Standards Primer

Prepared and delivered by The Cabling Partnership

28th November 2001

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AGENDA

Mike Gilmore

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ISO/IEC JTC1 SC25
Secretary: WG3: Generic Cabling
Member: Project Team: SOHO

CENELEC
50173 Ed.2 (2002)
Convenor: TC215 WG1: IT Cabling

BSI
Chairman TCT7/-/1: IT Cabling
Chairman TCT7/-/3: IT Cabling

Fibreoptic Industry Association
Standards Director
Technical Director

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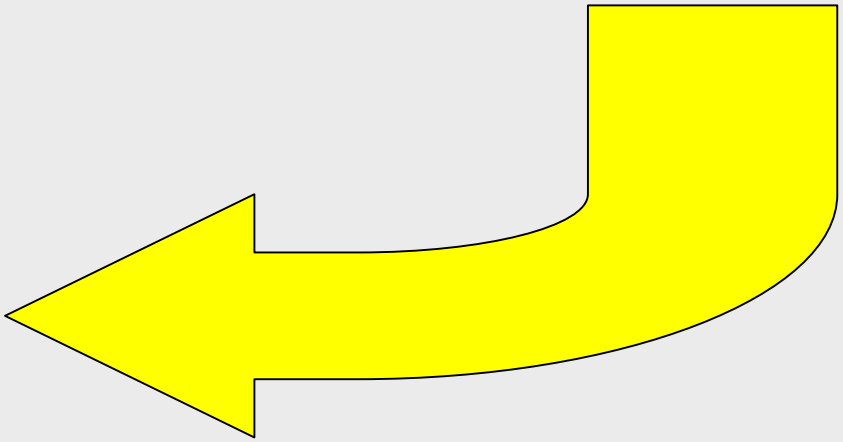
- Introduction
- Standards Inter-relationships
- Break
- Standards Inter-relationships
- Status of ISO/IEC and CLC
- Break
- The Differing Requirements
- Break
- The Differing Requirements
- Break
- Retro-Cabling
- New Projects
- Close

Agenda



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  - The Standards Matrix
  - CENELEC Cabling Standards
  - CENELEC Cable Standards
  - CENELEC Connecting Hardware Standards
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Standards Inter-relationships

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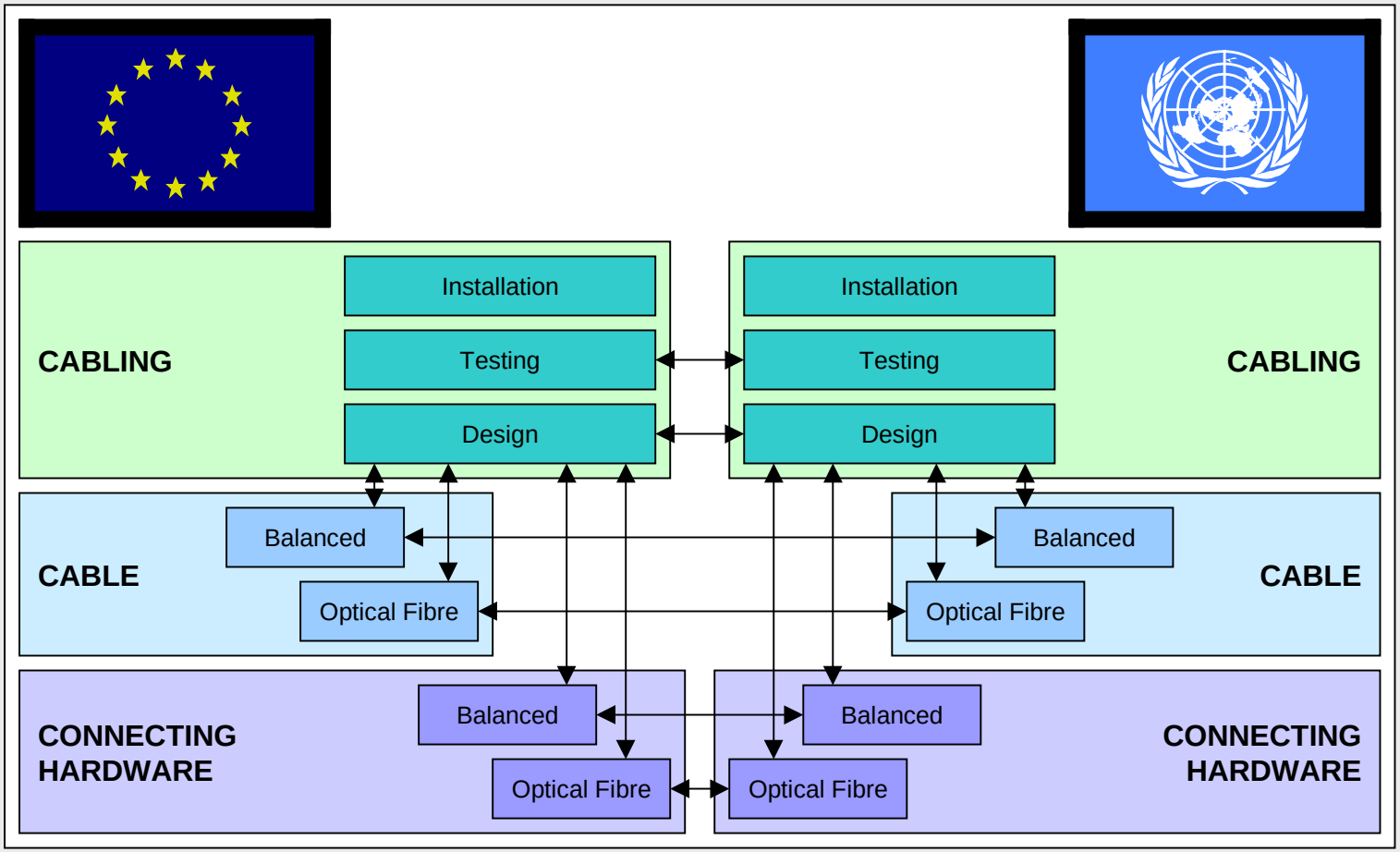
The Standards Matrix



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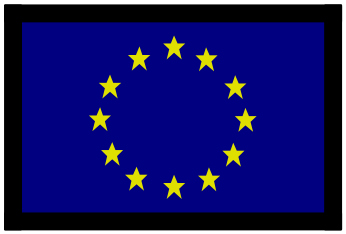
CLC Cabling Standards - I



All balanced and optical fibre cabling (not just generic)

CABLING

Installation	EN 50174-1	Ed. 1 (2001)
	EN 50174-2	Ed. 1 (2001)
	EN 50174-3	Ed. 1 (2003)

ARENA	REFERENCE	TITLE
EN	50174-1	Information technology - Cabling installation Part 1: Specification and quality assurance
EN	50174-2	Information technology - Cabling installation Part 2: Installation planning and practices inside buildings
EN	50174-3	Information technology - Cabling installation Part 3: Installation planning and practices outside buildings

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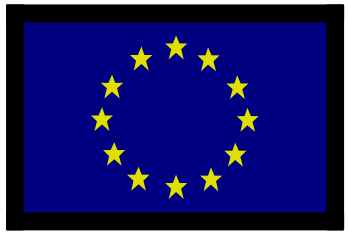
CLC Cabling Standards - II



All balanced and optical fibre cabling (not just generic)

CABLING | Testing | EN 50346 | Ed. 1 (2002)

ARENA	REFERENCE	TITLE
EN	50346	Information technology - Testing of installed cabling
IEC	61280-4-2	Fibre optic communication subsystem basic test procedures Part 4-2: Fibre optic cable plant - Single-mode fibre optic cable plant attenuation

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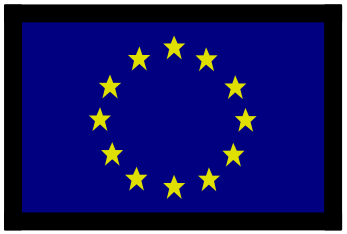
CLC Cabling Standards - III



CABLING

Design	EN 50173	Ed. 1 (1995)
		Ed. 1 A.1 (2000)
		Ed. 2 (2002)

ARENA	REFERENCE	TITLE
EN	50173	Information technology - Generic cabling systems

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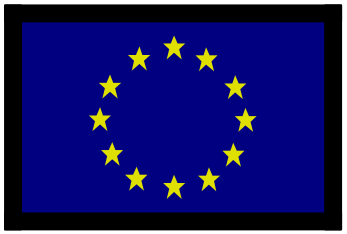
CLC Cabling Standards - IV



CABLING

Design	EN 50098-1	Ed. 1 (1998)
		Ed. 1 A.1 (2001)
	EN 50098-2	Ed. 1 (1996)

ARENA	REFERENCE	TITLE
EN	50098-1	Customer premises cabling for information technology Part 1: ISDN basic access
EN	50098-2	Customer premises cabling for information technology Part 2: 2048 kbit/s ISDN primary access and leased line network interface

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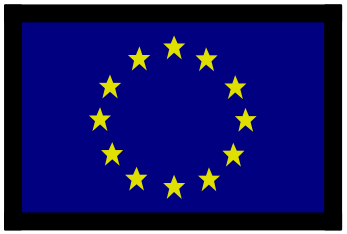
CLC Cabling Standards Committees



CABLING	Installation	EN 50174-1	CLC TC 215 WG1
		EN 50174-2	CLC TC 215 WG2
		EN 50174-3	CLC TC 215 WG2
	Testing	EN 50346	CLC TC 215 WG1
	Design	EN 50173	CLC TC 215 WG1
		EN 50098-1	CLC TC 215 WG1
		EN 50098-2	CLC TC 215 WG1

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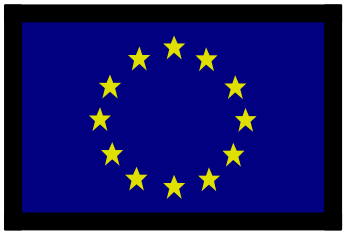
CLC Cable Standards - I



Partial reference from EN 50173 Ed.1

CABLE	Balanced	EN 50167	Ed. 1 (1994)
		EN 50168	Ed. 1 (1994)
		EN 50169	Ed. 1 (1994)

ARENA	REFERENCE	TITLE
EN	50167	Sectional specification for horizontal floor wiring cables with a common overall screen for use in digital communication
EN	50168	Sectional specification for work area wiring cables with a common overall screen for use in digital communication
EN	50169	Sectional specification for backbone cables, riser and campus, with a common overall screen for use in digital communication

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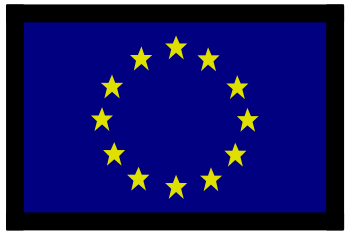
CLC Cable Standards - II



Complete reference from EN 50173 Ed.2

CABLE

Balanced

EN 50288-2-1	Ed. 1 (2001)	Ed. 1 A.1 (2002)
EN 50288-2-2	Ed. 1 (2001)	Ed. 1 A.1 (2002)
EN 50288-3-1	Ed. 1 (2001)	Ed. 1 A.1 (2002)
EN 50288-3-2	Ed. 1 (2001)	Ed. 1 A.1 (2002)
EN 50288-4-1	Ed. 1 (2001)	Ed. 1 A.1 (2002)
EN 50288-4-2	Ed. 1 (2001)	Ed. 1 A.1 (2002)
EN 50288-5-1		Ed. 1 (2002)
EN 50288-5-2		Ed. 1 (2002)
EN 50288-6-1		Ed. 1 (2002)
EN 50288-6-2		Ed. 1 (2002)

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CLC Cable Standards - III

ARENA	REFERENCE	TITLE
Euro Cat. 5e = Cat. 5 (2002)		
EN	50288-2-1	... screened cables … up to 100 MHz: Horizontal and building backbone cables
EN	50288-2-2	... screened cables … up to 100 MHz: Work area and patch cord cables
EN	50288-3-1	... unscreened cables … up to 100 MHz: Horizontal and building backbone cables
EN	50288-3-2	... unscreened cables … up to 100 MHz: Work area and patch cord cables
Euro Cat. 7		
EN	50288-4-1	... screened cables … up to 600 MHz: Horizontal and building backbone cables
EN	50288-4-2	... screened cables … up to 600 MHz: Work area and patch cord cables
Euro Cat. 6		
EN	50288-5-1	... screened cables … up to 250 MHz: Horizontal and building backbone cables
EN	50288-5-2	... screened cables … up to 250 MHz: Work area and patch cord cables
EN	50288-6-1	... unscreened cables … up to 250 MHz: Horizontal and building backbone cables
EN	50288-6-2	... unscreened cables … up to 250 MHz: Work area and patch cord cables

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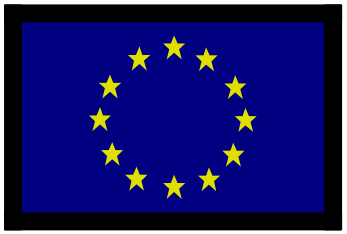
CLC OF Standards - I



Partial reference from
EN 50173 Ed.1 and Ed.2

CABLE	Optical fibre	SMF	EN 188100	Ed. 1 (1995)
		SMF	EN 188101	Ed. 1 (1995)
		50/125	EN 188201	Ed. 1 (1995)
		62.5/125	EN 188202	Ed. 1 (1995)

ARENA	REFERENCE	TITLE
EN	188100	Harmonized system of quality assessment for electronic components. Sectional specification: single-mode (SM) optical fibre.
EN	188101	Harmonized system of quality assessment for electronic components. Family specification: single-mode dispersion unshifted (B1.1) optical fibre.
EN	188201	Harmonized system of quality assessment for electronic components. Sectional specification: A1a graded index multimode optical fibres.
EN	188202	Harmonized system of quality assessment for electronic components. Sectional specification: A1a graded index multimode optical fibres.

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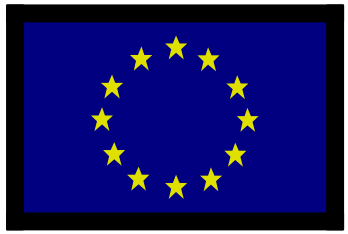
CLC OF Standards - II



CABLE

Optical fibre testing

- SMF
- MMF

EN 188000 (1994)

Reference from EN 50173 Ed.1

Proposed reference from EN 50173 Ed.2

EN 60793-1-40	Ed.1 (2002)	Attenuation
EN 60793-1-44		Cut off wavelength
EN 60793-1-40	Ed.1 (2002)	Attenuation
EN 60793-1-41		Bandwidth

ARENA	REFERENCE	TITLE
EN	188000	Generic specification for optical fibres
EN	60793-1-40	Optical fibres Part 1-40: Measurement methods and test procedures - Attenuation
EN	60793-1-41	Optical fibres Part 1-41: Measurement methods and test procedures - Bandwidth
EN	60793-1-44	Optical fibres Part 1-44: Measurement methods and test procedures - Cut off wavelength

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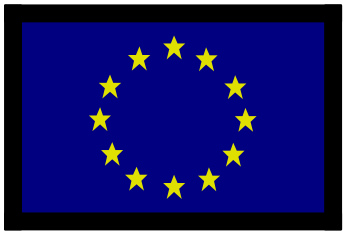
CLC OF Cable Standards



			Reference from EN 50173 Ed.1	Proposed reference from EN 50173 Ed.2	
CABLE	Optical fibre cable	General	EN 187000 (1994)	EN 60794-1-1	Ed.2 A.1 (2001)
		Indoor	IEC 60794-2	EN 60794-2	Ed.2 A.1(2001)
		Outdoor	IEC 60793-3	EN 60794-3	Ed.2 A.1(2001)

ARENA	REFERENCE	TITLE
EN	187000	Generic specification for optical fibre cables
EN/IEC	60794-1-1	Optical fibre cables -- Part 1-1: Generic specification - General
EN/IEC	60794-2	Indoor optical fibre cables Part 2: Indoor cables - Sectional specification
EN/IEC	60794-3	Optical fibre cables Part 3: Duct, buried and aerial cables - Sectional specification

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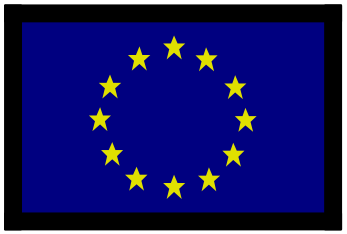
CLC Cable Standards Committees



CABLE	Balanced	EN 50288	CLC SC46XC
	Optical Fibre	EN 60793	CLC/TC86A
	OF Cable	EN 60794	CLC/TC86A

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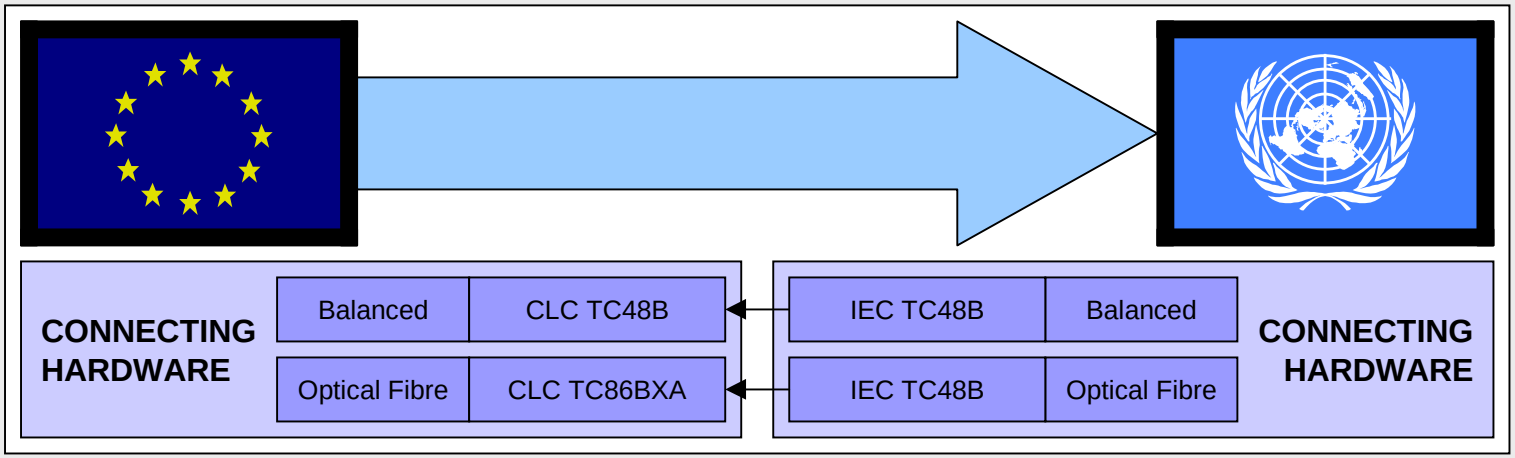
CLC Connecting Hardware



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Break

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Standards Inter-relationships

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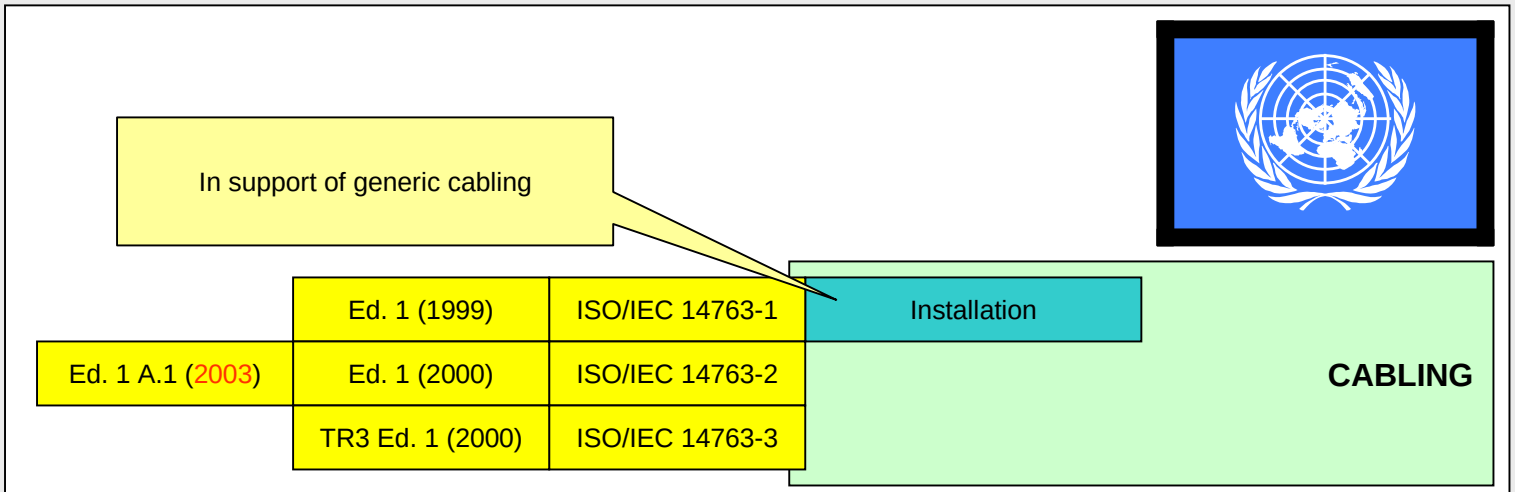
ISO/IEC Cabling Standards - I



ARENA	REFERENCE	TITLE
ISO/IEC	14763-1	Information technology - Implementation and operation of customer premises cabling Part 1: Administration
ISO/IEC	TR3 14763-2	Information technology - Implementation and operation of customer premises cabling Part 2: Planning and installation
ISO/IEC	TR3 14763-3	Information technology - Implementation and operation of customer premises cabling Part 3: Testing of optical fibre cabling

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ISO/IEC Cabling Standards - II

In support of generic cabling
• horizontal
• balanced

Ed. 1 A.1 (2001)	Ed. 1 (2000)	IEC 61935-1	Testing
	Ed. 1 (2002)	IEC 61280-4-1	
	Ed. 1 (1998)	IEC 61280-4-2	

CABLING

ARENA	REFERENCE	TITLE
IEC	61935-1	Generic cabling systems - Specification for the testing of balanced communication cabling in accordance with ISO/IEC 11801 - Part 1: Installed cabling
IEC	61280-4-1	Fibre optic communication subsystem basic test procedures - Part 4-2: Fibre optic cable plant - Multimode fibre optic cable plant attenuation
IEC	61280-4-2	Fibre optic communication subsystem basic test procedures - Part 4-2: Fibre optic cable plant - Single-mode fibre optic cable plant attenuation

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ISO/IEC Cabling Standards - III

CABLING

Ed. 1 (1995)	ISO/IEC 11801	Design
Ed. 1 A.1 (1999)		
Ed. 1 A.2 (1999)		
Ed. 1.2 (2000)		
Ed. 2 (2002)		

ARENA	REFERENCE	TITLE
ISO/IEC	11801	Information technology: Generic cabling for customer premises

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ISO/IEC Cabling Standards - IV

CABLING

Ed. 1 (1997)	ISO/IEC 14709-1	Design
Ed. 1 (1998)	ISO/IEC 14709-2	

ARENA	REFERENCE	TITLE
ISO/IEC	14709-1	Information technology: Configuration of Customer Premises Cabling (CPC) for applications Part 1: Integrated Services Digital Network (ISDN) basic access
ISO/IEC	14709-2	Information technology: Configuration of Customer Premises Cabling (CPC) for applications Part 2: Integrated Services Digital Network (ISDN) primary rate

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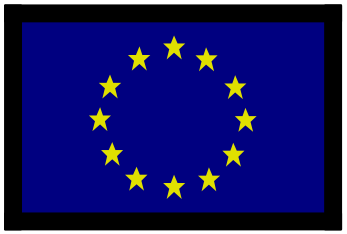
ISO Cabling Standards Committee



ISO/IEC JTC1 SC25 WG3	ISO/IEC 14673-1	Installation
ISO/IEC JTC1 SC25 WG3	ISO/IEC 14673-2	
IEC SC46A WG2	IEC 61935-1	Testing
ISO/IEC JTC1 SC25 WG3	ISO/IEC 14673-3	
ISO/IEC JTC1 SC25 WG3	ISO/IEC 11801	Design
ISO/IEC JTC1 SC25 WG3	ISO/IEC 14709-1	
ISO/IEC JTC1 SC25 WG3	ISO/IEC 14709-2	

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AGENDA

ISO/IEC Cable Standards - I

Partial reference from ISO/IEC 11801 Ed.1

Ed. 1 (1994) | IEC 61156-1 | Balanced | **CABLE**

ARENA	REFERENCE	TITLE
IEC	61156-1	Multicore and symmetrical pair/quad cables for digital communications Part 1: Generic specification

AGENDA

ISO/IEC Cable Standards - I

Proposed complete reference from ISO/IEC 11801 Ed.2

	Ed. 1 (1994)	IEC 61156-1	Balanced — **CABLE**
	Ed. 1 A.1 (1999)		
	Ed. 1 A.2 (2001)		
	Ed. 1.2 (2001)		
Ed. 1 A.1 (2002)	Ed. 1 PAS (2001)	IEC 61156-5	
Ed. 1 A.1 (2002)	Ed. 1 PAS (2001)	IEC 61156-6	

ARENA	REFERENCE	TITLE
IEC	61156-1	Multicore and symmetrical pair/quad cables for digital communications Part 1: Generic specification
IEC PAS	61156-5	Symmetrical pair/quad cables for digital communications with transmission characteristics up to 600MHz: Horizontal floor wiring: Sectional specification
IEC PAS	61156-6	Symmetrical pair/quad cables for digital communications with transmission characteristics up to 600MHz: Work area wiring: Sectional specification

AGENDA

IEC OF Standards - I

Proposed partial reference from ISO/IEC 11801 Ed.2

Partial reference from ISO/IEC 11801 Ed.1

Ed. 4 A.1(2001)	Ed. 1 (1992)	IEC 60793-2 (Type B1)	SMF	Optical fibre	**CABLE**
2000		ITU-T G.652	SMF		
Ed. 4 A.1(2001)	Ed. 1 (1992)	IEC 60793-2 (Type A1a)	50/125		
Ed. 4 A.1(2001)	Ed. 1 (1992)	IEC 60793-2 (Type A1b)	62.5/125		

ARENA	REFERENCE	TITLE
IEC	IEC 60793-2	Optical fibres Part 2: Product specifications
ITU-T	ITU-T G.652	Characteristics of a single-mode optical fibre cable

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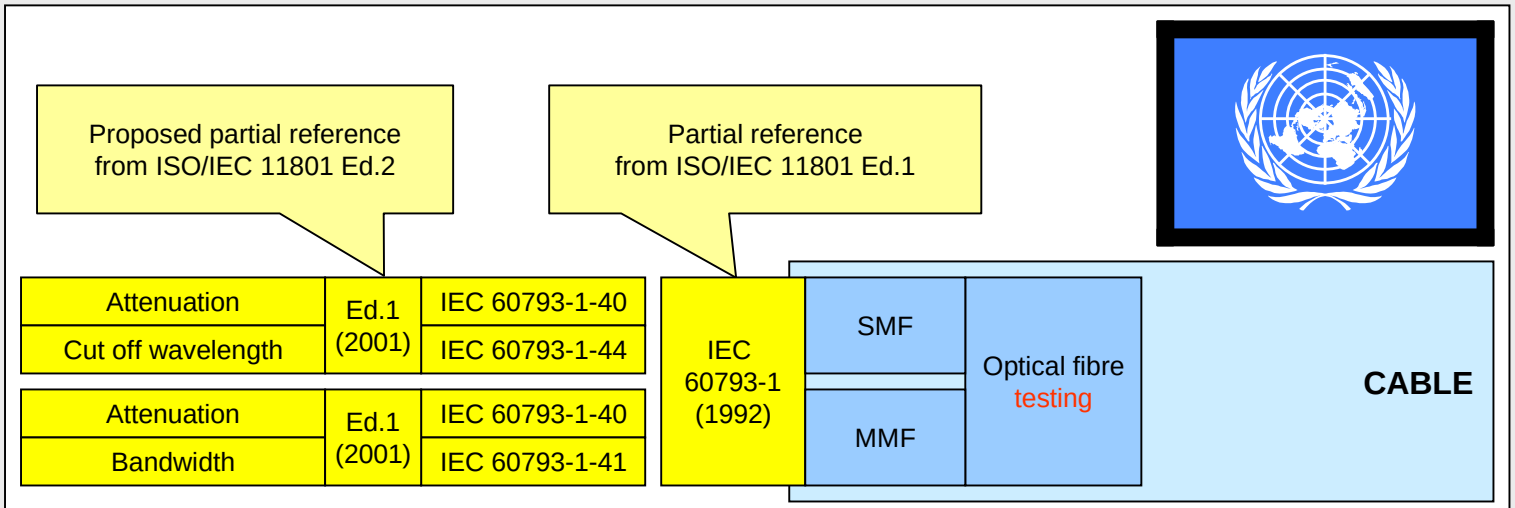
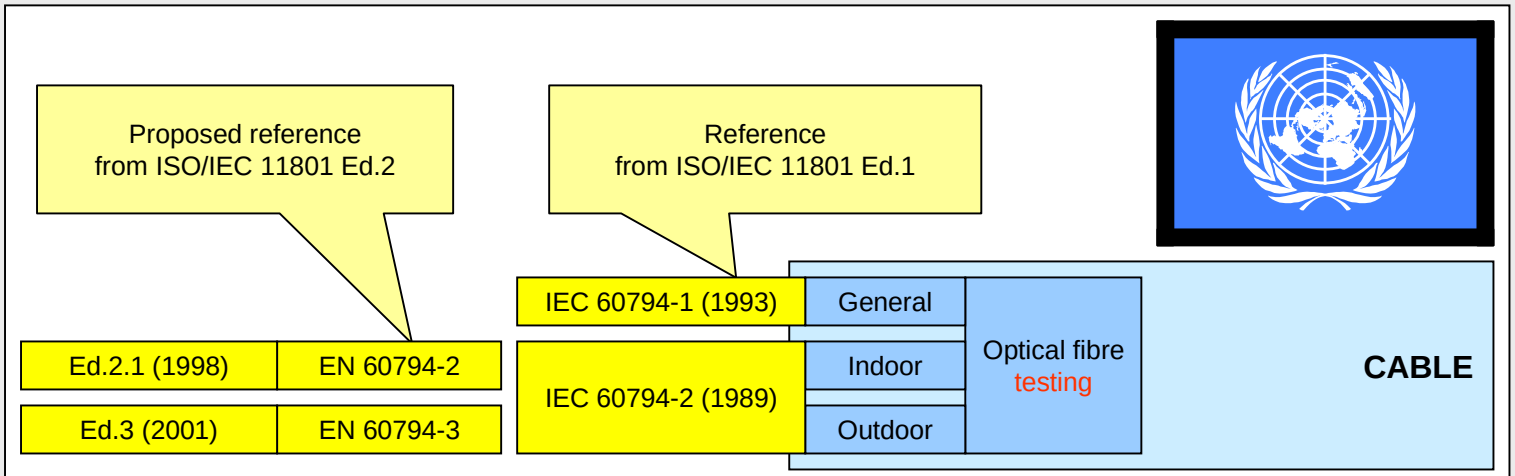
IEC OF Standards - I



ARENA	REFERENCE	TITLE
IEC	60793-1	Optical fibres Part 1: Generic specification
IEC	60793-1-40	Optical fibres Part 1-40: Measurement methods and test procedures - Attenuation
IEC	60793-1-41	Optical fibres Part 1-41: Measurement methods and test procedures - Bandwidth
IEC	60793-1-44	Optical fibres Part 1-44: Measurement methods and test procedures - Cut off wavelength

AGENDA

IEC OF Cable Standards



ARENA	REFERENCE	TITLE
IEC	60794-1	Optical fibre cables (discontinued) Part 1: Generic specification
IEC	60794-2	Optical fibre cables (discontinued) Part 2: Product specification
IEC	60794-2	Indoor optical fibre cables Part 2: Indoor cables - Sectional specification
IEC	60794-3	Optical fibre cables Part 3: Duct, buried and aerial cables - Sectional specification

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IEC Cable Standards Committees

IEC 61156	IEC SC46C	Balanced	**CABLE**
IEC 60793	IEC SC86A	Optical Fibre	
IEC 60794	IEC SC86A	OF Cable	

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Connecting Hardware Standards

Proposed complete reference from ISO/IEC 11801 Ed.2

Category 5 (2002)	Unscreened	Ed. 1 (2002)	IEC 60603-7-2	Balanced
Category 5 (2002)	Screened	Ed. 1 (2002)	IEC 60603-7-3	
Category 6	Unscreened	Ed. 1 (2002)	IEC 60603-7-4	
Category 6	Screened	Ed. 1 (2002)	IEC 60603-7-5	
Category 7		Ed. 1 (2002)	IEC 60603-7-7	
		Ed. 1 (2002)	IEC 61076-3-134	

CONNECTING HARDWARE

ARENA	REFERENCE	TITLE
IEC	60603-7-x	Detail specification for 8 way connectors, with assessed quality,including fixed and free connectors with common mounting features; test methods and related requirements for use at frequencies up to …..
IEC	61076-3-134	Connectors with assessed quality for use in d.c., low frequency analogue and in digital high speed data applications - Part 3-104: 8 way connectors for frequencies up to 600 MHz

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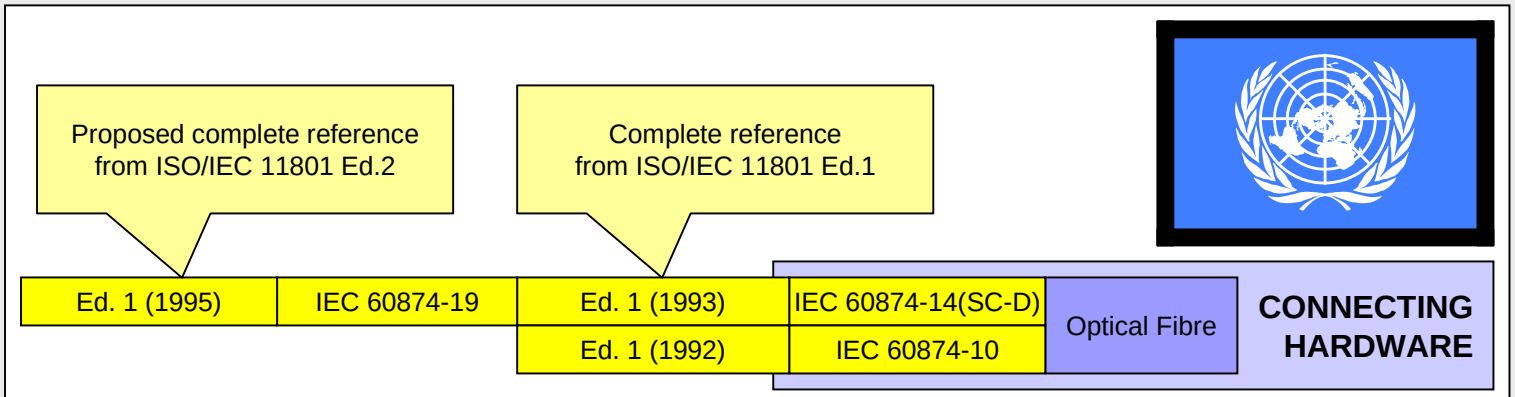
Connecting Hardware Standards



ARENA	REFERENCE	TITLE
IEC	60874-10	Connectors for optical fibres and cables Part 10: Sectional specification for fibre optic connector - Type BFOC2,5
IEC	60874-14	Connectors for optical fibres and cables Part 14: Sectional specification for fibre optic connector - Type SC
IEC	60874-19	Connectors for optical fibres and cables Part 19: Sectional specification for fibre optic connector - Type SC Duplex

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IEC CH Standards Committees

IEC 60603-7	IEC SC48B	Balanced	**CONNECTING HARDWARE**
IEC 61076-3-104			
IEC 60874-19	IEC SC86B	Optical Fibre	

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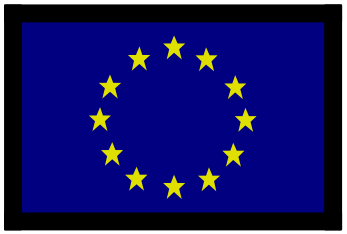
Standards Committee Relations



Design	CLC TC215 WG1	**CABLING**	ISO/IEC JTC1 SC25 WG3	Design
Installation	CLC TC215 WG1/2		ISO/IEC JTC1 SC25 WG3	Installation
Testing	CLC TC215 WG1		IEC SC46A WG2 (Cu) ISO/IEC JTC1 SC25 WG3 (OF)	Testing
Balanced	CLC SC46XC	**CABLE**	IEC SC46C	Balanced
Optical Fibre	CLC TC86A		IEC SC86A	Optical Fibre
OF Cable	CLC TC86A		IEC SC86A	OF Cable
Balanced	CLC SC48B	**CONNECTING HARDWARE**	IEC SC48B	Balanced
Optical Fibre	CLC TC86B		IEC SC86B	Optical Fibre

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The Status of the Standards

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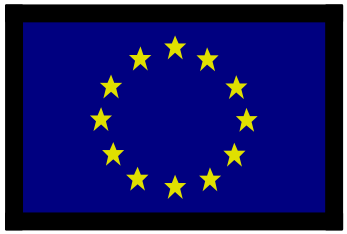
ISO, EN and US



EN 50173 Ed.2 (2002)

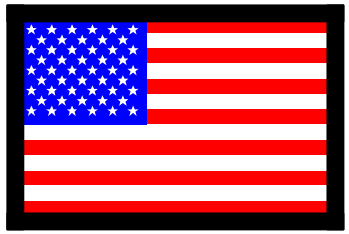
Information technology
-
Generic cabling systems

- SE — Completed
- 6MP begins — July, 2001
- 3MV begins — Q2, 2002
- publication — Q4, 2002

ISO/IEC 11801 Ed.2 (2002)

Information technology
-
Generic cabling for customer premises

- 2nd CD — Completed
- FCD — NOW (N739)
- FDIS — Q2, 2002
- publication — Q4, 2002



ANSI/TIA/EIA 568 B Series

Commercial building telecommunications cabling standard

- B.1 General Requirements
  - published
- B.2 Balanced Twisted-pair Cabling
  - published
  - Addendum 1
    - Category 6
    - Draft 10 (11/01)
- B.3 Optical Fibre Cabling
  - published

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8	OF channels and links		Copper and OF links	Annexes A/B
7	Copper	**REFERENCE IMPLEMENTATIONS**	Copper and OF	6
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4	…NFORMANCE			1.2
5	STRUCTURE			4
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Annex G	Calculation of links and channels			
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Worst case

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Break

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  - Maximum Implementations
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  - Implementation Rules
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The Differing Requirements

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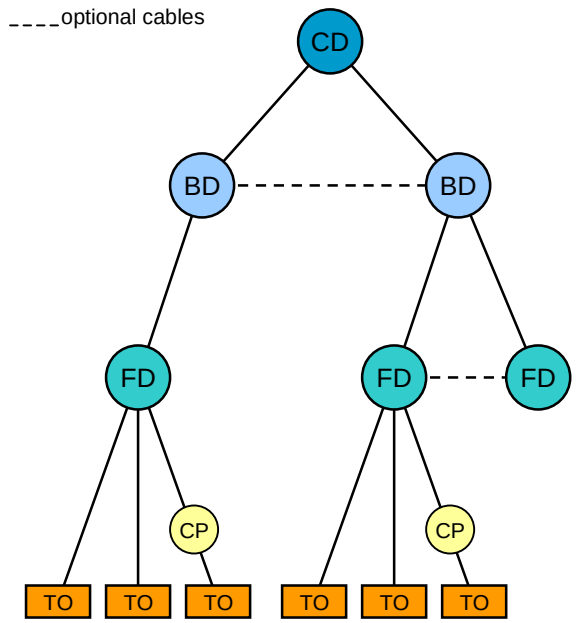
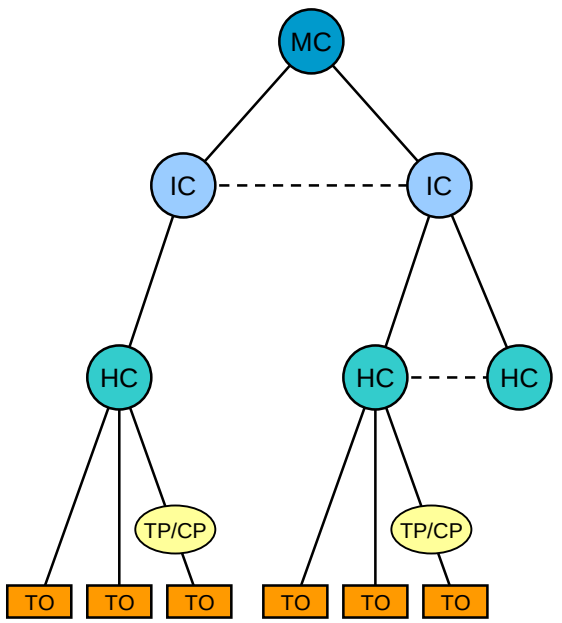
Structure

ISO/IEC and EN



CD	Campus distributor
BD	Building distributor
FD	Floor distributor
CP	Consolidation point
TO	Telecommunications outlet

ANSI/TIA/EIA-568-B.1



MC	Main cross-connect
IC	Intermediate cross-connect
HC	Horizontal cross-connect
CP	Consolidation point
TP	Transition point
TO	Telecommunications outlet

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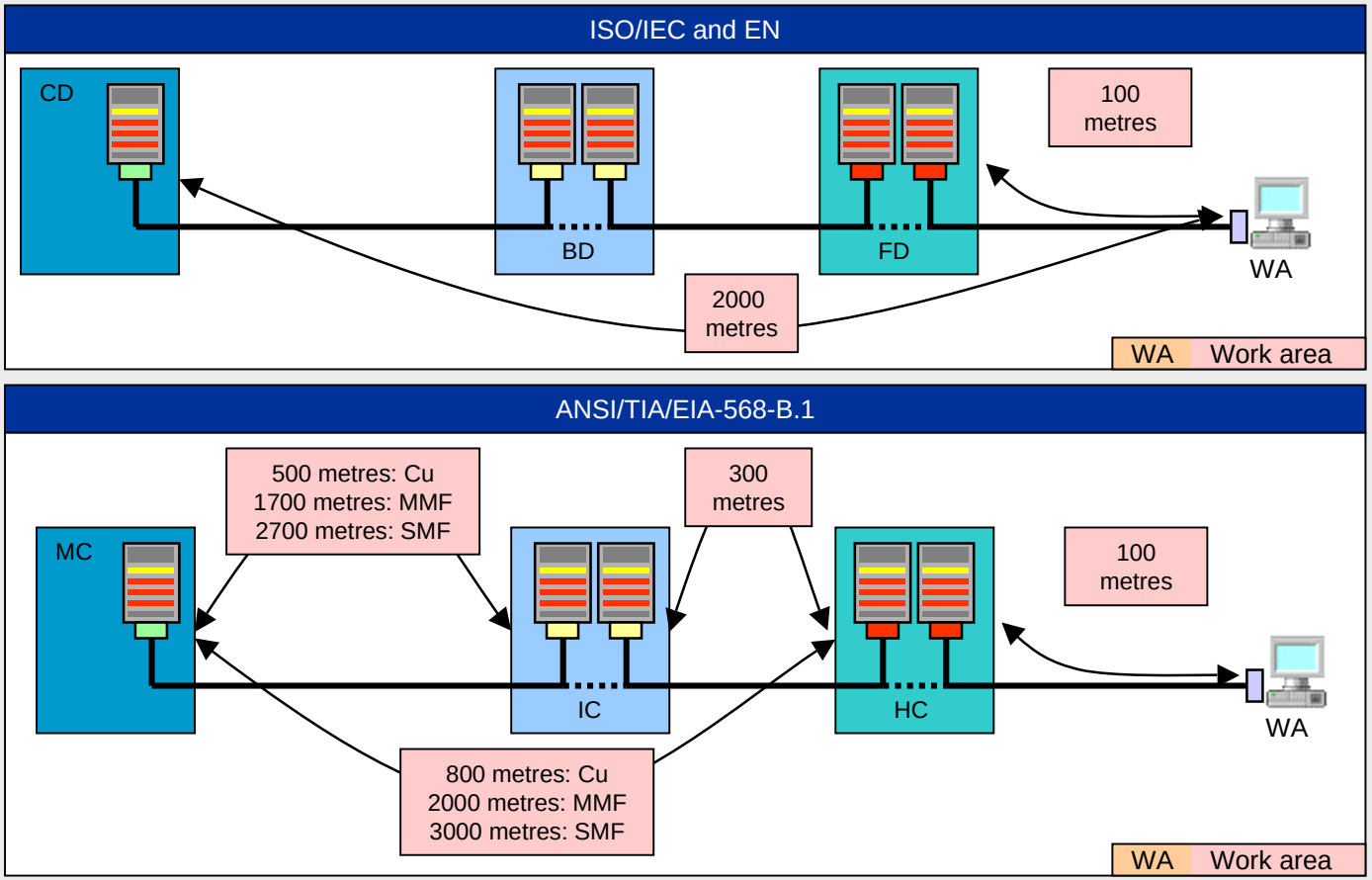
AGENDA

Maximum Implementations



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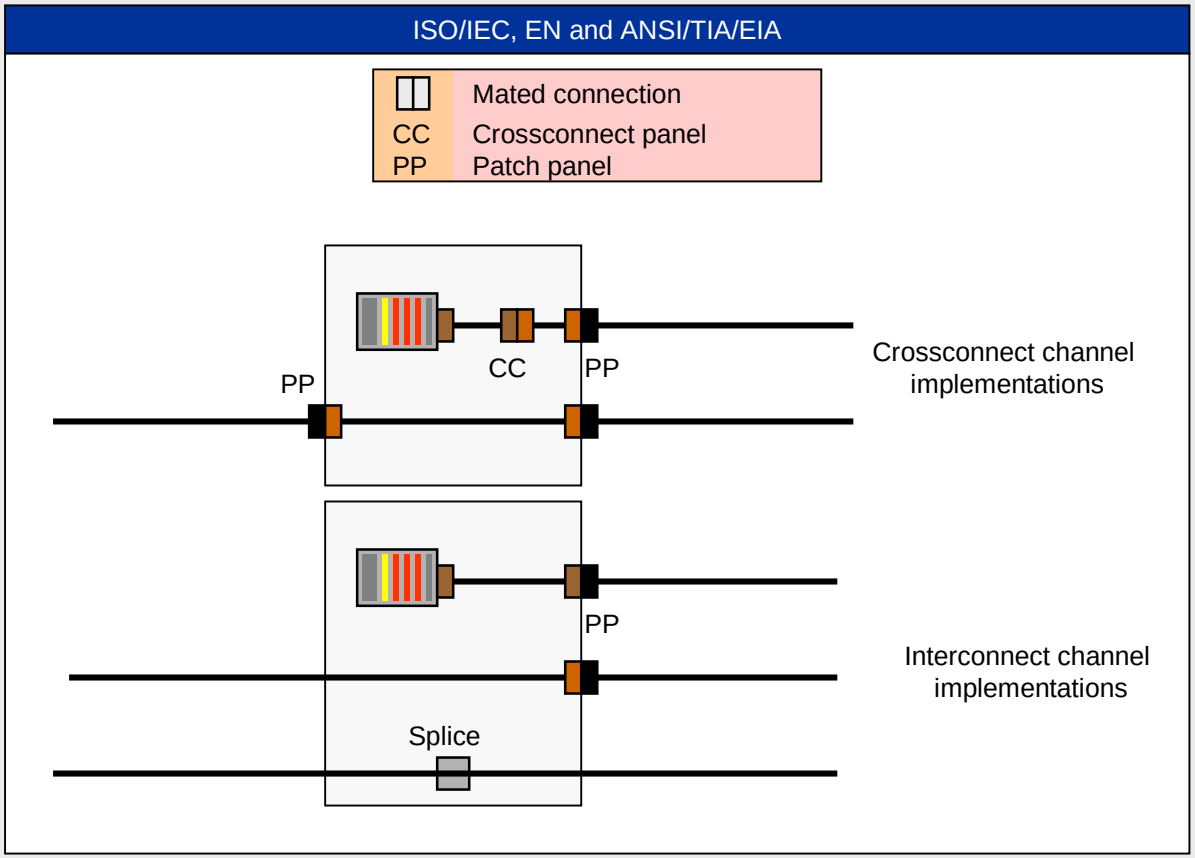
AGENDA

Inter/Cross-connects



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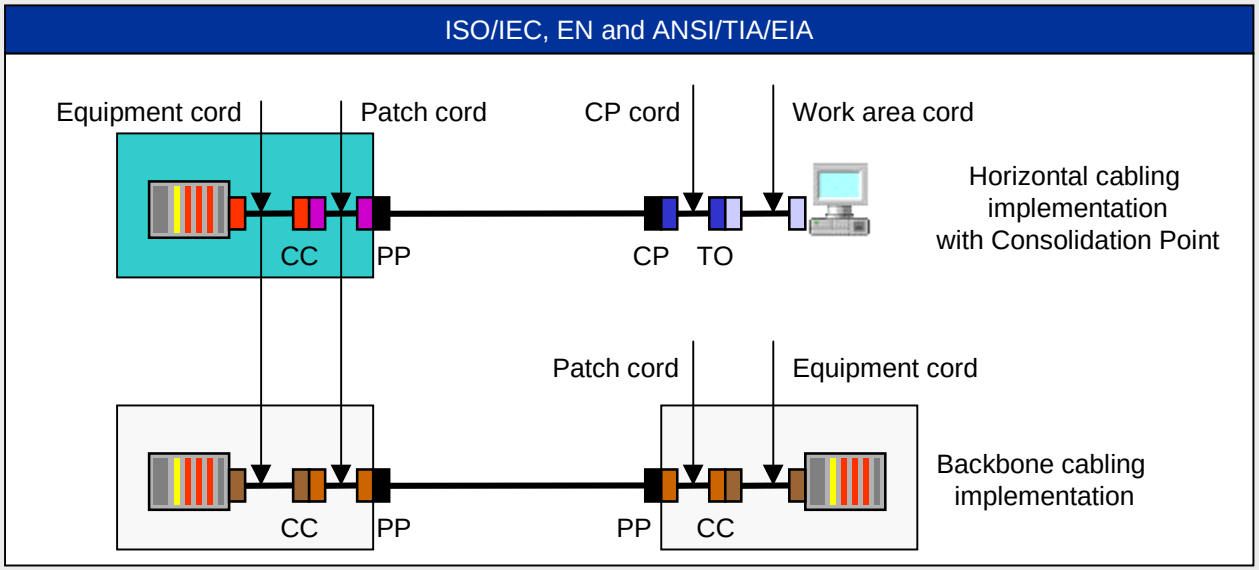
AGENDA

Cords



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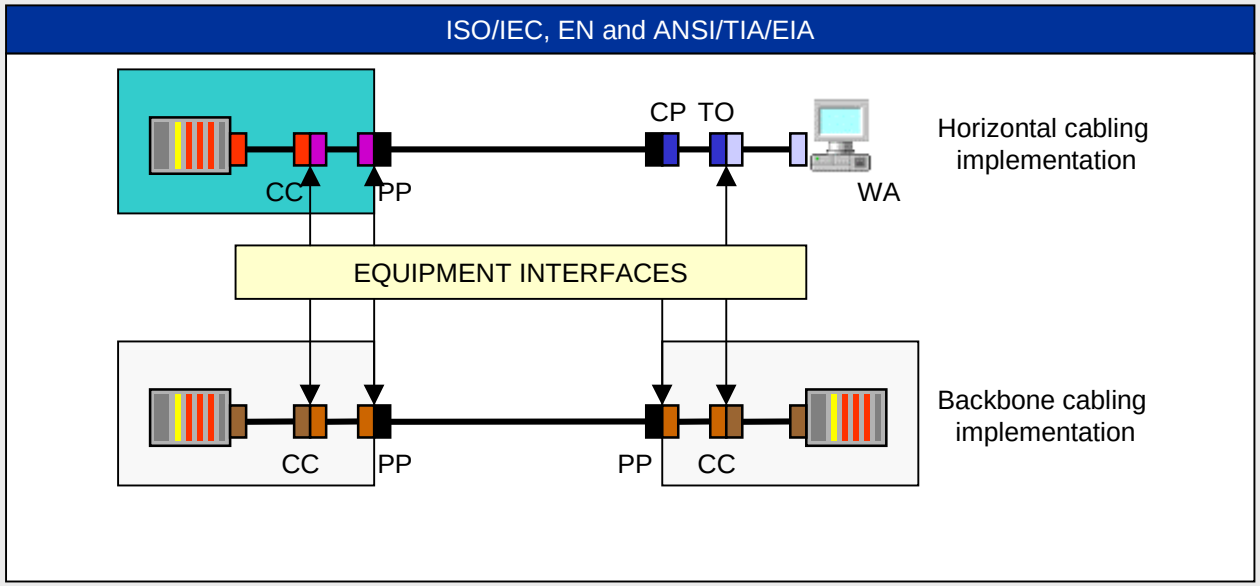
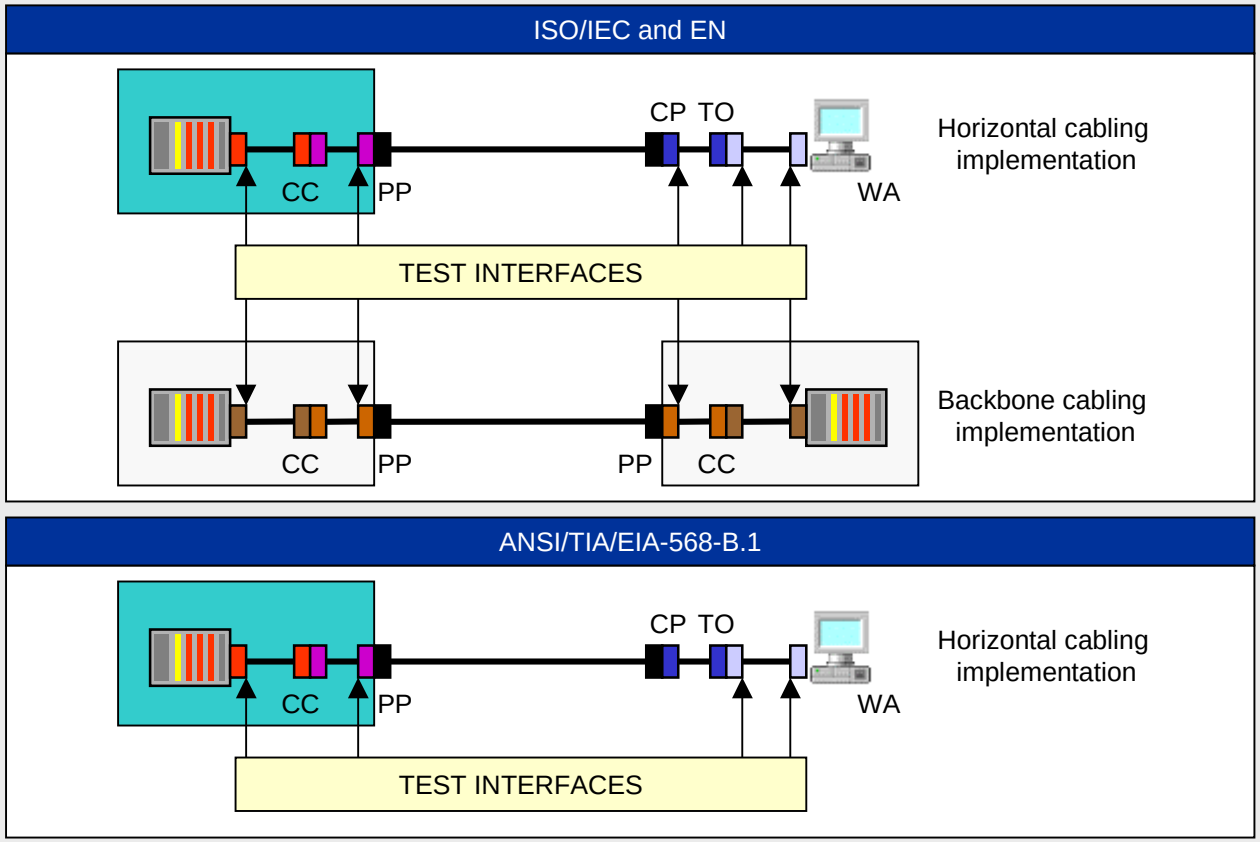
AGENDA

Equipment Interfaces



AGENDA

Test Interfaces



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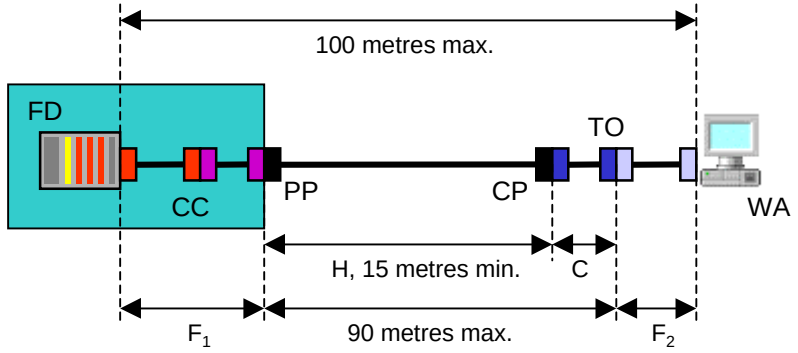
Implementation Rules

ISO/IEC and EN



$F = F_1 + F_2$

X = cord attenuation premium
Y = CP cable attenuation premium (if any)

No. of connections	Class D/Category 5	Class E/Category 6	Class F/Category 7
2	H = (109-FX)/T	H = (107-3[1]-FX)/T	H = (107-2[1]-FX)/T
3 w/o. CP	H = (107-FX)/T	H = (106-3[1]-FX)/T	H = (106-3[1]-FX)/T
3 inc. CP	H = (107-FX-CY)/T	H = (106-3[1]-FX-CY)/T	H = (106-3[1]-FX-CY)/T
4	H = (105-FX-CY)/T	H = (105-3[1]-FX-CY)/T	H = (105-4[1]-FX-CY)/T

T = 1 + (t-20) x α where t = maximum design temperature within link

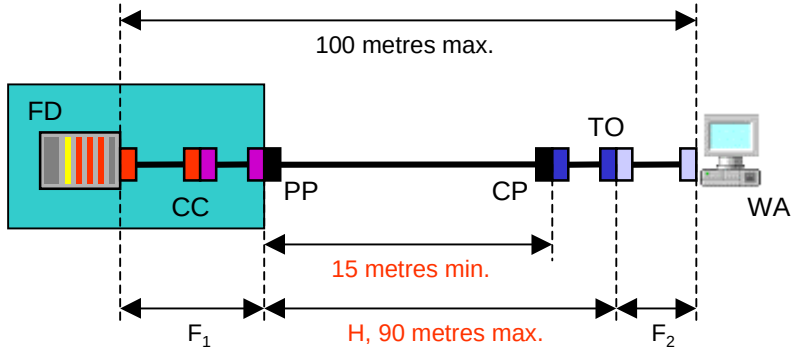
	for screened cables	for unscreened cables
X and Y	1.5 typically	1.2 typically
α	= 0.2 for t>20ºC	= 0.4 for 20ºC<t<40ºC = 0.6 for 40ºC<t<60ºC

Note 1: this length reduction is provides margin for insertion loss deviation.

AGENDA

Implementation Rules

ANSI/TIA/EIA-568-B.1



$F = F_1 + F_2$	X = cord attenuation premium

No. of connections	Class D/Category 5	Class E/Category 6
2,3 or 4	H = (102-FX)	

	for screened cables	for unscreened cables
X	1.5 typically	1.2 typically

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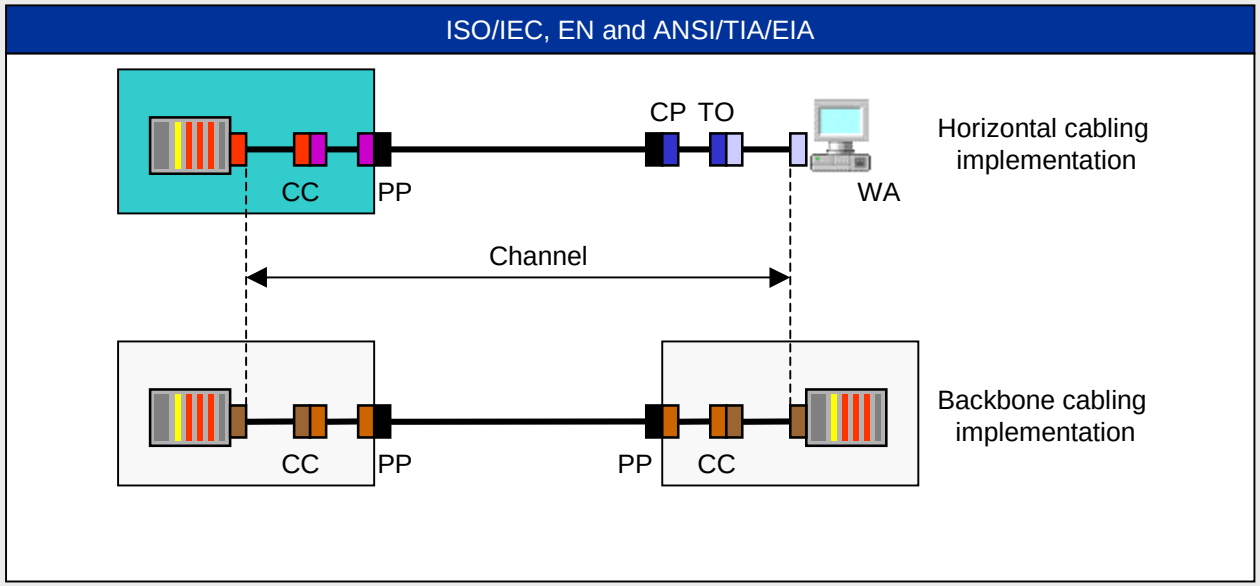
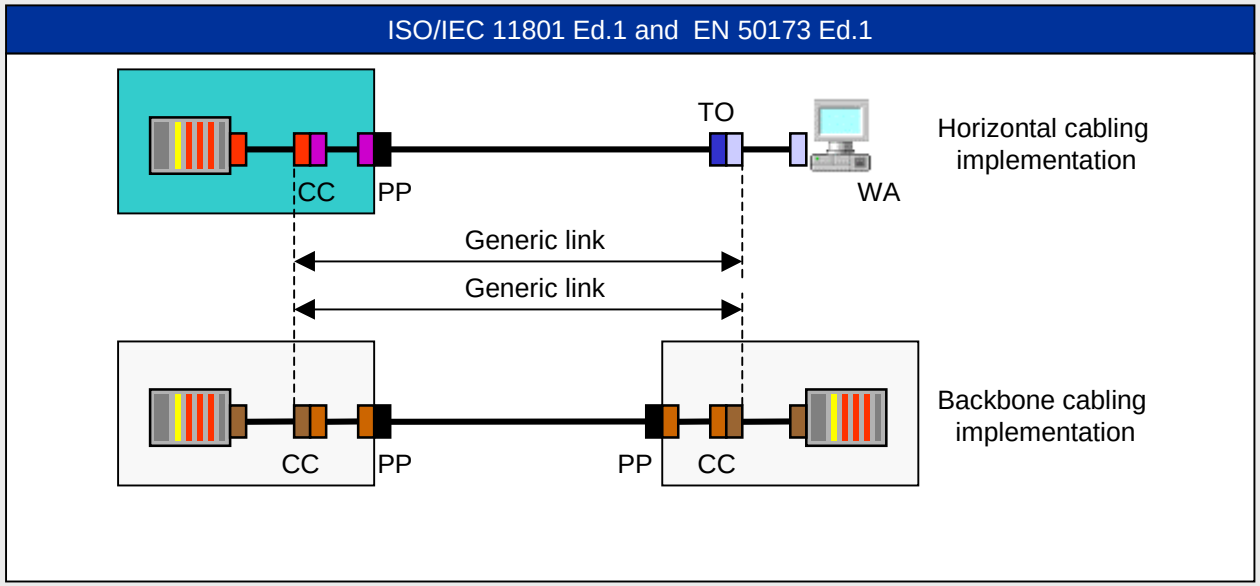
The Channel



AGENDA

Generic Link (1995)



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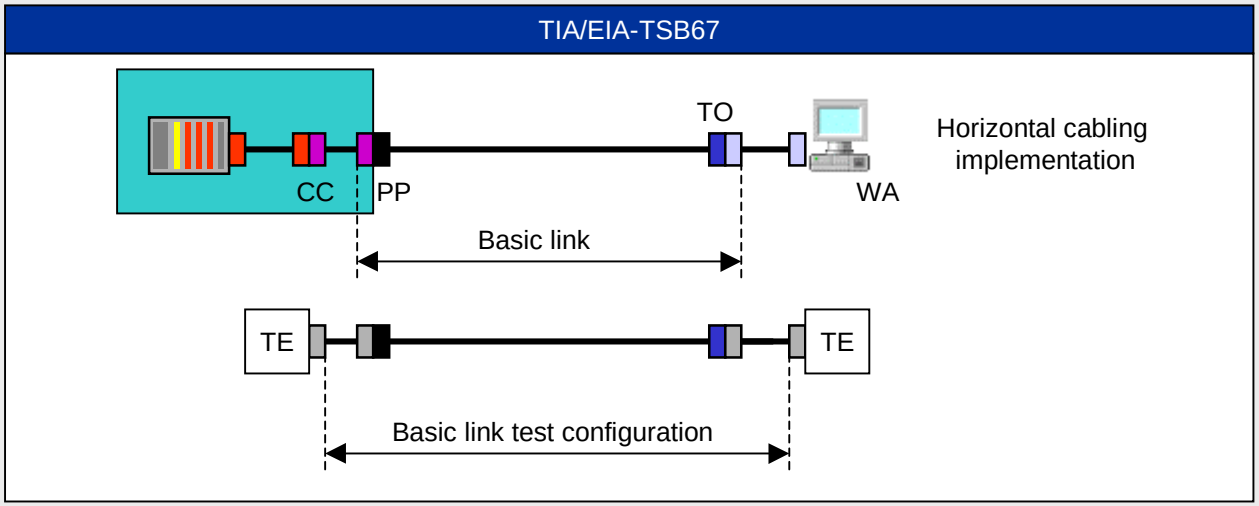
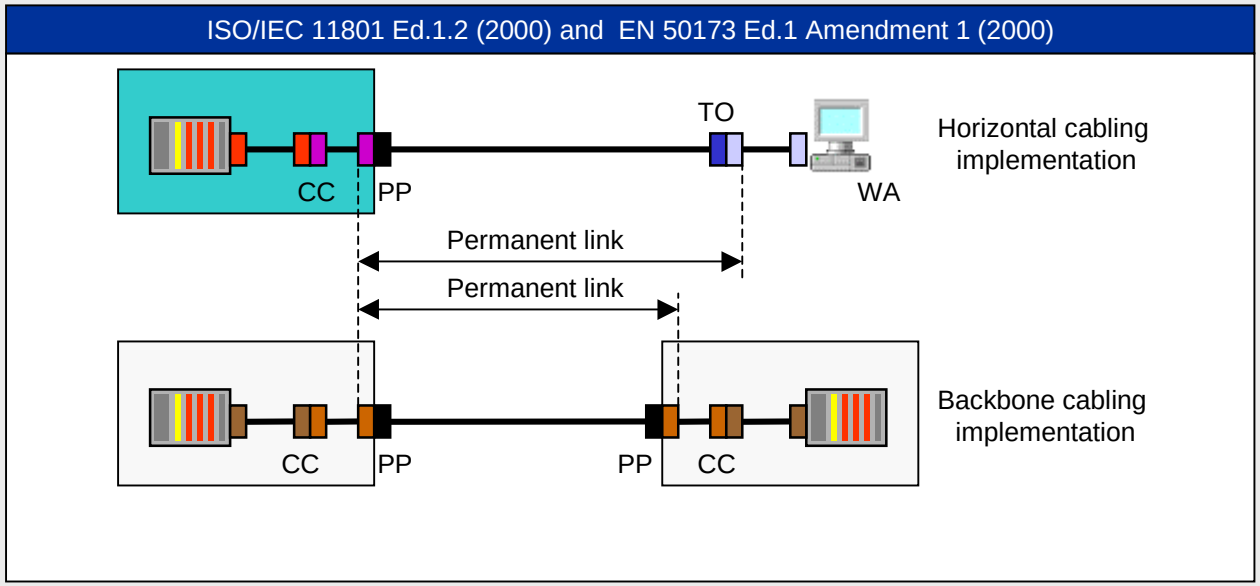
AGENDA

Basic Link (1997)



AGENDA

Permanent Link (2000)



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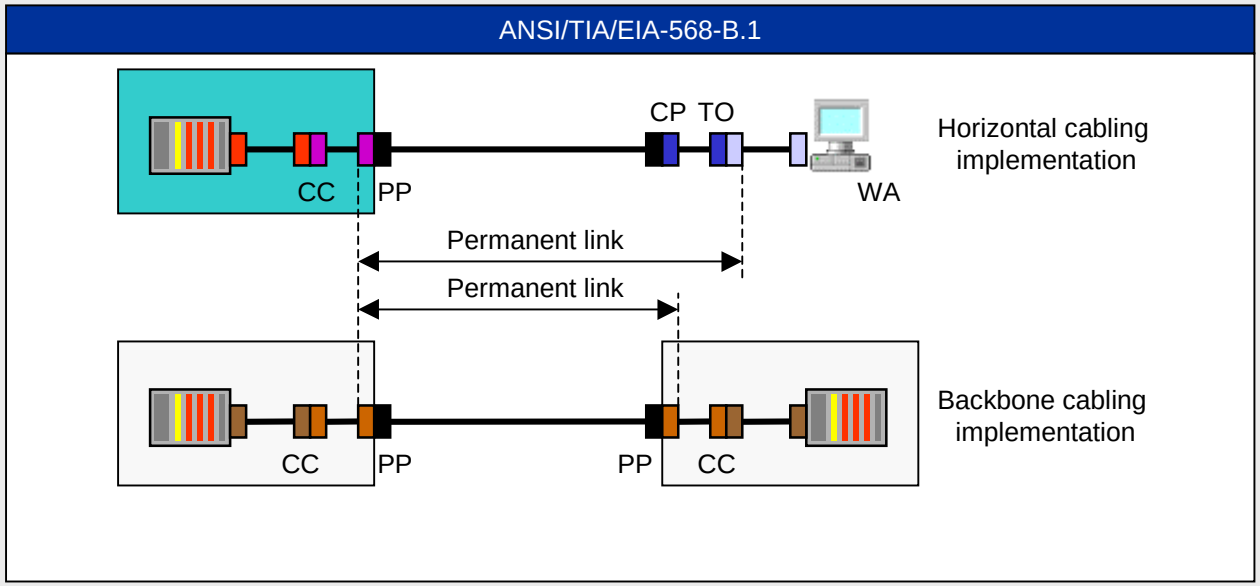
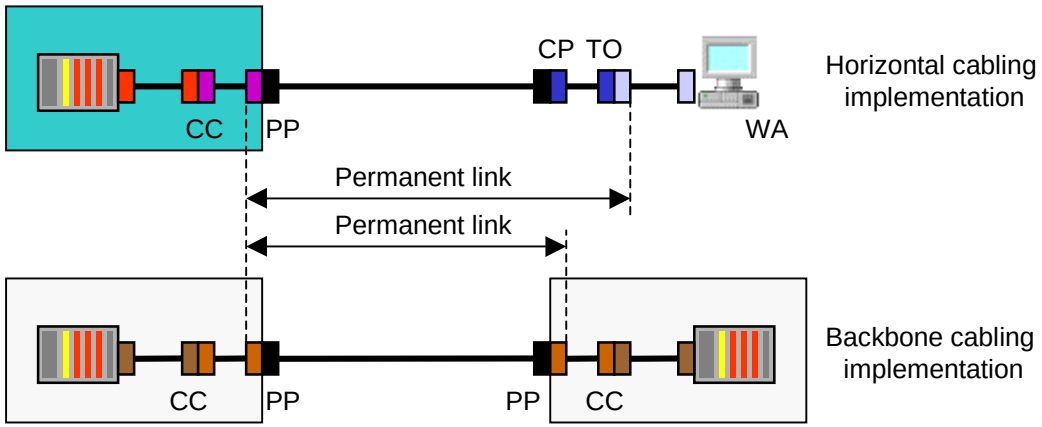
Permanent Link (2001)



AGENDA

Permanent Link (2002)

ISO/IEC 11801 Ed.2 (2002), EN 50173 Ed.2 (2002) and ANSI/TIA/EIA-568-B.1



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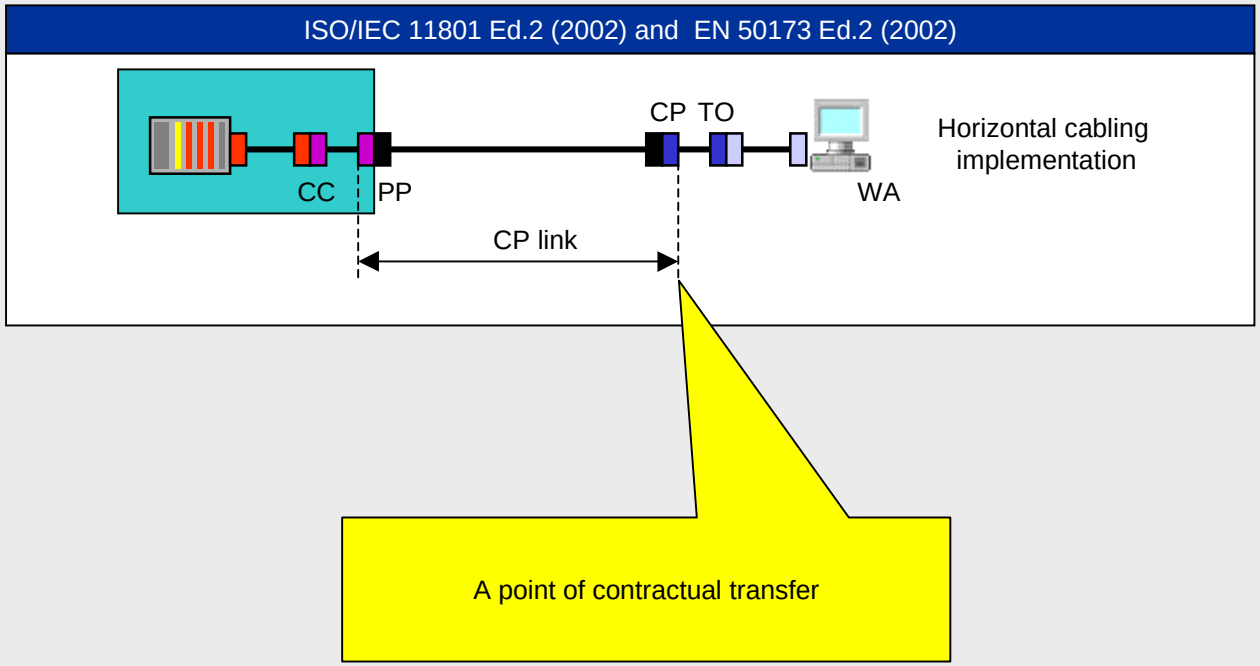
CP Link (2002)



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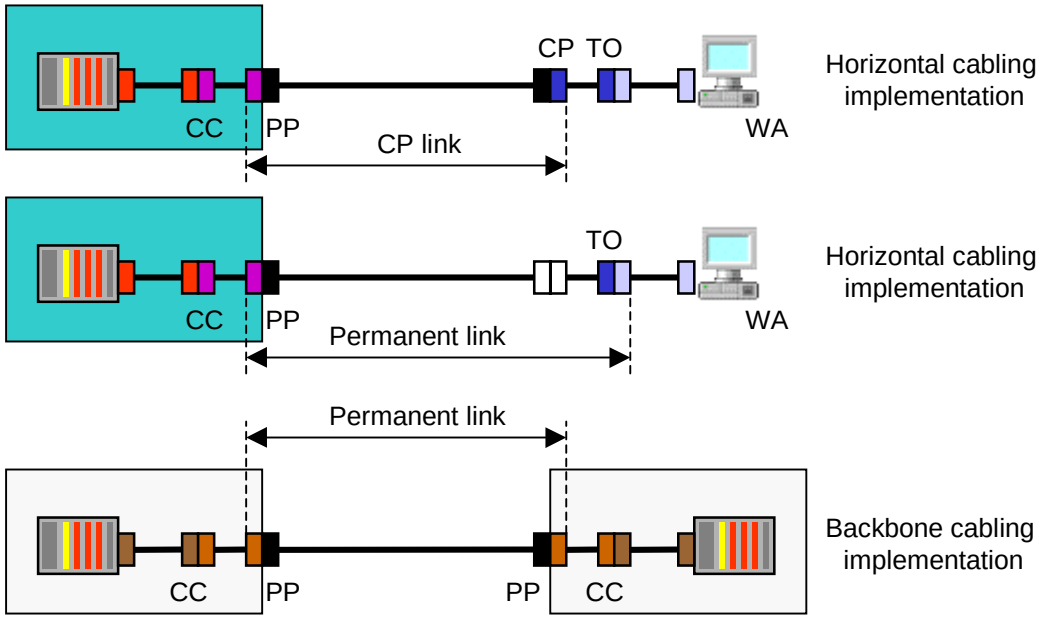
Link Limit Definition

ISO/IEC 11801 Ed.2 (2002), EN 50173 Ed.2 (2002) and ANSI/TIA/EIA-568-B.1

There are no restrictions on the length of:
- equipment and patch cords;
- CP cords/cables;
- work area cords.



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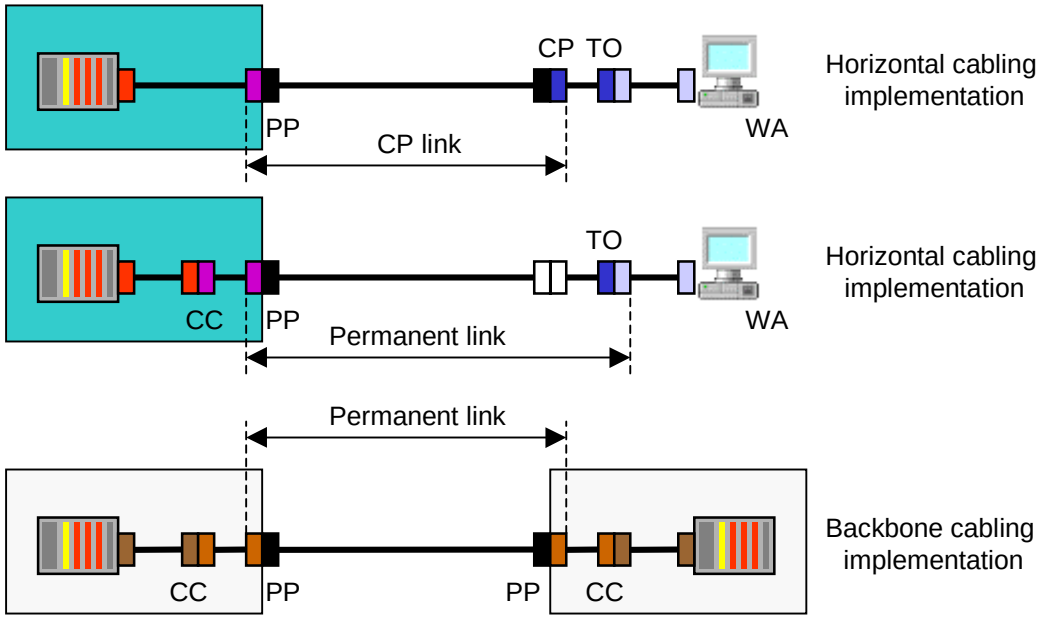
Link Measurement Validity

ISO/IEC 11801 Ed.2 (2002) and EN 50173 Ed.2 (2002)

CONFORMANCE

"Channel performance shall be explicitly verified where a channel is created by adding more than one cord to either end of a link meeting the requirements of Annex A".



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Break

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The Differing Requirements

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AGENDA

Channel Requirements Summary

	Parameter	ISO/IEC and EN Class D (2002)	568-B.1 Category 5e	ISO/IEC and EN Class E	568-B.2.1 Category 6
Transmission parameters	Return loss	Harmonized[1]		Harmonized[1]	
	Attenuation/insertion loss	Not harmonized		Not harmonized	
	NEXT	Harmonized		Harmonized	
	PS NEXT	Harmonized		Harmonized	
	ACR	NEXT[2]	Not specified	NEXT[2]	Not specified
	PS ACR	PSNEXT[2]	Not specified	PSNEXT[2]	Not specified
	ELFEXT	Harmonized		Harmonized	
	PS ELFEXT	Harmonized		Harmonized	
Protocol function parameters	Propagation delay	Harmonized		Harmonized	
	Delay skew	Harmonized		Harmonized	
Current carrying parameters	d.c. loop resistance		Not specified		Not specified
	d.c. resistance unbalance		Not specified		Not specified
	d.c. current carrying capacity		Not specified		Not specified
Other parameters	Length	Not specified		Not specified	

NOTE 1: 3dB get-out clause in ISO/IEC and EN
NOTE 2: 4dB get-out clause in ISO/IEC and EN

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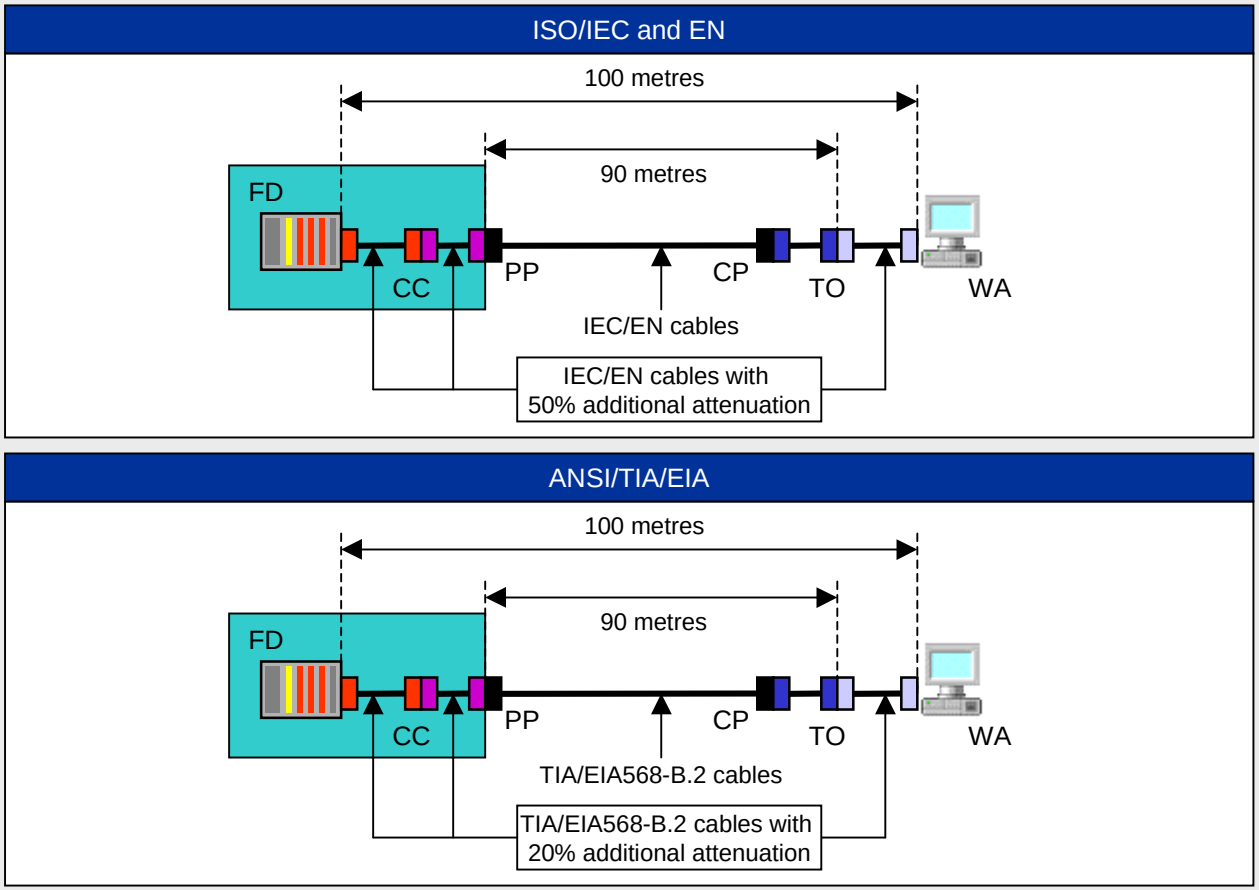
AGENDA

- Introduction
- Standards Inter-relationships
- Break
- Standards Inter-relationships
- Status of ISO/IEC and CLC
- Break
- The Differing Requirements
- Break
- The Differing Requirements
- Break
- Retro-Cabling
- New Projects
- Close

Channel Models



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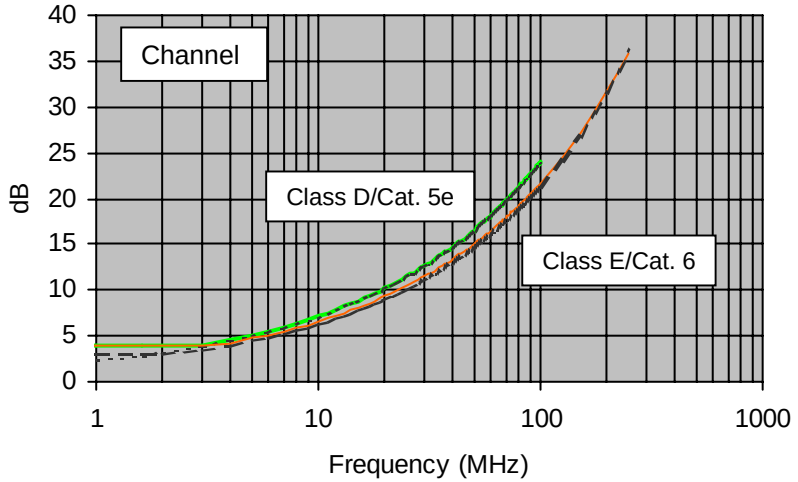
AGENDA

Attenuation/Insertion Loss

ISO/IEC and EN	568-B.1
Class D (2002)	Category 5e
1,05*(1,9108*sqrt(f)+0,0222*f+0,2/sqrt(f))+4*0,04*sqrt(f) 4dB min	1,02*(1,967*sqrt(f)+0,023*f+0,2/sqrt(f))+4*0,02*sqrt(f))
	568-B.2.1
Class E	Category 6
1,05*(1,82*sqrt(f)+0,0169*f+0,25/sqrt(f))+4*0,02*sqrt(f)) 4dB min.	1,02*(1,808*sqrt(f)+0,017*f+0,2/sqrt(f))+4*0,02*sqrt(f)) + 0,0003*$f^{1.5}$ 3dB min.



	Class D	Cat. 5e
f	dB	dB
16	9,1	9,1
100	24,0	24,0

	Class E	Cat. 6
f	dB	dB
16	8,3	8,0
100	21,7	21,3
200	33,9	33,8
250	35,9	36,0

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AGENDA

PL Requirements Summary

	Parameter	ISO/IEC and EN Class D (2002)	568-B.1 Category 5e	ISO/IEC and EN Class E	568-B.2.1 Category 6
Transmission parameters	Return loss	Harmonized[1,3]		Harmonized[1,3]	
	Attenuation/insertion loss	Not harmonized		Not harmonized	
	NEXT	Harmonized		Harmonized	
	PS NEXT	Harmonized		Harmonized	
	ACR	NEXT[2,3]	Not specified	NEXT[2,3]	Not specified
	PS ACR	PSNEXT[2,3]	Not specified	PSNEXT[2,3]	Not specified
	ELFEXT	Harmonized		Harmonized	
	PS ELFEXT	Harmonized		Harmonized	
Protocol function parameters	Propagation delay	Harmonized		Harmonized	
	Delay skew	Harmonized		Harmonized	
Current carrying parameters	d.c. loop resistance	Specified	Not specified	Specified	Not specified
	d.c. resistance unbalance	Channel	Not specified	Channel	Not specified
	d.c. current carrying capacity	Channel	Not specified	Channel	Not specified
Other parameters	Length	Not specified		Not specified	

NOTE 1: 3dB get-out clause in ISO/IEC and EN
NOTE 2: 4dB get-out clause in ISO/IEC and EN
NOTE 3: TO-CP get-out clause in EN 50173 6MP

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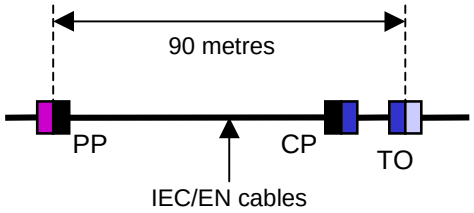
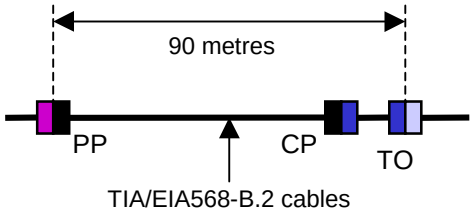
AGENDA

Maximum PL Models

ISO/IEC and EN



ANSI/TIA/EIA



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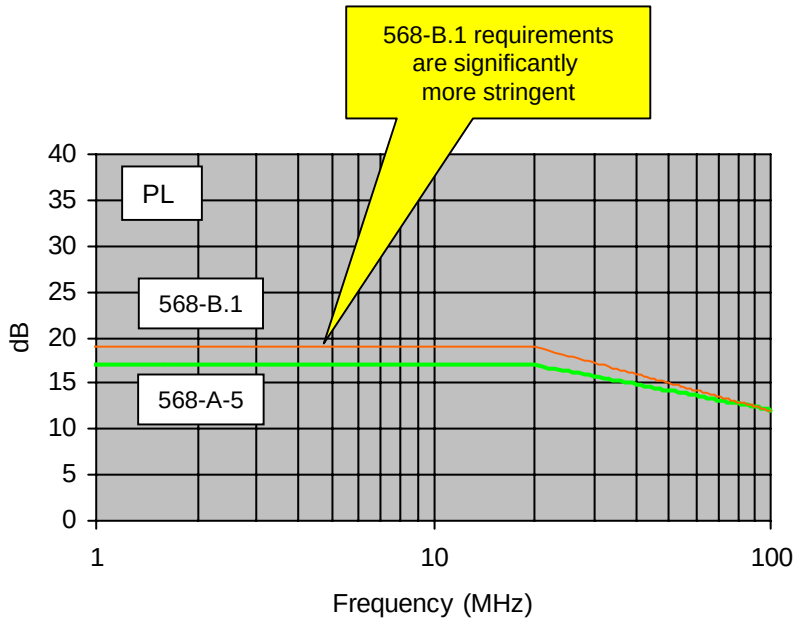
AGENDA

Return Loss

568-A Addendum 5	568-B.1
Category 5e	Category 5e
17-7log(f/20), 17,0 dB max.	19-10log(f/20), 19,0 dB max.



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Attenuation/Insertion Loss

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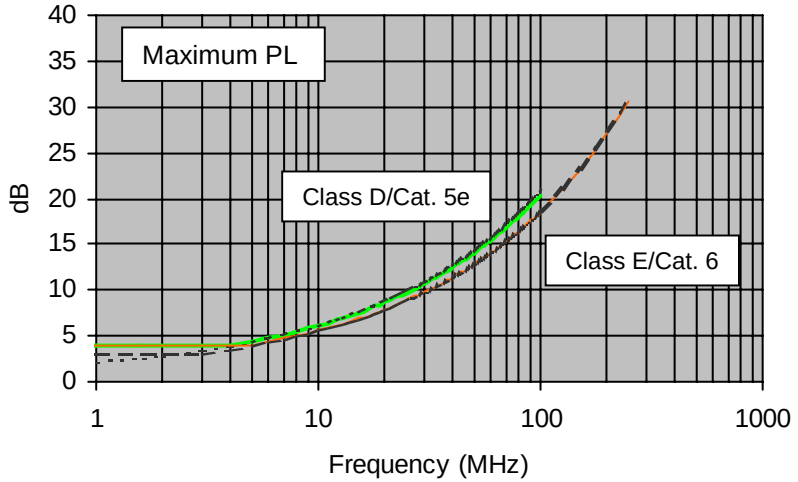
0,9*(1,9108*sqrt(f)+0,0222*f+0,2/sqrt(f))+3*0,04*sqrt(f) 4dB min	0,9*(1,967*sqrt(f)+0,023*f+0,2/sqrt(f))+3*0,02*sqrt(f))
	568-B.2.1
Class E	Category 6
0,9*(1,82*sqrt(f)+0,0169*f+0,25/sqrt(f))+3*0,02*sqrt(f)) 4dB min.	0,9*(1,808*sqrt(f)+0,017*f+0,2/sqrt(f))+3*0,02*sqrt(f)) + 0,00015*$f^{1.5}$ 3dB min.



f	Class D dB	Cat. 5e dB
16	7,7	7,9
100	20,4	21,0

f	Class E dB	Cat. 6 dB
16	7,0	7,1
100	27,1	27,4
200	18,5	18,6
250	30,7	31,1

AGENDA

CP Link Requirements Summary

	Parameter	ISO/IEC and EN Class D (2002)	568-B.1 Category 5e	ISO/IEC and EN Class E	568-B.2.1 Category 6
Transmission parameters	Return loss	PL	Not specified	PL	Not specified
	Attenuation/insertion loss	Length dependent		Length dependent	
	NEXT	PL		PL	
	PS NEXT	PL		PL	
	ACR	NEXT[1]		NEXT[1]	
	PS ACR	PSNEXT[1]		PSNEXT[1]	
	ELFEXT	PL++		PL++	
	PS ELFEXT	PL++		PL++	
Protocol function parameters	Propagation delay	Length dependent		Length dependent	
	Delay skew	Length dependent		Length dependent	
Current carrying parameters	d.c. loop resistance	Length dependent		Length dependent	
	d.c. resistance unbalance	Channel		Channel	
	d.c. current carrying capacity	Channel		Channel	

NOTE 1: 4dB get-out clause in ISO/IEC and EN

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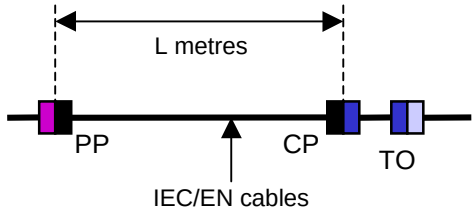
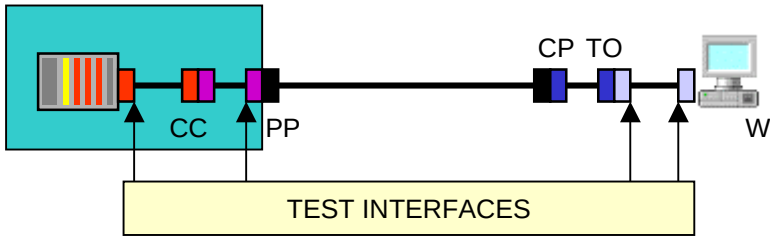
AGENDA

CP Link Model

ISO/IEC and EN



ANSI/TIA/EIA-568-B.1



Horizontal cabling implementation

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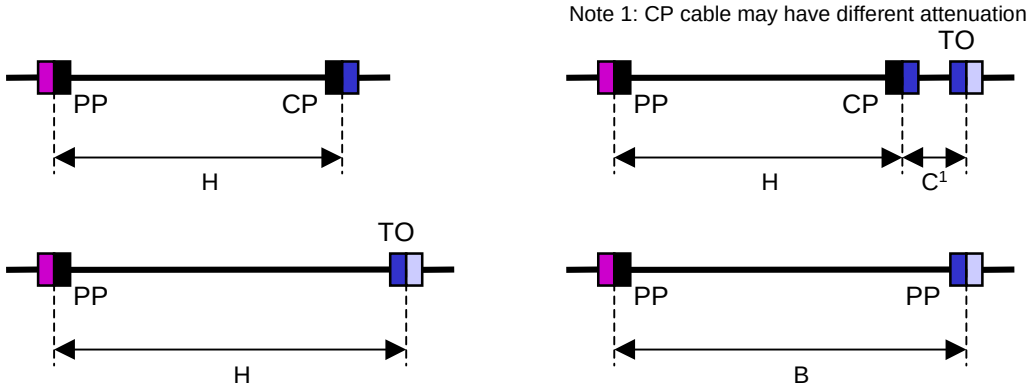
AGENDA

Channel and Link Test Limits

	ISO/IEC and EN	ANSI/TIA/EIA-568-B
Channel	Design independent Fixed limit	Design independent Fixed limit
Permanent Link	Design dependent Fixed maximum implementation limit	Design independent Fixed limit
CP Link	Design dependent Fixed maximum implementation limit	No specified limits

Complex requirement - Difficult to verify

Simple requirement - Inadequate QA



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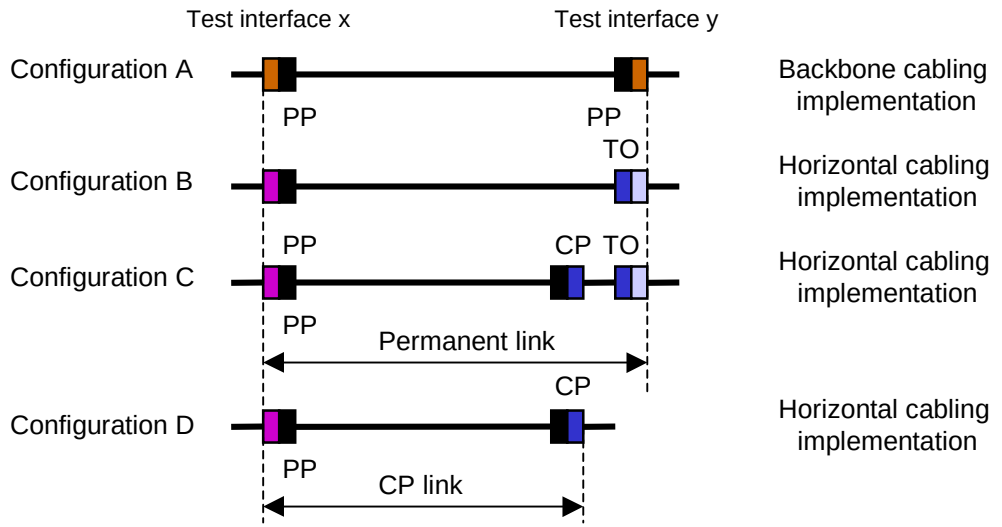
AGENDA

Theoretical Link Limits - I

	Formulae taking the form
Return loss	Channel + 2 dB
NEXT	-20*log(10^(-0,05*(function of log(f))+N*10^(function of log(f)))
PSNEXT	-20*log(10^(-0,05*(function of log(f))+N*10^(function of log(f)))
ELFEXT	-20*log(10^(-0,05*(function of log(f))+n*10^(function of log(f)))
PSELFEXT	-20*log(10^(-0,05*(function of log(f))+n*10^(function of log(f)))
	N = 1 for Configurations A, B and D N = 1 for Configuration C at "Test interface x" and N=2 at "Test interface y"
	n = 2 for Configurations A, B and D, n = 3 for Configuration C



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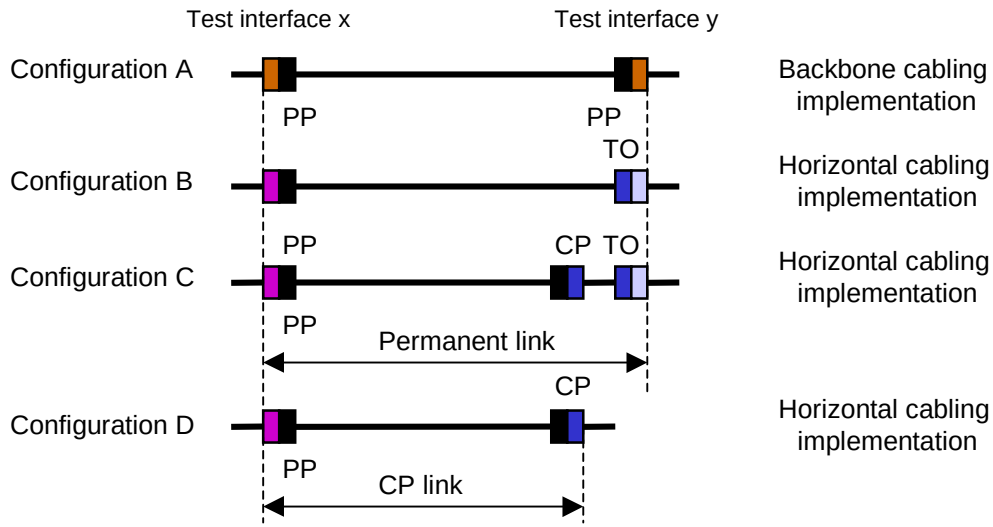
AGENDA

Theoretical Link Limits - II

	Formulae taking the form
Propagation delay	(L/100)*(0,534+0,036/sqrt(f)) + n*0,0025
Delay skew	(L/100)*0,045 + n*0,00125
	n = 2 for Configurations A, B and D, n = 3 for Configuration C
	$L = L_{PL} + L_{CP}$ L_{PL} = length of fixed cable (m), L_{CP} = length of CP cord (where present) (m)



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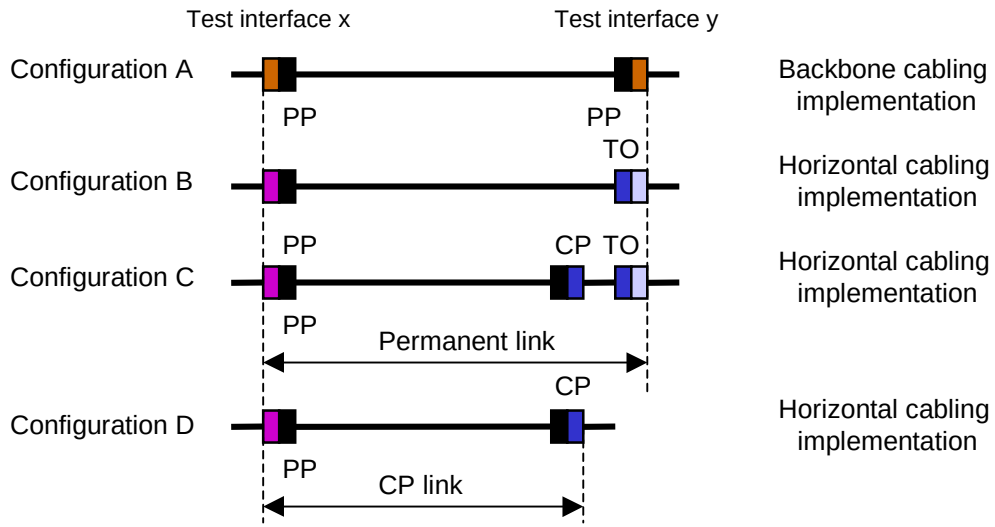
AGENDA

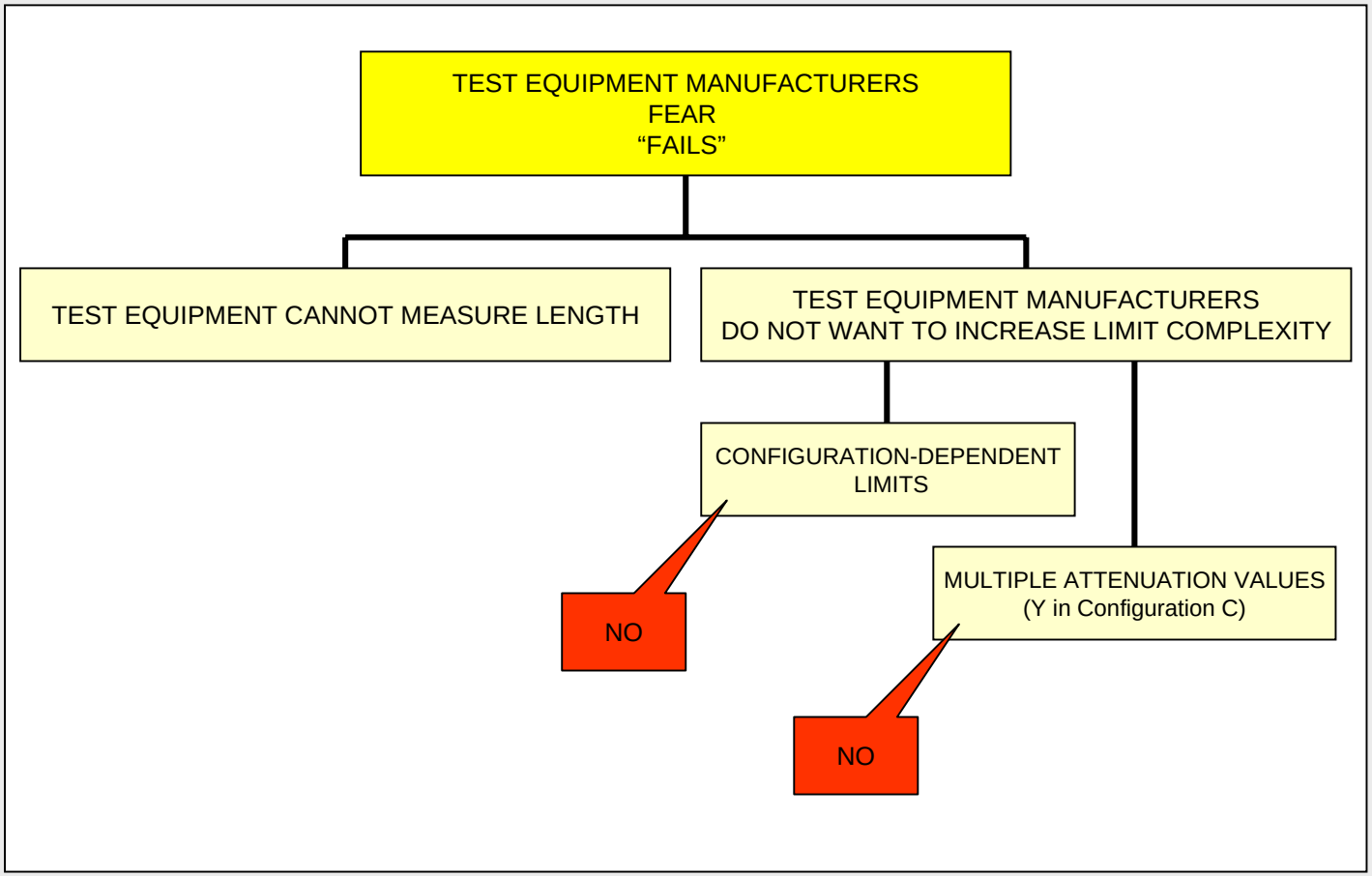
Theoretical Link Limits - III

	Formulae taking the form	
Insertion loss/attenuation	(L/100)*(A*sqrt(f)+B*f+C/sqrt(f)) + n*D*sqrt(f)	
d.c. loop resistance	(L/100)*22 + n*0,4	
d.c. resistance unbalance	Within a pair	3%
	n = 2 for Configurations A, B and D, n = 3 for Configuration C	
	$L = L_{PL} + L_{CP}*Y$ L_{PL} = length of fixed cable (m), L_{CP} = length of CP cord (where present) (m) Y = the ratio of CP cable attenuation (dB/m) to fixed horizontal cable attenuation (dB/m)	



AGENDA

Test Equipment Limitations



AGENDA

ISO/EN Length Dependencies

	Formulae taking the form	
Propagation delay	(L/100)*(0,534+0,036/sqrt(f)) + n*0,0025	
Delay skew	(L/100)*0,045 + n*0,00125	
	$L = L_{PL} + L_{CP}$ L_{PL} = length of fixed cable (m), L_{CP} = length of CP cord (where present) (m)	
Insertion loss/attenuation	(L/100)*(A*sqrt(f)+B*f+C/sqrt(f)) + n*D*sqrt(f)	
d.c. loop resistance	(L/100)*22 + n*0,4	
d.c. resistance unbalance	Within a pair	3%
	n = 2 for Configurations A, B and D, n = 3 for Configuration C	
	$L = L_{PL} + L_{CP}*Y$ L_{PL} = length of fixed cable (m), L_{CP} = length of CP cord (where present) (m) Y = the ratio of CP cable attenuation (dB/m) to fixed horizontal cable attenuation (dB/m)	

FCD ISO/IEC 11801 (N739) contains a practical alternative

A practical method of meeting this requirement is to demonstrate that the margin between the measured value and the channel limits are adequate to accommodate any additional cabling components used to create the channel.

An improved wording is proposed for EN 50173 3MV

Where the maximum lengths of channel components to be added to the link are known and specified for the cabling, the margin between the measured value of ……. and the channel limits shall exceed the total ……. of:

- the specified maximum lengths of cords used to create the channel;
- the specified maximum lengths of additional cables/connections, where appropriate, used to create the channel.

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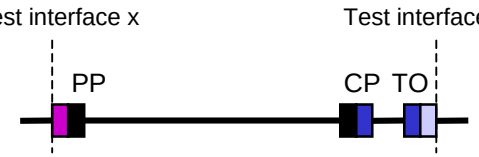
AGENDA

ISO/EN Return Loss

Return loss	Formulae taking the form Channel + 2 dB
NEXT	-20*log(10^(-0,05*(function of log(f))+N*10^(function of log(f)))
PSNEXT	-20*log(10^(-0,05*(function of log(f))+N*10^(function of log(f)))
ELFEXT	-20*log(10^(-0,05*(function of log(f))+n*10^(function of log(f)))
PSELFEXT	-20*log(10^(-0,05*(function of log(f))+n*10^(function of log(f)))
	N = 1 for Configurations A, B and D N = 1 for Configuration C at "Test interface x" and N=2 at "Test interface y"
	n = 2 for Configurations A, B and D, n = 3 for Configuration C

EN 50173 6MP contains Configuration C get-out clause



For configuration C ….. close proximity of TO and CP connections can ….FAIL

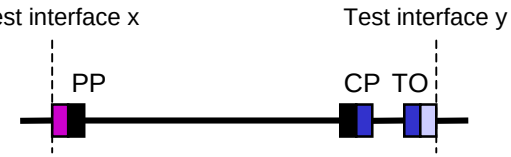
Such results are compliant provided that:
a) the measured link values at test interface "y", and a complete channel, comply with the channel requirements
or
b) a complete channel complies with the channel requirements.

AGENDA

EN NEXT/PSNEXT

	Formulae taking the form
Return loss	Channel + 2 dB
NEXT	-20*log(10^(-0,05*(function of log(f))+10^(function of log(f)))
PSNEXT	-20*log(10^(-0,05*(function of log(f))+10^(function of log(f)))
ELFEXT	-20*log(10^(-0,05*(function of log(f))+n*10^(function of log(f)))
PSELFEXT	-20*log(10^(-0,05*(function of log(f))+n*10^(function of log(f)))
	n = 2 for Configurations A, B and D, n = 3 for Configuration C

EN 50173 6MP contains Configuration C get-out clause



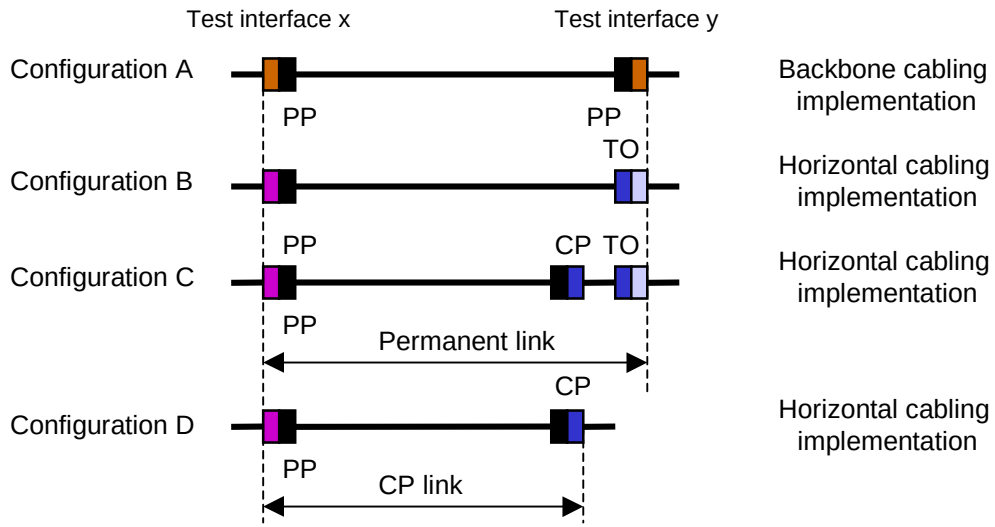
For configuration C ….. close proximity of TO and CP connections can ….FAIL

Such results are compliant provided that the measured link values at test interface “y” comply with the channel requirements.

AGENDA

ISO/EN Outstanding Items

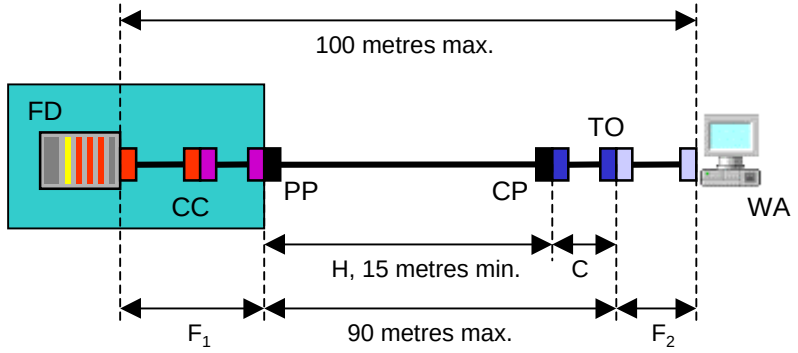
	Formulae taking the form
Return loss	Channel + 2 dB
NEXT	-20*log(10^(-0,05*(function of log(f))+10^(function of log(f)))
PSNEXT	-20*log(10^(-0,05*(function of log(f))+10^(function of log(f)))
ELFEXT	-20*log(10^(-0,05*(function of log(f))+n*10^(function of log(f)))
PSELFEXT	-20*log(10^(-0,05*(function of log(f))+n*10^(function of log(f)))
	n = 2 for Configurations A, B and D, n = 3 for Configuration C



AGENDA

Implementation Rules

ISO/IEC and EN



$F = F_1 + F_2$	X = cord attenuation premium Y = CP cable attenuation premium (if any)

No. of connections	Class D/Category 5	Class E/Category 6	Class F/Category 7
2	H = (109-FX)/T	H = (107-3[1]-FX)/T	H = (107-2[1]-FX)/T
3 w/o. CP	H = (107-FX)/T	H = (106-3[1]-FX)/T	H = (106-3[1]-FX)/T
3 inc. CP	H = (107-FX-CY)/T	H = (106-3[1]-FX-CY)/T	H = (106-3[1]-FX-CY)/T
4	H = (105-FX-CY)/T	H = (105-3[1]-FX-CY)/T	H = (105-4[1]-FX-CY)/T

T = 1 + (t-20) x α where t = maximum design temperature within link

	for screened cables	for unscreened cables
X and Y	1.5 typically	1.2 typically
α	= 0.2 for t>20ºC	= 0.4 for 20ºC<t<40ºC = 0.6 for 40ºC<t<60ºC

Note 1: this length reduction is provides margin for insertion loss deviation.

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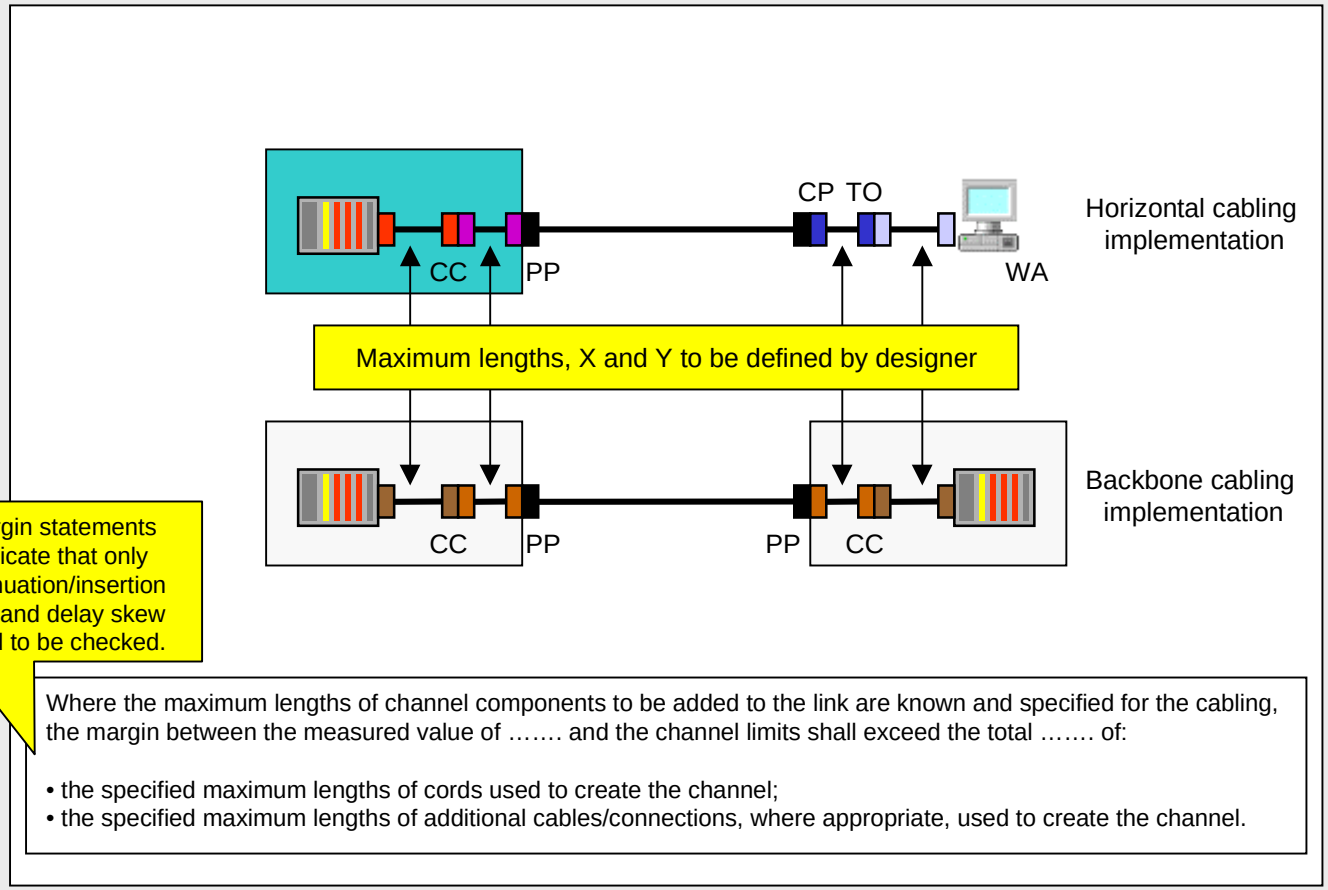
AGENDA

Channel Design



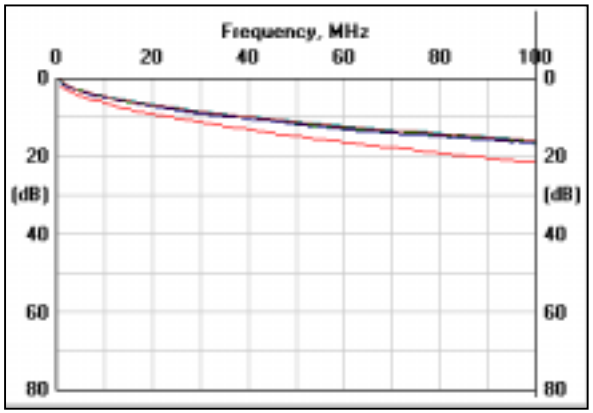
Where the maximum lengths of channel components to be added to the link are known and specified for the cabling, the margin between the measured value of ……. and the channel limits shall exceed the total ……. of:

- the specified maximum lengths of cords used to create the channel;
- the specified maximum lengths of additional cables/connections, where appropriate, used to create the channel.

AGENDA

Attenuation and Delay Skew

ATTENUATION/INSERTION LOSS



The highest measured attenuation/insertion loss occurs at the highest measurement frequency.

The test equipment will have to report the margin between the measured value and the channel limit at:
- 100 MHz for Class D compliance;
- 250 MHz for Class E compliance.

The installer has to check that the margin is acceptable.

	Class D	Class E
Connection	0,2 dB	0,32 dB
Solid cable	0,21 dB/m	0,33 dB/m
Stranded cable		
Unscreened cable	0,25 dB/m	0,40 dB/m
Screened cable	0,32 dB/m	0,50 dB/m

DELAY SKEW

Delay skew is constant with frequency

The installer has to check that the margin is acceptable.

	Class D	Class E
Connection	1,25 ns	
Cable	0,45 ns/m	

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AGENDA

Break

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- Retro-Cabling
  - Balanced Cabling Evolution
  - Disappearing Specifications
  - The Old Classes
  - The Old Components
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Retro-Cabling

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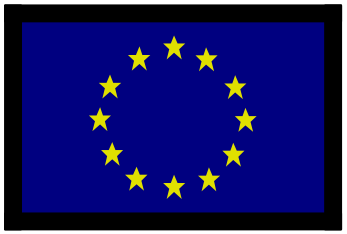
AGENDA

Balanced Cabling Evolution



CABLING DESIGN

EN 50173	Ed. 1 (1995)	Cabling	Class A	Class B	Class C (1995)	Class D (1995)		
		Components			Cat. 3	Cat. 5 (1995)		
	Ed. 1 A.1 (2000)	Cabling	Class A	Class B	Class C (2000)	Class D (2000)		
		Components			Cat. 3	Cat. 5 (1995)		
	Ed. 2 (2002)	Cabling	Class A	Class B	Class C (2002)	Class D (2002)	Class E	Class F
		Components				Cat. 5 (2002)	Cat . 6	Cat. 7

ISO/IEC 11801	Ed. 1 (1995)	Cabling	Class A	Class B	Class C (1995)	Class D (1995)		
		Components			Cat. 3 / Cat. 4	Cat. 5 (1995)		
	Ed. 1 A.1 (1999)	Cabling	Class A	Class B	Class C (1995)	Class D (1995)		
		Components			Cat. 3 / Cat. 4	Cat. 5 (1995)		
	Ed. 1 A.2 (1999)	Cabling	Class A	Class B	Class C (2000)	Class D (2000)		
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	Ed. 1.2 (2000)	Cabling	Class A	Class B	Class C (2000)	Class D (2000)		
		Components			Cat. 3 / Cat. 4	Cat. 5 (1995)		
	Ed. 2 (2002)	Cabling	Class A	Class B	Class C (2002)	Class D (2002)	Class E	Class F
		Components				Cat. 5 (2002)	Cat . 6	Cat. 7

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- Break
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- New Projects
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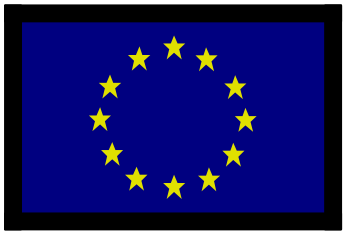
Disappearing Specifications



CABLING DESIGN

EN 50173	Ed. 1 (1995)	Cabling	Class A	Class B	Class C (1995)	Class D (1995)			
					Cat. 3	Cat. 5 (1995)			
	Ed. 1 A.1 (2000)	Cabling	Class A	Class B	Class C (2000)	Class D (2000)			
					Cat. 3	Cat. 5 (1995)			
	Ed. 2 (2002)		Class A	Class B	Class C (2002)	Class D (2002)	Class E	Class F	
						Cat. 5 (2002)	Cat . 6	Cat. 7	
ISO/IEC 11801	Ed. 1 (1995)		Class A	Class B	Class C (1995)	Class D (1995)			
					Cat. 3	Cat. 4	Cat. 5 (1995)		
	Ed. 1 A.1 (1999)		Class A	Class B	Class C (1995)	Class D (1995)			
					Cat. 3	Cat. 4	Cat. 5 (1995)		
	Ed. 1 A.2 (1999)		Class A	Class B	Class C (1995)	Class D (2000)			
					Cat. 3	Cat. 4	Cat. 5 (1995)		
	Ed. 1.2 (2000)	Components	Class A	Class B	Class C (2000)	Class D (2000)			
					Cat. 3	Cat. 4	Cat. 5 (1995)		
	Ed. 2 (2002)		Class A	Class B	Class C (2002)	Class D (2002)	Class E	Class F	
						Cat. 5 (2002)	Cat . 6	Cat. 7	

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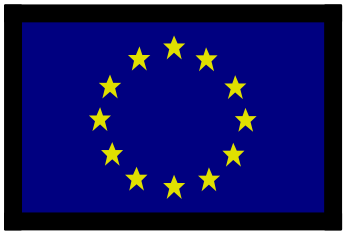
AGENDA

The Old Classes



CABLING DESIGN

EN 50173	Ed. 2 (2002) Annex E	Cabling	Class A	Class B	Class C (1995)	Class D (1995)			
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			Class A	Class B	Class C (2002)	Class D (2002)	Class E	Class F	
						Cat. 5 (2002)	Cat . 6	Cat. 7	
			Class A	Class B	Class C (1995)	Class D (1995)			
					Cat. 3	Cat. 4	Cat. 5 (1995)		
ISO/IEC 11801	Ed. 2 (2002) Annex H	Cabling	Class A	Class B	Class C (1995)	Class D (1995)			
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		Cabling	Class A	Class B	Class C (1995)	Class D (2000)			
					Cat. 3	Cat. 4	Cat. 5 (1995)		
		Cabling	Class A	Class B	Class C (2000)	Class D (2000)			
					Cat. 3	Cat. 4	Cat. 5 (1995)		
			Class A	Class B	Class C (2002)	Class D (2002)	Class E	Class F	
						Cat. 5 (2002)	Cat . 6	Cat. 7	

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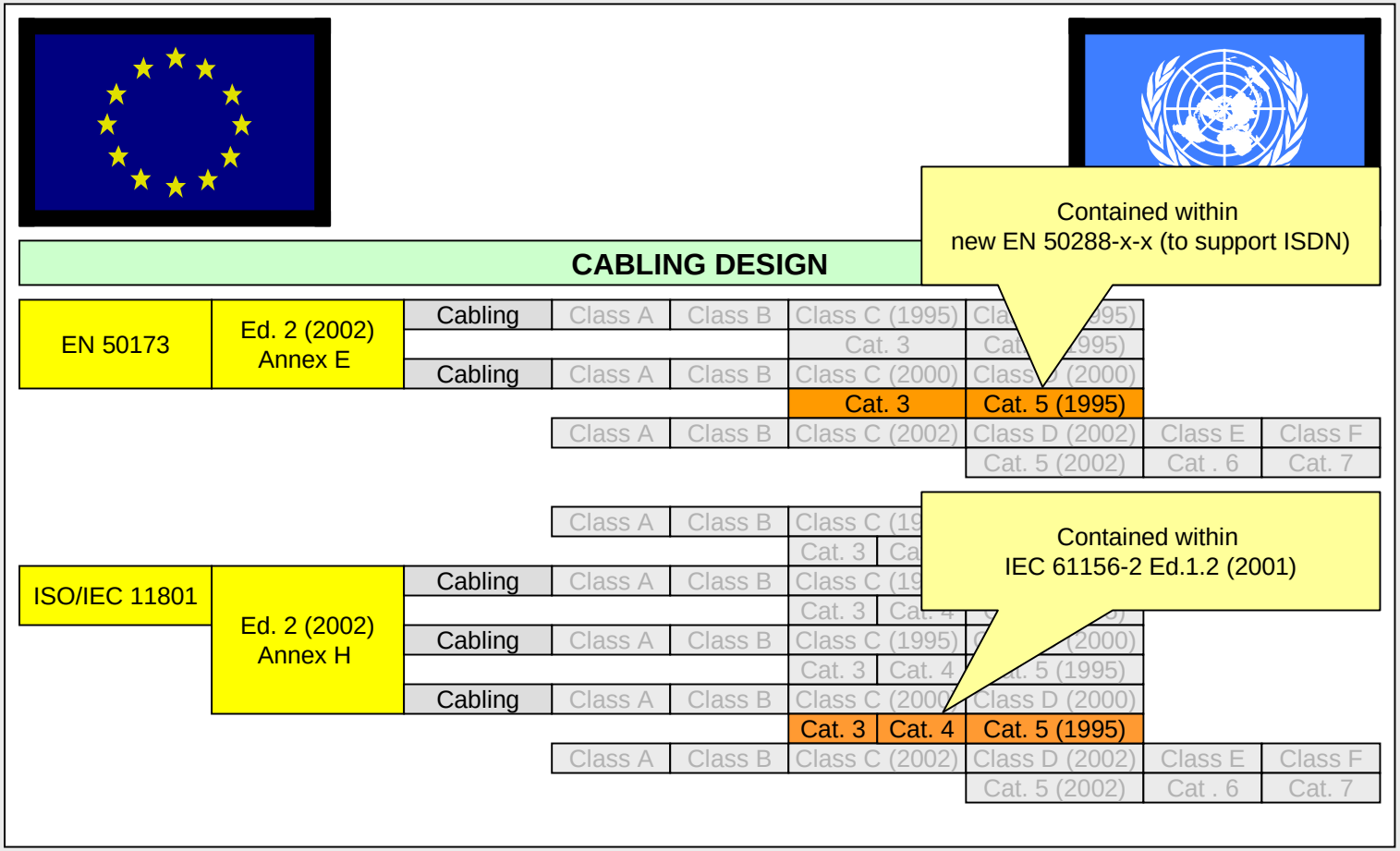
AGENDA

The Old Components



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  - Industrial (CLC)
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New Projects

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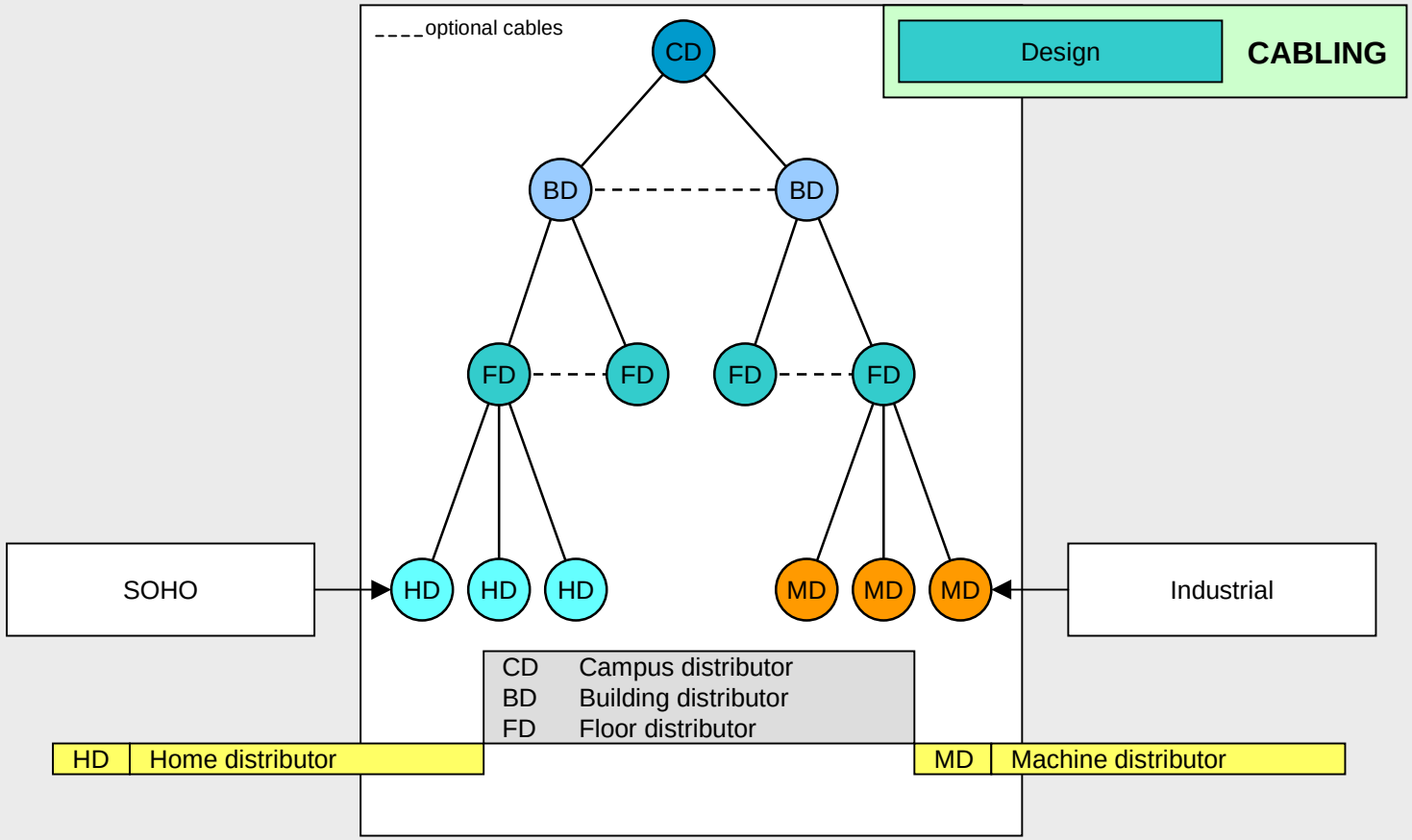
Extensions of Generic Cabling



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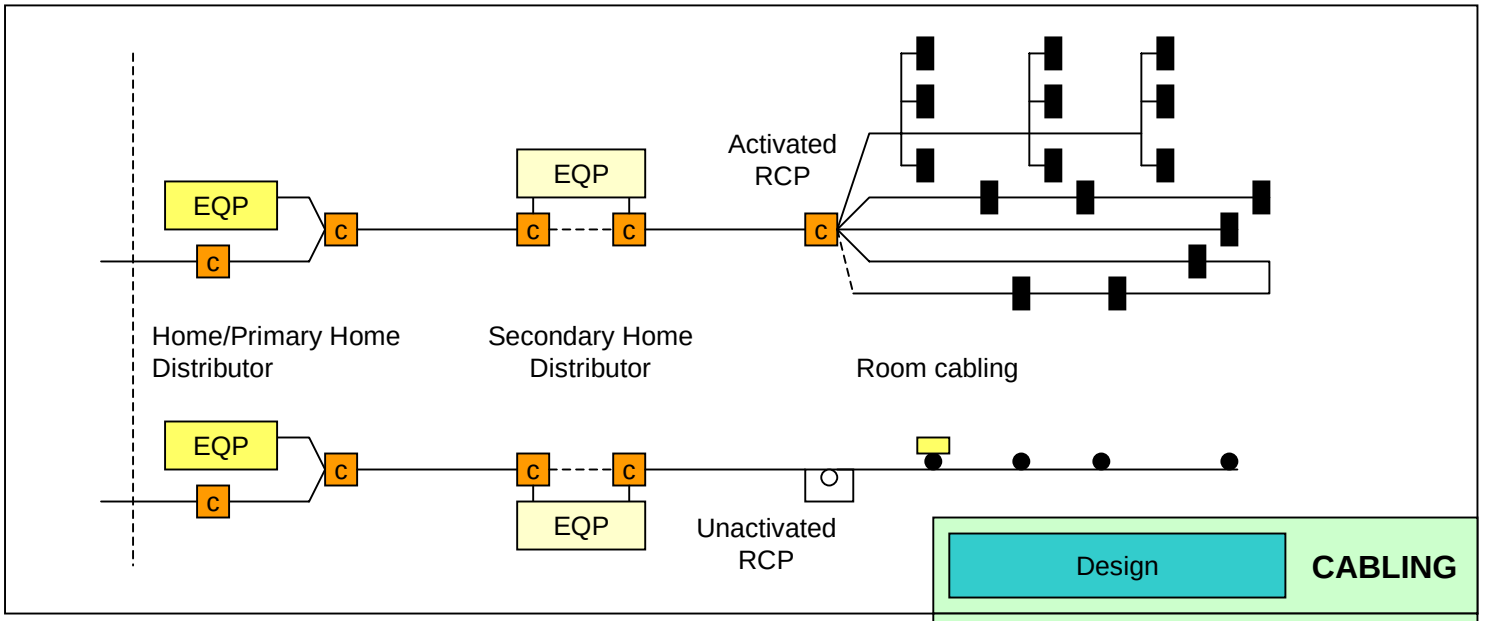
AGENDA

SOHO (ISO/IEC)

ARENA	REFERENCE	TITLE
IEC	15018	Information technology - Integrated cabling system for residential and SOHO (Small Office, Home Office) environments



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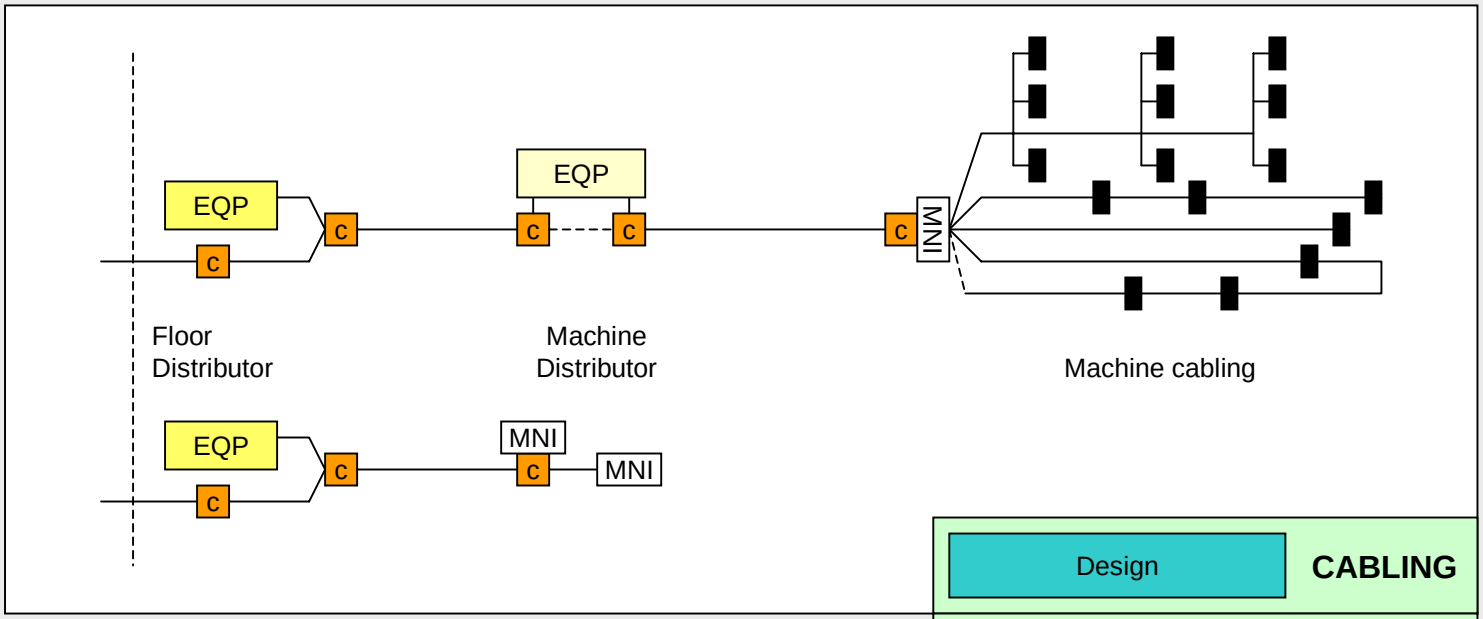
AGENDA

Industrial - I (CLC)

ARENA	REFERENCE	TITLE
EN	Not allocated	Information technology - Generic cabling systems - Industrial environments



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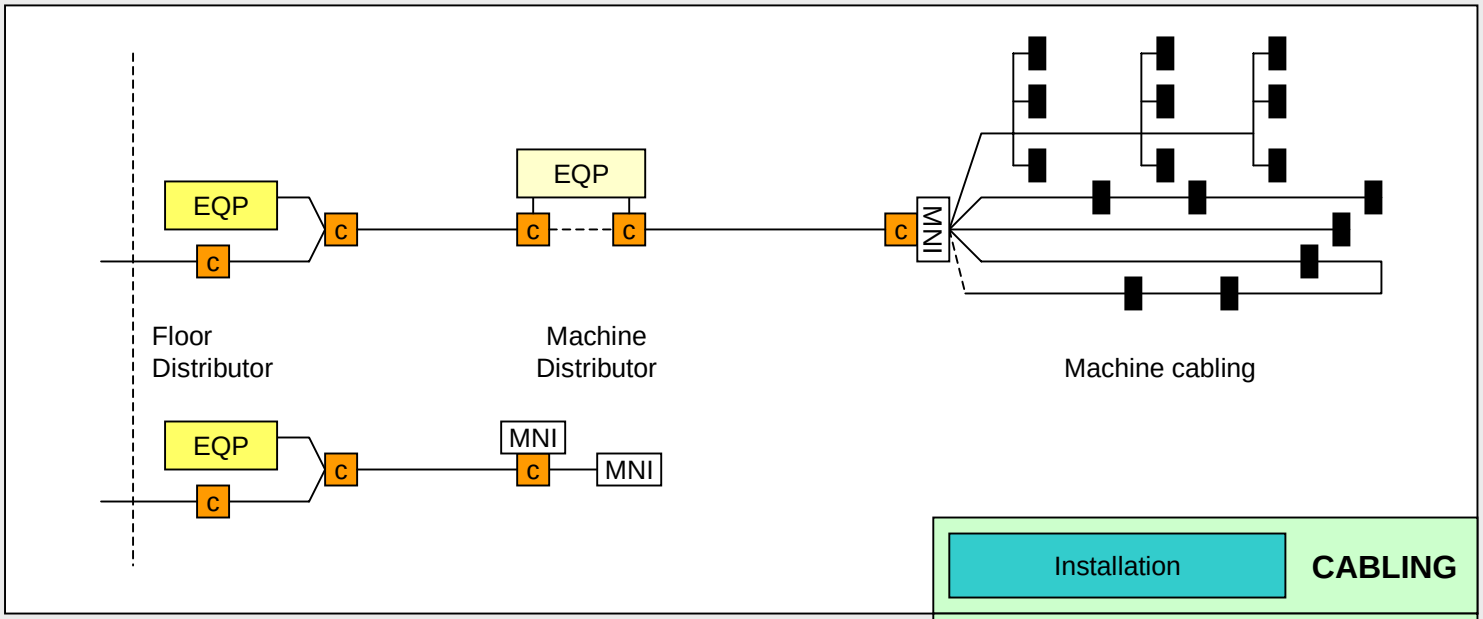
AGENDA

Industrial - II (CLC)

ARENA	REFERENCE	TITLE
EN	Not allocated	Information technology - Cabling installation



AGENDA

Close

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