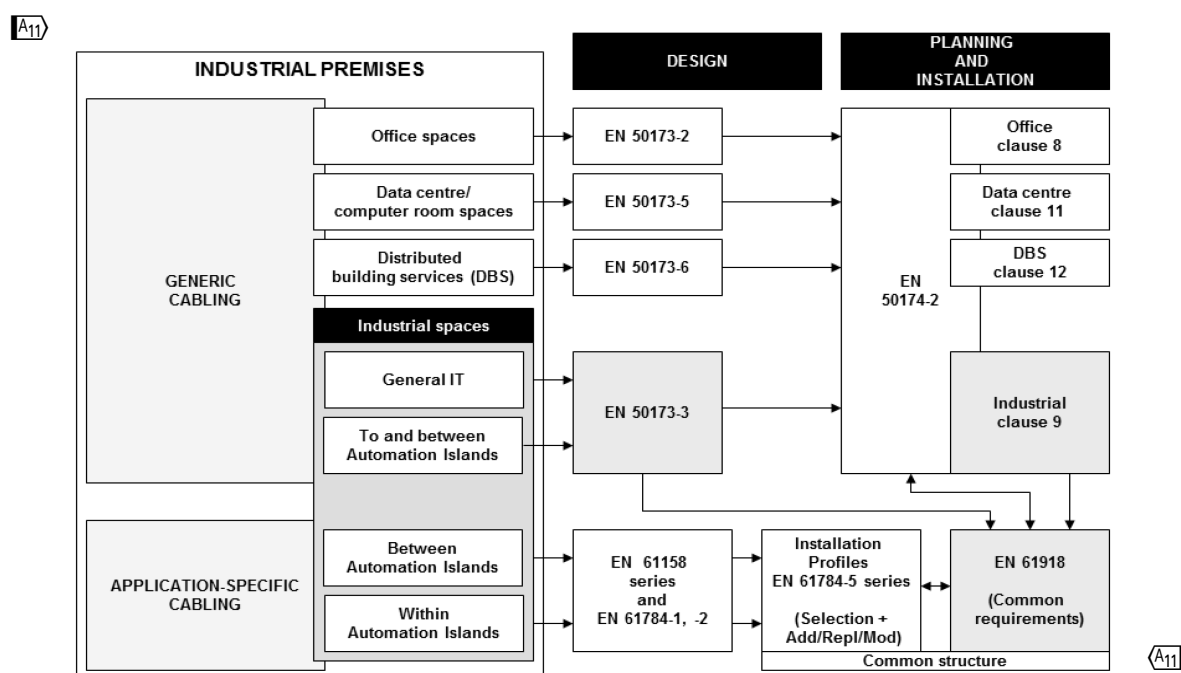


Figure 2 – Standards relationships

One of the advantages of this structure is that the users of a network know which installation requirements are common to most networks and which are specific to a particular network.

Every single plant/factory has its own installation needs in accordance with the specific critical conditions that apply to the specific application. This document and its companion standards described above provide a set of mandatory installation requirements ("shalls") and a number of recommendations ("shoulds"). It is up to the owner of the specific industrial enterprise to explicitly request that the cabling installation be implemented in accordance with these standards and to list all recommendations that shall be considered as mandatory requirements for the specific case.

INDUSTRIAL COMMUNICATION NETWORKS –

Installation of communication networks in industrial premises

1 Scope

This document specifies basic requirements for the installation of media for communication networks within and between the automation islands, of industrial sites. This document covers balanced and optical fibre cabling. It also covers the cabling infrastructure for wireless media, but not the wireless media itself. Additional media are covered in IEC 61784-5 (all parts).

This document is a companion standard to the communication networks of the industrial automation islands and especially to the communication networks specified in IEC 61158 (all parts) and IEC 61784 (all parts).

In addition, this document covers the connection between the generic telecommunications cabling specified in ISO/IEC 11801-3 and the specific communication cabling of an automation island, where an automation outlet (AO) replaces the telecommunication outlet (TO) of ISO/IEC 11801-3.

NOTE If the interface used at the AO does not conform to that specified for the TO of ISO/IEC 11801-3, the cabling no longer conforms to ISO/IEC 11801-3 although certain features, including performance, of generic cabling may be retained.

This document provides guidelines that cope with the critical aspects of the industrial automation area (safety, security and environmental aspects such as mechanical, liquid, particulate, climatic, chemicals and electromagnetic interference).

This document does not recognise implementations of power distribution with or through Ethernet balanced cabling systems.

This document deals with the roles of planner, installer, verifier, and acceptance test personnel, administration and maintenance personnel and specifies the relevant responsibilities and/or gives guidance.

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.

A11 Text deleted **A11**

A11 HD 60364 (series), *Low-voltage electrical installations* **A11**

IEC 60512-29-100, *Connectors for electronic equipment – Tests and measurements – Part 29-100: Signal integrity tests up to 500 MHz on M12 style connectors – Tests 29a to 29g*

IEC 60603 (all parts), *Connectors for electronic equipment*

IEC 60603-7 (all parts), *Connectors for electronic equipment – Part 7: Detail specification for 8-way, unshielded, free and fixed connectors*

IEC 60757, *Code for designation of colours*

IEC 60793 (all parts), *Optical fibres*

IEC 60793-2-10, *Optical fibres – Part 2-10: Product specifications – Sectional specification for category A1 multimode fibres*

IEC 60794 (all parts), *Optical fibre cables*

IEC 60807-2, *Rectangular connectors for frequencies below 3 MHz – Part 2: Detail specification for a range of connectors, with assessed quality, with trapezoidal shaped metal shells and round contacts – Fixed solder contact types*

IEC 60807-3, *Rectangular connectors for frequencies below 3 MHz – Part 3: Detail specification for a range of connectors with trapezoidal shaped metal shells and round contacts – Removable crimp contact types with closed crimp barrels, rear insertion/rear extraction*

IEC 60825-2, *Safety of laser products – Part 2: Safety of optical fibre communication systems (OFCS)*

IEC 60950-1, *Information technology equipment – Safety – Part 1: General requirements*

IEC 61076-2-101, *Connectors for electronic equipment – Product requirements – Part 2-101: Circular connectors – Detail specification for M12 connectors with screw-locking*

IEC 61076-2-109, *Connectors for electronic equipment – Product requirements – Part 2-109: Circular connectors – Detail specification for connectors with M 12 x 1 screw-locking, for data transmission frequencies up to 500 MHz*

IEC 61076-3-106, *Connectors for electronic equipment – Product requirements – Part 3-106: Rectangular connectors – Detail specification for protective housings for use with 8-way shielded and unshielded connectors for industrial environments incorporating the IEC 60603-7 series interface*

IEC 61076-3-117, *Connectors for electronic equipment – Product requirements – Part 3-117: Rectangular connectors – Detail specification for protective housings for use with 8-way shielded and unshielded connectors for industrial environments incorporating the IEC 60603-7 series interface – Variant 14 related to IEC 61076-3-106 – Push-pull coupling*

 Text deleted 

IEC 61158 (all parts), *Industrial communication networks – Fieldbus specifications*

IEC 61158-2:2014, *Industrial communication networks – Fieldbus specifications – Part 2: Physical layer specification and service definition*

IEC 61169-8, *Radio-frequency connectors – Part 8: Sectional specification – RF coaxial connectors with inner diameter of outer conductor 6,5 mm (0,256 in) with bayonet lock – Characteristic impedance 50 ohms (type BNC)*

IEC 61753 (all parts), *Fibre optic interconnecting devices and passive components performance standard*

IEC 61753-1, *Fibre optic interconnecting devices and passive components performance standard – Part 1: General and guidance for performance standards*

IEC 61753-1-3, *Fibre optic interconnecting devices and passive components – Performance standard – Part 1-3: General and guidance for single-mode fibre optic connector and cable assembly for industrial environment, Category I*

IEC 61754-2, *Fibre optic connector interfaces – Part 2: Type BFOC/2,5 connector family*

IEC 61754-4, *Fibre optic interconnecting devices and passive components – Fibre optic connector interfaces – Part 4: Type SC connector family*

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

IEC 61754-22, *Fibre optic connector interfaces – Part 22: Type F-SMA connector family*

IEC 61754-24, *Fibre optic interconnecting devices and passive components – Fibre optic connector interfaces – Part 24: Type SC-RJ connector family*

IEC 61784 (all parts), *Industrial communication networks – Profiles*

IEC 61784-1:—, *Industrial communication networks – Profiles – Part 1: Fieldbus profiles*¹

IEC 61784-2:—, *Industrial communication networks – Profiles – Part 2: Additional fieldbus profiles for real-time networks based on ISO/IEC 8802-3*²

IEC 61784-3 (all parts), *Industrial communication networks – Profiles – Part 3: Functional safety fieldbuses – General rules and profile definitions*

IEC 61784-5 (all parts), *Industrial communication networks – Profiles – Part 5: Installation of fieldbuses*

IEC 61935-1:2015, *Specification for the testing of balanced and coaxial information technology cabling – Part 1: Installed balanced cabling as specified in ISO/IEC 11801 and related standards*

IEC 61935-2, *Specification for the testing of balanced and coaxial information technology cabling – Part 2: Cords as specified in ISO/IEC 11801 and related standards*

IEC 62439 (all parts), *Industrial communication networks – High availability automation networks*

IEC 62443 (all parts), *Security for industrial automation and control systems*³

¹ Under preparation. Stage at the time of publication: IEC/FDIS 61784-1:2018

² Under preparation. Stage at the time of publication: IEC/FDIS 61784-2:2018.

IEC 62708, *Documents kinds for electrical and instrumentation projects in the process industry*

ISO/IEC 8802-3, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Standard for Ethernet*

A11 Text deleted A11

ISO/IEC 14763-3:2014, *Information technology – Implementation and operation of customer premises cabling – Part 3: Testing of optical fibre cabling*

ISO/IEC 14763-4:2018, *Information technology – Implementation and operation of customer premises cabling – Part 4: Measurement of end-to-end (E2E)-Links*

ISO/IEC TS 29125:2017, *Information Technology – Telecommunications cabling requirements for remote powering of terminal equipment*

A11 EN 50173 (series), *Information technology – Generic cabling systems* A11

A11 EN 50174 (series), *Information technology – Cabling installation* A11

A11 EN 50288 (series), *Multi-element metallic cables used in analogue and digital communications and control* A11

EN 50310, *Application of Equipotential Bonding and Earthing in Buildings with Information Technology Equipment*

IEEE Std 802.3-2015, *IEEE Standard for Ethernet*, available at <http://www.ieee.org>

ANSI/(NFPA) T3.5.29 R1-2007, *Fluid power systems and components – Electrically-controlled industrial valves – Interface dimensions for electrical connectors*

In IEC 61918 the generic cabling is intended as 'in accordance with ISO/IEC 11801-3, whereas in EN IEC 61918 the generic cabling shall be intended as 'in accordance with EN 50173-3.

3 Terms, definitions, and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61158 (all parts), IEC 61784 (all parts), ISO/IEC 8802-3, ISO/IEC 11801-1, and ISO/IEC 11801-3, some of which have been repeated here for convenience of the user, 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

acceptance test

contractual test to prove to the customer that the installed cabling meets certain conditions of its specification

Note 1 to entry The network owner or a third party usually performs this action.

[SOURCE: IEC 60050-151:2001, 151-16-23, modified – "Item" has been changed to "installed cabling" and Note 1 to entry has been added]

3.1.2

active network element

network element containing electrically and/or optically active components that allows extension of the network

Note 1 to entry: Examples of active network elements are repeaters and switches.

3.1.3

active network

network in which data transmission between non-immediately-connected devices is dependent on active elements within those intervening devices that form the connection path

Note 1 to entry: A failure of an active network element can disrupt the network communications.

3.1.4

administration

methodology defining the documentation requirements of a cabling system and its containment, the labelling of functional elements and the process by which moves, additions and changes are recorded

3.1.5

apparatus

one or more pieces of equipment having specific and defined overall functions within industrial premises served by one or more network interfaces

Note 1 to entry: This definition applies only to IT equipment. It does not apply to devices that implement automation functions.

[SOURCE: ISO/IEC 11801-3:2017, 3.1.1, modified – Note 1 to entry has been added]

3.1.6

automation island

AI

premises where combination of all systems that control, monitor, and protect the process of a plant is installed

Note 1 to entry: A plant may contain one or more AIs. Examples of a plant that has more than one AI are: a plant that is divided in various distinct physical (geographical) areas, or a plant that is composed of several distinct processes, or a plant where a large process is divided in various distinct sub-processes.

3.1.7

automation island attachment cabling

AI attachment cabling

cabling used to connect the automation outlet (AO) to the network interface (NI) for the automation island

3.1.8**automation island network**

network used for the communication within and among systems of an AI

3.1.9**automation outlet****AO**

fixed connecting hardware which provides an interface to the network(s) of an automation island

Note 1 to entry: For generic cabling in accordance with ISO/IEC 11801-3, the AO replaces the TO and is the demarcation point between the generic communications cabling and the automation communication cabling.

Note 2 to entry: Where the interface used at the AO does not conform to that specified for the TO of ISO/IEC 11801-3, the generic cabling no longer conforms to ISO/IEC 11801-3.

3.1.10**balanced cable**

cable consisting of one or more metallic symmetrical cable elements (twisted pairs or quads)

Note 1 to entry: There is a great variety of shielded cable and unshielded cable construction and a number of systems to identify these constructions in a shortened form. See ISO/IEC 11801-1:2017, Annex D for acronyms to use.

[SOURCE: ISO/IEC 11801-1:2017, 3.1.12, modified – Note 1 to entry has been added]

3.1.11**bonding**

act of connecting together exposed conductive parts and extraneous conductive parts of apparatus, systems, or installations that are at essentially the same potential

Note 1 to entry: For safety purposes, bonding generally involves (but not necessarily) a connection to the immediately adjacent earthing system.

[SOURCE: IEC TR 61000-5-2:1997, 3.1]

3.1.12**bridge**

device, operating at the data link layer of the OSI model, used to connect two networks

3.1.13**bulkhead**

wall or barrier which maintains the ingress and climatic environmental classifications applicable on either side

[SOURCE: ISO/IEC 11801-3:2017, 3.1.5]

3.1.14**bulkhead connector**

connector assembly mounted to a bulkhead which provides electrical or optical signal pass-through while maintaining environmental integrity

3.1.15**bulkhead connection**

one (or two) optical or electrical connection(s) within a bulkhead connector assembly

3.1.16**bulkhead cable gland**

hardware at an enclosure bulkhead that provides cable passage for power or signals while maintaining environmental integrity

Note 1 to entry: This hardware has no electrical connections.

3.1.17

bus

passive network having a long trunk and a number of spurs where each spur is used to connect a device to the trunk

Note 1 to entry: In a bus, all the communicating devices share a common medium to transfer data.

3.1.18

bus bar

low-impedance conductor to which several electric circuits can be connected at separate points

Note 1 to entry: In many cases, the bus bar consists of a bar.

[SOURCE: IEC 60050-151:2001, 151-12-30]

3.1.19

cable

assembly of one or more conductors and/or optical fibres, with a protective covering and possibly filling, insulating and protective material

[SOURCE: IEC 60050-151:2001, 151-12-38]

3.1.20

cable gland

installation hardware designed to permit the entry of a cable into an enclosure and which provides sealing and retention

[SOURCE: IEC 60670-1:2015, 3.10, modified – Definition has been adapted for all kinds of cables]

3.1.21

cabling

system of communication cables, cords and connecting hardware that can support the connection of automation equipment

[SOURCE: ISO/IEC 11801-1:2017, 3.1.21, modified – A reference to automation equipment has been added]

3.1.22

channel

end-to-end transmission path connecting any two pieces of application specific equipment

Note 1 to entry: Equipment cords are included in the channel, but not the connecting hardware into the application specific equipment.

Note 2 to entry: Channels specified in this document may only comprise passive components.

[SOURCE: ISO/IEC 11801-1:2017, 3.1.26, modified – Note 1 to entry and Note 2 to entry have been added]

3.1.23

condition-based (conditional) maintenance

preventive activity performed on the basis of the documentation of the performance degradation of an item (as results of, for example, auto diagnostic or wear measurement)

Note 1 to entry: It is based on a proper visibility of performance degradation or intermittent failures.

3.1.24**connection (of conductors)**

intentional electric contact between conductors

[SOURCE: IEC 60050-151:2001, 151-12-07, modified – Text referring to conductors has been selected]

3.1.25**connection (of optical fibres)**

intentional alignment between optical fibres to allow light to pass through

[SOURCE: IEC 60050-151:2001, 151-12-07, modified – Text has been adapted to cover optical fibres.]

3.1.26**connector**

<conductors> component providing conductor connection and disconnection

Note 1 to entry: The connector is the mated pair.

Note 2 to entry: A connector has one or more contact members.

[SOURCE: IEC 60050-151:2001, 151-12-19, modified – The definition has been adapted and Note 1 to entry has been added]

3.1.27**connector**

<optical fibres> component normally attached to an optical cable or piece of apparatus, for the purpose of providing optical interconnection/disconnection of optical fibres or cables

Note 1 to entry: The connector is the mated pair.

Note 2 to entry: The connector usually consists of two plugs mated together in an adaptor.

3.1.28**cord**

cable, cable unit, or cable element, with a minimum of one termination

[SOURCE: ISO/IEC 11801-1:2017, 3.1.36]

3.1.29**corrective maintenance**

maintenance carried out after a fault recognition and intended to put an item into a state in which it can perform a required function

[SOURCE: IEC 60050-191:1990³, 191-07-08]

3.1.30**daisy chain**

bus where each passive network interface connects two trunk sections and provides a DC coupling between those sections

Note 1 to entry: One of the sections may be a bus terminator.

Note 2 to entry: With regard to the use of “daisy chain” term for active networks, see the definition given for linear topology.

³ Withdrawn.

3.1.31

device

physical entity connected to the fieldbus composed of communication element and possibly other functional elements

[SOURCE: IEC 61158-2:2014, 3.1.13, modified – Some details have been deleted.]

3.1.32

distributor

functional element enabling the termination and connection of cabling subsystems to other cabling subsystems or transmission equipment

[SOURCE: ISO/IEC 11801-1: 2017, 3.1.41]

3.1.33

earth (noun), en GB

ground (noun), en US

conductive mass of the Earth, whose electric potential at any point is conventionally taken as zero

[SOURCE: IEC 61131-2: 2017, 3.1.10]

3.1.34

earth (verb), en GB

ground (verb), en US

make an electric connection between a given point in a system or in an installation or in equipment and a local earth

Note 1 to entry: The connection to local earth may be intentional, or unintentional or accidental.

Note 2 to entry: The connection may be permanent or temporary.

[SOURCE: IEC 60050-195:1998, 195-01-08]

3.1.35

enclosure

housing affording the type and degree of protection suitable for the intended application

[SOURCE: IEC 61131-2: 2017, 3.1.13]

3.1.36

end-to-end link

E2E link

end to end transmission path formed by structured cabling based on passive components including the portion of the end connection that is attached to the link and the portion of the end connection that is attached to the end equipment

[SOURCE: ISO/IEC TR 11801-9902:2017, 3.1.1]

3.1.37

equipotential bonding

provision of electric connections between conductive parts, intended to achieve equipotentiality

[SOURCE: IEC 60050-195:1998, 195-01-10]

3.1.38**equipotential bonding system**

interconnection of conductive parts providing equal potential between those parts

Note 1 to entry: If an equipotential bonding system is earthed, it forms part of an earthing arrangement.

[SOURCE: IEC 60050-195:1998, 195-02-22]

3.1.39**failure**

termination of the ability of an item to perform a required function

Note 1 to entry: After failure, the item has a fault.

Note 2 to entry: Failure is an event, as distinguished from fault, which is a state.

[SOURCE: IEC 60050-191:1990, 191-04-01]

3.1.40**fault**

state characterized by the inability to perform a required function, excluding the inability during preventive maintenance or other planned actions, or due to lack of external resources

Note 1 to entry: IEC 61508-4 defines fault as an abnormal condition that may cause a reduction in, or loss of, the capability of a functional unit to perform a required function.

[SOURCE: IEC 60050-191:1990, 191-05-01, modified – Note 1 to entry has been changed and Note 2 to entry has been deleted]

3.1.41**functional earth**, en GB**functional ground**, en US

earthing point or points in a system or in an installation or in equipment, used for purposes other than electrical safety

[SOURCE: IEC 60050-195:1998, 195-01-13]

3.1.42**high flex cable**

cable that can withstand high number of repeated flexes (usually millions of cycles) while maintaining the specified performance

3.1.43**inactive metal part**

any non-current carrying metal that may be contacted by a person

3.1.44**inspection**

taking measures for the observation and evaluation of the actual condition

3.1.45**intermediate cable**

cable connecting the intermediate distributor to the telecommunication outlet

[SOURCE: ISO/IEC 11801-3:2017, 3.1.9]

3.1.46

intermediate distributor

distributor used to make connections between the intermediate cable, other cabling subsystems and active equipment

[SOURCE: ISO/IEC 11801-3:2017, 3.1.10]

3.1.47

intermediate industrial distributor

intermediate distributor used to make connections to and between automation islands and transmit critical process control, monitoring and automation data (PCMA) between them

[SOURCE:ISO/IEC 11801-3:2017, 3.1.11]

3.1.48

jack

part of the connector which mates with a plug

Note 1 to entry: This document uses the term jack to refer to a fixed connector.

[SOURCE: IEC 60050-581:2008, 581-26-24, modified – Text has been adapted for automation applications and Note 1 to entry has been added]

3.1.49

jack-to-jack adaptor

J-J adaptor

back-to-back jacks that have one type of jack on one side and another type of jack on the other side and do not are on an enclosure/environmental barrier

3.1.50

jack-to-jack coupler

J-J coupler

back-to-back jacks that have the same type of jack on both sides and do not are on an enclosure/environmental barrier

3.1.51

linear topology

topology where the nodes are connected in series, with two nodes connected to only one other node and all others each connected to two other nodes (that is, connected in the shape of a line)

Note 1 to entry: This topology corresponds to that of an open ring.

3.1.52

maintenance

combination of all technical and corresponding administrative actions, including supervision actions, intended to retain an item in, or restore it to, a state in which it can perform a required function

Note 1 to entry: See "preventive maintenance", and "corrective maintenance", for a more detailed definition of maintenance.

Note 2 to entry: The required function may be defined as a stated condition.

[SOURCE: IEC 60050-191:1990, 191-07-01, modified – "Administrative actions" has been replaced by"corresponding administrative actions" and the two notes to entry have been added]

3.1.53**maintenance intervention**

taking measures for retaining the specified condition

3.1.54**mean time between failures****MTBF**

expectation of the time between failures

[SOURCE: IEC 60050-191:1990, 191-12-08]

3.1.55**mean time to recovery****MTTR**

expectation of the time to restoration

Note 1 to entry: In IEC 60050-191:1990, 191-13-08, the use of "mean time to repair" (MTTR) is deprecated.

[SOURCE: IEC 60050-191:1990, 191-13-08]

3.1.56**network**

all of the media, connectors, repeaters, routers, gateways and associated node communication elements by which a given set of communicating devices are interconnected

[SOURCE: IEC 61158-2:2014, 3.1.30]

3.1.57**node**

end-point of a branch in a network

3.1.58**passive network**

network in which data transmission is independent of active elements within the device attached to the network

Note 1 to entry: Failure of a device does not affect the propagation of information.

3.1.59**pathway**

cable route used to accommodate cables between termination points

Note 1 to entry: The cable route (e.g., conduit, ductwork, tray, or tube) is defined by a physical structure.

[SOURCE: ISO/IEC 14763-2:2012, 3.1.43, modified – The definition has been adapted and Note 1 to entry has been added.]

3.1.60**permanent link**

transmission path between distributors or between the telecommunications/automation outlet and the intermediate distributor

Note 1 to entry: It excludes apparatus attachment cords, equipment cords, patch cords and jumpers but includes the connection at each end.

Note 2 to entry: This is a modification to the definition of ISO/IEC 11801 in order to allow it be used for the CPs in accordance with IEC 61784-5 (all parts).

[SOURCE: ISO/IEC 11801-1:2017, 3.1.69, modified – The definition and Note 1 to entry have been adapted and Note 2 to entry has been added]

3.1.61

plug

connector used to make connections to a jack

Note 1 to entry: This document uses the term plug to refer to a free connector.

3.1.62

preventive maintenance

maintenance carried out at predetermined intervals or according to prescribed criteria and intended to reduce the probability of failure or the degradation of the functioning of an item

[SOURCE: IEC 60050-191:1990, 191-07-07]

3.1.63

protective earthing conductor

protective conductor provided for protective earthing

[SOURCE: IEC 60050-195:1998, 195-02-11]

3.1.64

quad

cable element that comprises four insulated conductors twisted together

Note 1 to entry: Two diametrically facing conductors form a transmission pair also referred to as a side circuit.

[SOURCE: ISO/IEC 11801-1:2017, 3.1.75]

3.1.65

RC earthing

earthing via a parallel RC circuit

3.1.66

recovery (of a high resilience item)

event when an item regains its specified degree of communication performance and fault resilience after correction of a fault

Note 1 to entry: High availability networks provide resilience to enable acceptable communication to continue after one fault and possibly after multiple faults.

3.1.67

repair

take measures for the re-establishment of the specified condition

3.1.68

repeater

two-port active physical layer device that receives and retransmits all signals to increase the distance and number of devices for which signals can be correctly transferred for a given medium

[SOURCE: IEC 61158-2:2014, 3.1.38]

3.1.69

resistance to earth

real part of an impedance to earth

[SOURCE: IEC 60050-195:1998, 195-01-18]

3.1.70**restoration**

state when a communication network regains its designed level of resilience redundancy

3.1.71**ring**

active network where each node is connected in series to two other nodes

3.1.72**scheduled maintenance**

preventive activity (time or number-of-actions directed) performed either on predefined schedule or on units of use (e.g. number of start-ups)

[SOURCE: IEC 60050-191:1990, 191-07-10, modified – The definition has been adapted and a reference to units of use has been added]

3.1.73**segment**

trunk-cable section of a network that is terminated at both ends by its characteristic impedance

Note 1 to entry: Segments are linked by repeaters within a logical link and by bridges to form a network.

[SOURCE: IEC 61158-2:2014, 3.1.39 modified – The definition and the note to entry have been adapted]

3.1.74

shield (of a cable), en US

screen (of a cable), en GB

surrounding metallic layer to confine the electromagnetic field within the cable and to protect the cable from external electrical influence

Note 1 to entry: Metallic sheaths, armours and earthed concentric conductors may also serve as a shield.

Note 2 to entry: For generic cabling in industrial premises, ISO/IEC 11801-3 uses the term screen instead of shield.

Note 3 to entry: See also Note 1 to entry of the balanced cable definition.

[SOURCE: IEC 61158-2:2014, 3.1.41 modified – The definition has been adapted and the term screen has been added; Notes 2 and 3 to entry have been added]

3.1.75**(optical fibre or electrical conductor) splice**

a permanent, or semi-permanent, joint whose purpose is to couple optical power between two optical fibres or to joint two electrical conductors

Note 1 to entry: Joining without connectors.

3.1.76**spur**

branch-line (i.e. a link connected to a larger one at a point in its route) that is a final circuit

Note 1 to entry: The alternative term “drop cable” is used in IEC 61158.

[SOURCE: IEC 61158-2:2014, 3.1.42]

3.1.77

star

network of three or more devices where all devices are connected to a central point (which may be active or passive)

3.1.78

tap

point of attachment from a node or spur to the trunk cable

Note 1 to entry: A tap provides easy removal of a node without disrupting the link.

[SOURCE: IEC 61158-2:2014, 3.3.34]

3.1.79

telecommunication outlet

TO

fixed connecting device which provides an interface to the terminal equipment

[SOURCE: ISO/IEC 11801-1:2017, 3.1.80]

3.1.80

terminator

entity used to terminate a transmission line in its characteristic impedance to prevent reflections

Note 1 to entry: In some instances, the terminator may be embedded in an end device or in a connector.

[SOURCE: IEC 61158-2:2014, 3.1.43, modified – The definition and Note 1 to entry have been modified]

3.1.81

(network) topology

pattern of the relative positions and interconnections of the individual elements (of the network)

Note 1 to entry: The term topology is sometimes overloaded to include considerations of the delay, attenuation and physical media classes of the paths interconnecting network nodes.

[SOURCE: IEC 60050-131:2002, 131-13-02, modified – Text has been adapted for communication networks and a Note 1 to entry has been added]

3.1.82

troubleshooting

locating the fault(s)

3.1.83

trunk

main communication highway acting as a source of main supply to a number of other lines (spurs)

[SOURCE: IEC 61158-2:2014, 3.1.46]

3.1.84

validation

part of the acceptance test that is solved with measurements

3.1.85

verification

action to assess that an installation is in accordance with its specification

Note 1 to entry: The installer usually performs this action.

Note 2 to entry: This action usually covers verification of component correct selection, physical layout, communication earthing, isolation and continuity of network components.

3.1.86

wire map

mapping of connector pin-to-pin terminations of a cable

3.2 Abbreviated terms

For the purposes of this document, the following abbreviated terms apply.

AC	Alternating current
A.I.	Action item
AI	Automation island
AO	Automation outlet
AWG	American Wire Gauge
BD	Building distributor (ISO/IEC 11801-1)
BER	Bit error rate
BFOC	Bayonet fibre optic connector
BNC	Bayonet Neill Concelman (connector for coaxial cable having a bayonet-type shell)
CBN	Common bonding network
CP	Communication profile (IEC 61784-1)
CPF	Communication profile family (IEC 61784-1)
DC	Direct current
DCR	Direct current resistance
EFT	Electrical fast transient
EFT/B	Electrical fast transient / burst (IEC 61000-4-4)
ELFEXT	Equal level far-end crosstalk
ELTCTL	Equal level transverse conversion transfer loss
EMC	Electromagnetic compatibility (IEC 60050-161, 161-01-07)
EMI	Electromagnetic interference (IEC 60050-161, 161-01-06)
ESD	Electrical static discharge
E2E	End-to-end
FD	Floor distributor (ISO/IEC 11801-1)
FE	Functional earth
ffs	For further study
FI	Fieldbus interface
FOC	Fibre optical connector
F-SMA	Fibre sub miniature version A (IEC 61754-22)
HP	Horse power
ID	Intermediate distributor
IDC	Insulation displacement contact
IID	Industrial intermediate distributor
IP	International protection (IEC 60529)
J-J	Jack-to-jack

kbit/s	One thousand bits per second
LC	Optical fibre connector in accordance with IEC 61754-20
LV	Low voltage
Max.	Maximum
Mbit/s	Million bits per second
MD	Machine distributor (ISO/IEC 11801-1)
MDI	Medium dependent interface (IEEE 803.2)
MDIX	Medium dependent crossover interface (IEEE 803.2)
MHV	Medium high voltage
MICE	Mechanical, Ingress, Climatic and Chemical, Electromagnetic (ISO/IEC 11801-1)
Min.	Minimum
MTBF	Mean time between failures
MTTR	Mean time to repair (use deprecated in IEC 60050-191:1990, 191-13-08) replaced with mean time to recovery
N	Neutral
NA	Numerical aperture (IEC 60793 (all parts))
na	Not available
NEXT	Near end crosstalk loss
NI	Network interface (ISO/IEC 11801-3)
No.	Number
OF	Optical fibre
OMx	Cabled multimode optical fibre category x; where x=1, 2, 3, 4
OSx	Cabled single mode optical fibre category x; where x=1, 1a, 2
PE	Protective earthing conductor (IEC 60050-195:1998, 195-02-11)
P&ID	Pipe and instrumentation diagram
PMA	Physical medium attachment (IEEE 803.2)
PoE	Power over Ethernet
POF	Plastic optical fibre
PSELFEXT	Power sum equal-level far-end crosstalk loss
RC	Resistor-capacitor (circuit)
Rep	Repeater
SC	Optical fibre connector in accordance with IEC 61754-4
SC-RJ	Optical fibre connector in accordance with IEC 61754-24
TCL	Transverse conversion loss
TNC	Threaded Neill Concelman (threaded version of the BNC connector)
TO	Telecommunication outlet
UV	Ultraviolet
Var.	Variant

3.3 Conventions for installation profiles

Conventions for installation profiles are described in IEC 61784-5 (all parts).

4 Installation planning

4.1 General

4.1.1 Objective

Clause 4 addresses the planning of cabling and associated infrastructures to support communication networks used between and within automation islands in industrial premises.

4.1.2 Cabling in industrial premises

The cabling may comprise:

- automation communication cabling for use within or between AIs as specified in the communication profiles of IEC 61784-1 or IEC 61784-2 and in the relevant installation profiles of IEC 61784-5 (all parts);
- generic telecommunications cabling for industrial premises as specified in ISO/IEC 11801-3 (see Annex A);
- elements of generic cabling modified to meet the needs of automation communication cabling within an AI in accordance with the installation profiles of IEC 61784-5 (all parts);
- the apparatus attachment cabling between the TO and the AI in accordance with ISO/IEC 11801-3 with regard to the connection and with this document with regard to the cables;
- the AI attachment cabling between the AO and the AI in accordance with this document and the relevant installation profile(s) of IEC 61784-5 (all parts).

ISO/IEC 11801-3 specifies the structure of generic cabling connected to an AI where the TO interface allows connection of wide range of networking equipment.

Where a designated connection from generic cabling to automation communication cabling within an AI is desired, an AO specified within this document may replace the TO, as shown in Figure 3.

An AI may contain (see Figure 4)

- one or more industrial automation apparatus conforming to generic cabling requirements,
- one or more industrial automation applications implemented with an AI network that uses Ethernet (ISO/IEC 8802-3)-based and non-Ethernet-based cabling that conform to IEC 61784-1 or IEC 61784-2.

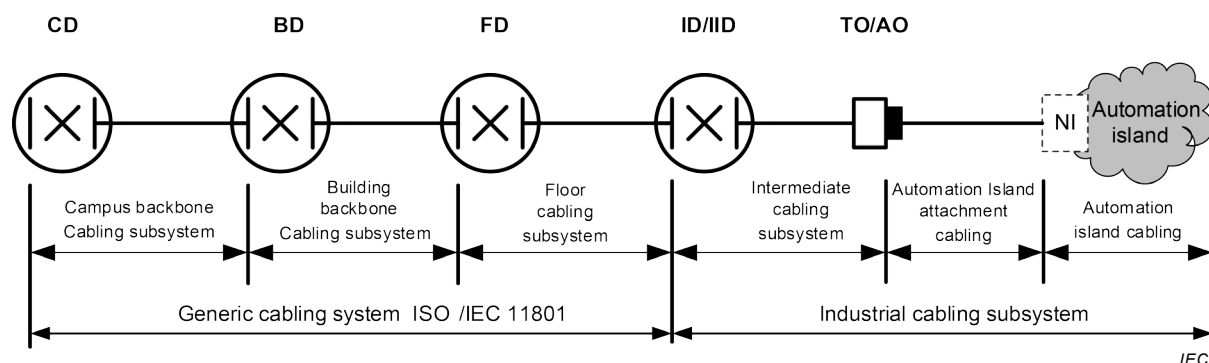


Figure 3 – Automation island cabling attached to elements of generic cabling

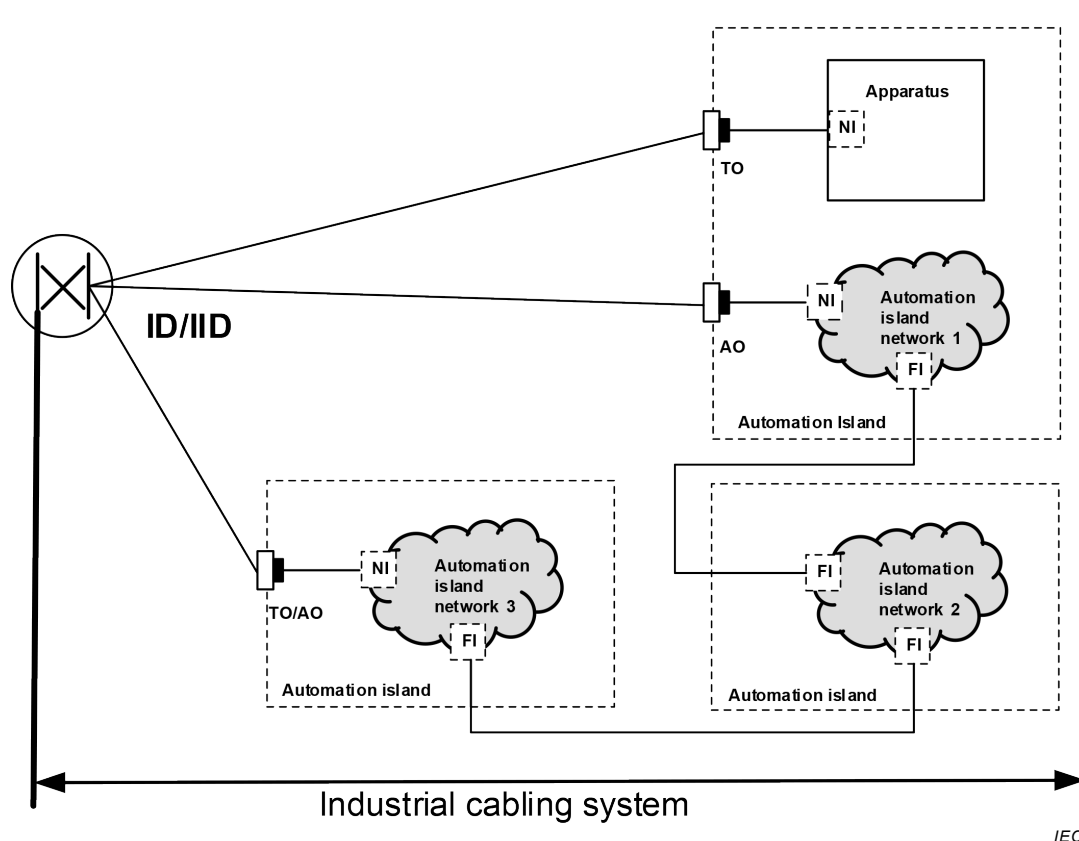


Figure 4 – Automation islands

The interconnections between the AI network and the generic cabling may be achieved through an appropriate converter/adaptor (see Figure 5), while the connections among AIs may be achieved through one or more fieldbus to fieldbus connections (defined in the installation profiles in IEC 61784-5 (all parts)) and appropriate converter/adapters or through the generic cabling (see Figure 4).

In general, converter/adapters, such as routers, bridges, and gateways, shall be used to provide physical conversion and protocol transformation between different fieldbuses as specified in the relevant CP installation profiles. If the two interconnected interfaces (NI and FI) have matching specifications, then the converter/adaptor function may not be necessary.

If the interconnection between the AIs is through the intermediate distributor/intermediate industrial distributor (ID/IID in Figure 4), it is the responsibility of the planner to check the suitability of the generic cabling to support the requirements for the installation of the communication networks as defined by this document. In this case, the channel performance shall be met from the ID/IID up to the NI (excluding the connector interface at the NI).

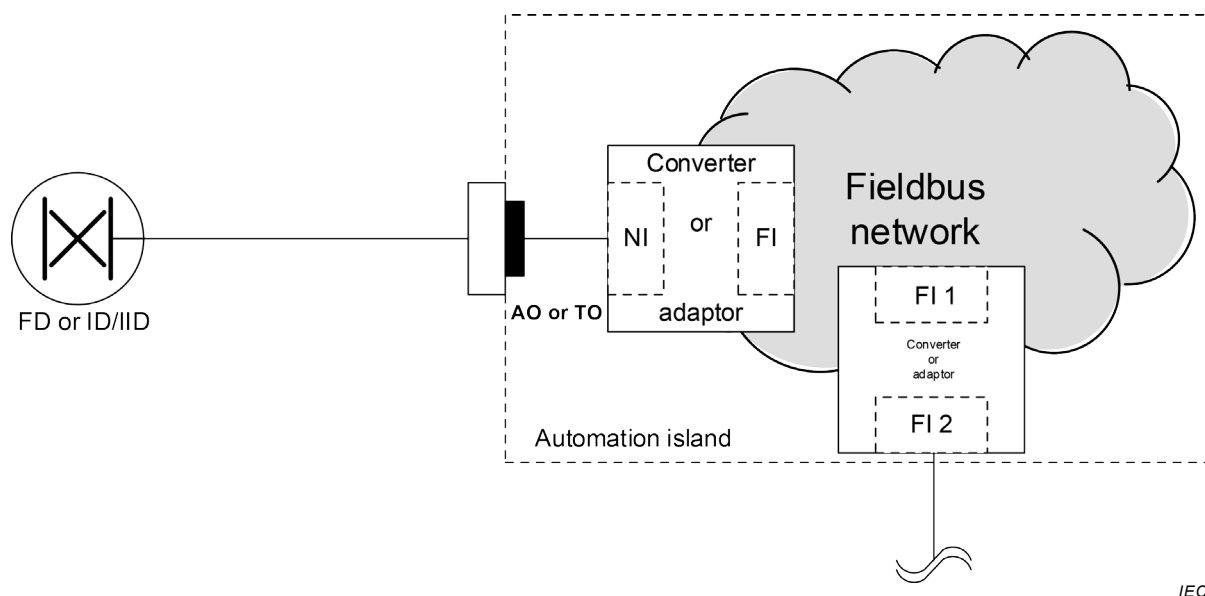


Figure 5 – Automation island network external connections

4.1.3 The planning process

The planning of the communication of an automation system is the responsibility (see Annex L) of one or more of the following: building network designer, automation designer and or machine designer.

The input for the installation planning depends on the kind of industrial automation application. This input is made up of general design requirements, operating manuals for machines or piping and instrumentation diagrams (P&ID) for process installations.

This input is made up of general design requirements, operating manuals for machines or piping and instrumentation diagrams (P&ID) for process installations according to IEC 62708.

Installation planning of industrial communication networks is accomplished through three basic steps.

Step 1 addresses the following installation-specific factors (see 4.2):

- safety
 - the solutions shall comply with existing local and national regulations. Under this condition, safety requirements specified in IEC 60950-1 may be taken into consideration;
 - if a communication network is installed with easily accessible terminals and wires, IEC 60364-4-41 concerning protection against electrical shock and EMC requirements should be applied;
 - intrinsic safe network is out of scope for this document but may be addressed in the CP installation profiles (IEC 61784-5 (all parts)).
- security;
- environmental
 - the use of the MICE (Mechanical, Ingress, Climatic and Chemical, and Electromagnetic) methodology for description of environmental performance, as described in 4.2.3, is recommended;
 - distinctive of industrial sites is the presence of low voltage (LV) and medium-high-voltage (MHV) power networks in close neighbourhood of the communication network.

The RF influence of neighbouring high-power transmitters (e.g. television transmitters) shall be taken into account;

- electromagnetic compatibility.

Step 2 addresses the capabilities of the different communication networks (see 4.3):

- topologies;
- network characteristics.

Step 3 addresses the selection and use of cabling components in response to steps 1 and 2 (see 4.4).

The result of the planning process in 4.2, 4.3 and 4.4 is the production of the cabling planning documentation described in 4.5, which shall comprise:

- a) a statement, signed by the responsible planner, explaining how the planned installation complies with the safety and security requirements and environmental conditions such as mechanical, liquid, particulate, climatic, chemicals and electromagnetic interference and including all necessary documents (e.g. plans and lists) for the installation that result from step 1;
- b) documentation of the planned network topology, characteristics, physical extension and transmission performances that results from step 2;
- c) the component specifications, where the conformity of the component data with the planned network requirements (functional and electrical safety, environmental conditions, and EMC requirements) is documented as result of step 3;
- d) a table for comparison of nominal and actual network performance values.

4.1.4 Specific requirements for CPs

Additional information for a specific industrial network may be found in the respective installation profile.

4.1.5 Specific requirements for generic cabling in accordance with ISO/IEC 11801-3

See ISO/IEC 14763-2.

4.2 Planning requirements

4.2.1 Safety

4.2.1.1 General

The planner shall take into consideration regulations for safety in communication networks with specific attention to mounting, cabling, verification, and validation.

The planner shall include all applicable requirements for safety in the cabling planning documentation.

4.2.1.2 Electrical safety

The proper implementation of the requirements of this document assumes that electrical installations are in accordance with the relevant standards within IEC 60364 (all parts), IEC 61010-2-201 or local and national regulations as required.

4.2.1.3 Functional safety

Where digital communications are used to contribute to one or more safety functions, the communication system should have sufficient integrity (taking into account hardware,

software, and the specified environment) to meet the safety integrity requirements of every safety function.

For example, wiring used to support safety instrumented systems may require special installation practice (e.g. complete segregation from all other cabling) and labelling (e.g. special conduit colouring) to meet enhanced integrity requirements.

The requirements for safety integrity may include special measures applicable to the several phases of the life cycle of the related communication media (see the relevant technology parts of the IEC 61784-3 and/or IEC 61784-5 (all parts)). The planner shall apply such special measures.

4.2.1.4 Intrinsic safety

Where required, the planner shall plan the network in accordance with applicable intrinsic safety standards and IEC 61158-2 and the applicable CPs of IEC 61784-1.

4.2.1.5 Safety of optical fibre communication systems

Optical fibre cabling shall be planned in accordance with the safety requirements of IEC 60825-2 or local regulations.

4.2.2 Security

Where communication networks in accordance with IEC 62443 are planned, the planner shall apply all additional requirements for security.

EXAMPLE A typical request is to use additional protection against mechanical manipulation and electromagnetic emission.

The universal nature of generic cabling produces additional security concerns since the cabling may be used to provide applications that are managed by different groups within industrial premises. For example, generic cabling may provide basic telephony services, information technology and building control services in addition to the connections to the AIs. The prevention of accidental disruption to any of these services requires careful consideration.

Physical security requires the application of requirements described in 4.4.9.1, 4.4.9.6, 4.4.11, 5.2.1.2.

4.2.3 Environmental considerations and EMC

4.2.3.1 Description methodology

The planner shall provide a precise description of the environment to be used as a basis for the selection of components and for the mitigation requirements.

ISO/IEC 11801-1 applies an environmental assessment called “MICE” classification. This approach is recommended for all CPs because it allows the planner to describe the environmental conditions in a precise and unambiguous way.

The use of this approach is explained here and in Annex B for the benefit of the planner and the installer.

NOTE 1 The MICE classification system of ISO/IEC 11801-1 is not a component test specification.

NOTE 2 The MICE classification system of ISO/IEC 11801-1 does not replace existing international or national standards.

NOTE 3 Existing international or national standards for components contain the test requirements and schedules for product qualification.

4.2.3.2 Use of the described environment to produce a bill of material

The planner shall produce a bill of material of components that meets the targeted environment through the following steps.

- Establish the ambient environmental conditions for each significantly different region within the application space (for example, beside the machine, in the control room, between the above).
- Define the components that make up the communications system including their environmental specifications.
- Define the additional mitigation to bridge between the component(s) specifications and the targeted environment, if the component does not meet the targeted environment.

The planner shall provide the environmental description either through the use of the MICE tables (that provides a precise classification of the environment) or by an equivalent methodology. The planner shall address the environmental requirements by specifying a combination of component selection and mitigation techniques to be applied (see Figure 6).

Products, such as enclosures, necessary to provide mitigation shall also be included in the bill of material.

Compatibility of components can be met by any combination of the following three methods:

- installation related isolation (for example protection with enclosure);
- separation (for example physical separation from other components);
- component enhancement (design enhancement of the component parameters, for example by adding a cable shield or external shield). The supplier of the equipment may provide enhancements to the components reducing the installation requirements.

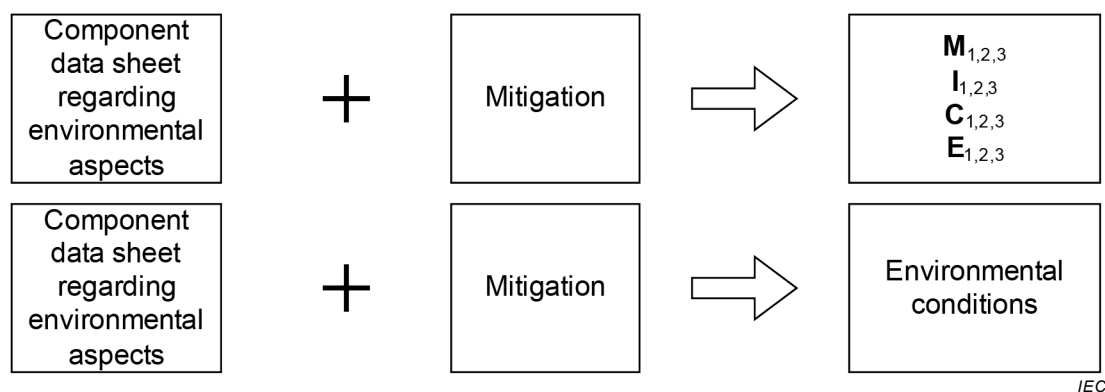


Figure 6 – How to meet environmental conditions

Figure 7 shows how the three methods (isolation, separation and enhancement) work together to provide a cost effective, technically feasible solution for a given application with regard to the environment. Examples of use of the MICE concept are provided in Annex B, where the meaning of the subscripts 1, 2, 3 is explained.

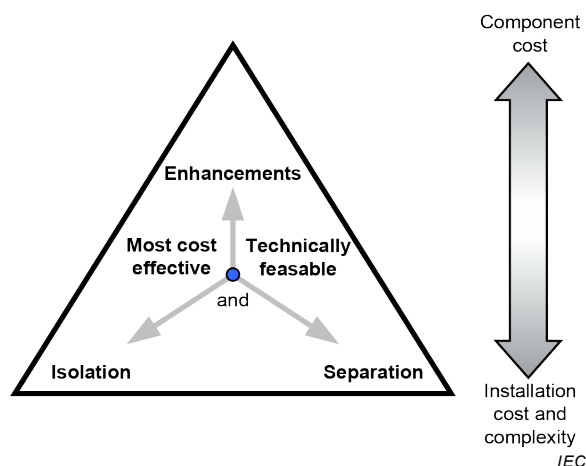


Figure 7 – How enhancement, isolation and separation work together

4.2.4 Specific requirements for generic cabling in accordance with ISO/IEC 11801-3

See ISO/IEC 14763-2.

4.3 Network capabilities

4.3.1 Network topology

4.3.1.1 Common description

For the industrial AI networks, there are two fundamental themes.

- a) Physical topology of the communication network, from a physical composition standpoint.
Hereafter the basic physical topologies of a network are divided in two groups:
 - physical topology for passive networks;
 - physical topology for active networks.
- b) Logical topology of the communication network, from an information propagation standpoint. This is outside the scope of this document and may be covered by IEC 61784-1 and IEC 61784-2.

NOTE 1 As an example of the difference between the physical and the logical topology, a planner can select a physical star to be installed in order to support a logical ring topology.

The planner shall select the most appropriate physical topology on the basis of the application requirements (see also Annex C) and according to the topologies that are specified for the specific CP. The basic topologies defined in 4.3.1.2 and in 4.3.1.3, and combinations of them (see 4.3.1.4) are the appropriate physical topologies for AI networks.

NOTE 2 Not all fieldbuses support all the basic topologies and combination of them.

4.3.1.2 Basic physical topologies for passive networks

The basic physical topologies for passive network, represented in Figure 8, are the following.

- Bus
- Star

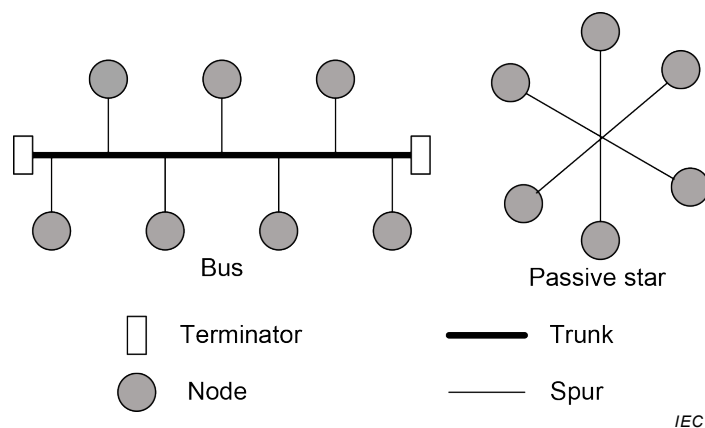


Figure 8 – Basic physical topologies for passive networks

4.3.1.3 Basic physical topologies for active networks

The basic physical topologies for active networks, represented in Figure 9, are the following.

- Star
- Ring
- Linear

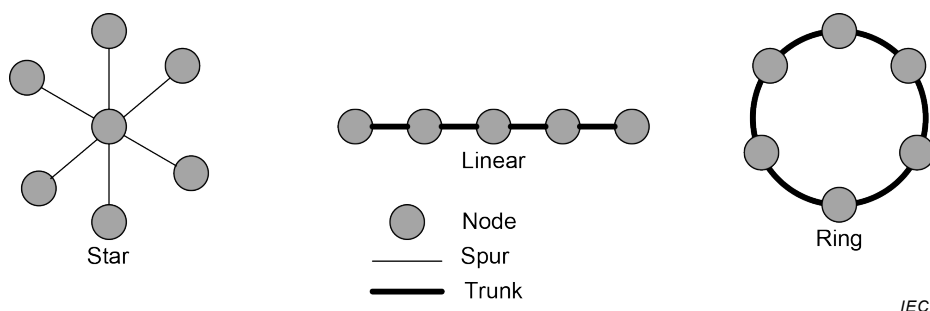


Figure 9 – Basic physical topologies for active networks

4.3.1.4 Combination of basic topologies

Combinations of basic topologies are permitted and are defined in the CP installation profile.

Figure 10 provides an example of a common configuration of two passive bus segments interconnected by an active bus repeater.

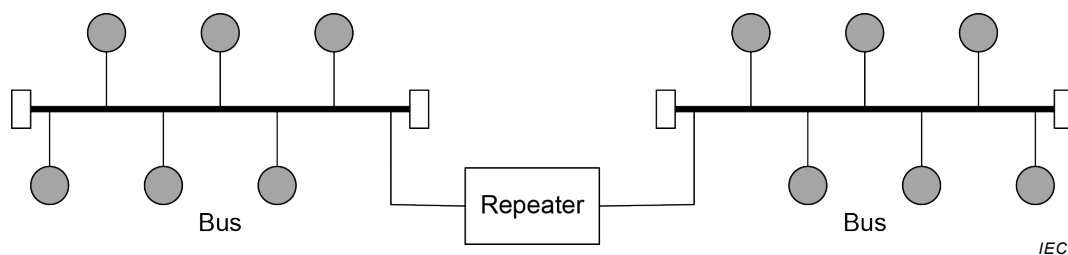


Figure 10 – Example of combination of basic topologies

4.3.1.5 Specific requirements for CPs

Additional information regarding topology requirements for a specific industrial network may be found in the respective installation profile.

4.3.1.6 Specific requirements for generic cabling in accordance with ISO/IEC 11801-3

Generic cabling channels in accordance with ISO/IEC 11801-3 may constitute elements of the networks described in 4.3.1.2 to 4.3.1.5. Specific restrictions are detailed in ISO/IEC 11801-3 and may be expanded upon or modified by the respective installation profile.

4.3.2 Network characteristics

4.3.2.1 General

It is common practice to subnet an industrial AI network when there are a large number of devices to be connected.

Every network specification consists of the following basic characteristics:

- transfer rates;
- media type and performance;
- maximum number of devices (nodes) including repeaters per segment;
- maximum number of devices (nodes) including repeaters per network;
- maximum number of repeaters (that connect segments);
- maximum segment length.

NOTE Transfer rates can be expressed as bandwidth capacity or effective data throughput rates using the modulation and encoding methods of a specific Fieldbus technology. Requirements for effective data rate values can also include statements of maximum acceptable values for BER and burst errors (such as in 23.9 of IEC 61158-2:2014 and Annex K).

4.3.2.2 Network characteristics for balanced cabling not based on Ethernet

For balanced cabling not based on Ethernet, the planner shall use the basic network characteristics defined in the respective installation profile according to the templates given in Table 1.