BICSI Day Athens

Evolution of copper cabling: how new systems for Intelligent buildings and changing our infrastructure design

Gautier Humbert, RCDD

Standards Coordinator
Digital Infrastructures
Legrand

District Chair
Mainland Europe
BICSI

This presentation is:

CPD CERTIFIED
The CPD Certification Service

15th November 2019

Agenda

1. Structure of ISO/IEC 11801 Series
2. Update of 25G Ethernet
3. Single Pair Ethernet: ISO vs. TIA
4. Fiber Optic Testing ISO/IEC 14763-3
5. “Unstructured” Cabling topologies
6. ISO/IEC 11801-99xx TRs

Agenda

1. Structure of ISO/IEC 11801 Series
2. Update of 25G Ethernet
3. Single Pair Ethernet: ISO vs. TIA
4. Fiber Optic Testing ISO/IEC 14763-3
5. “Unstructured” Cabling topologies
6. ISO/IEC 11801-99xx TRs

ISO, International

Components

ISO Information Technology Generic Cabling Systems

Performance, Design	Implementation	Validation	Technical Reports
ISO/IEC 11801-1 (2017) General requirements	**ISO/IEC 14763-2** Planning and Installation Implementation	**ISO/IEC 14763-3** Testing of Fiber Optic Cabling	**ISO/IEC TR 24704 (2004)** Cabling for wireless access points
ISO/IEC 11801-2 (2017) Offices and commercial buildings	**ISO/IEC 30129** Bonding and Grounding	**ISO/IEC 14763-4 (Draft)** Measurement of E2E, MP… DA links	**ISO/IEC TR 24750 (2007)** Assessment and mitigation of installed balanced cabling channels in order to support 10GBASE-T
ISO/IEC 11801-3 (2017) Industrial premises			**ISO/IEC TR 29125 (2010)** Requirements for RP of terminal equipment
ISO/IEC 11801-4 (2017) Homes			**ISO/IEC TS 29125 (2017)** Add. requirements for RP of terminal equipment
ISO/IEC 11801-5 (2017) Data centers			
ISO/IEC 11801-6 (2017) Distributed building services			

All new TRs are no named:
ISO/IEC TR 11801 99xx

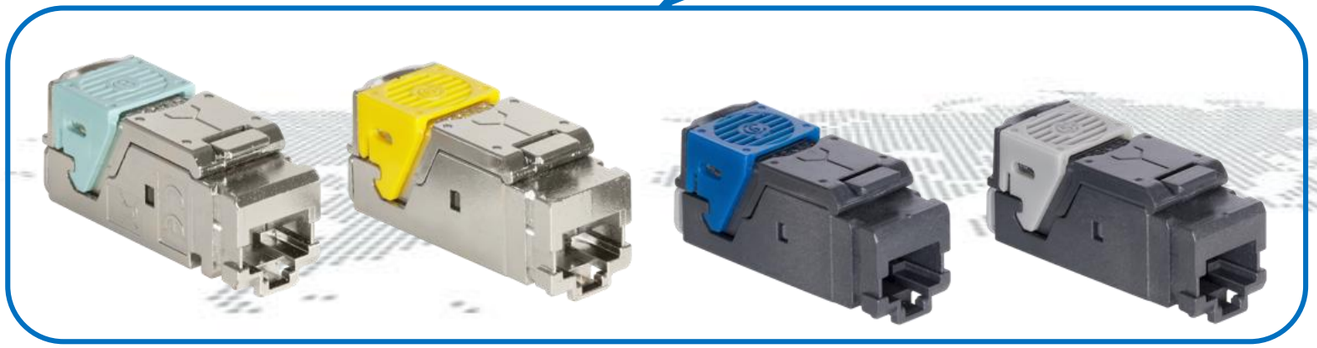
TRs can be to prepare a standard, or to give guidance.

Agenda

1. Structure of ISO/IEC 11801 Series
2. Update of 25G Ethernet
3. Single Pair Ethernet: ISO vs. TIA
4. Fiber Optic Testing ISO/IEC 14763-3
5. “Unstructured” Cabling topologies
6. ISO/IEC 11801-99xx TRs

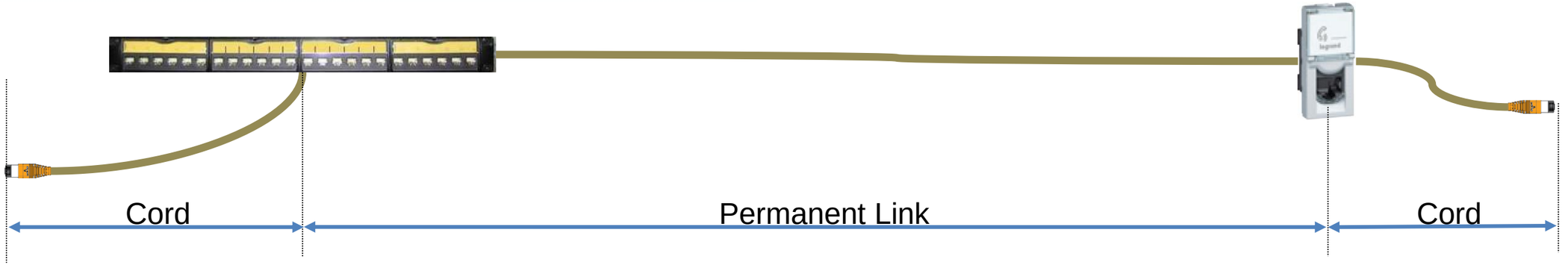
Cat.8, Class I and Class II

	Frequency	25 G Base-T	40 G Base-T	Cable	Connectors
TIA Cat.8	2 GHz	Yes	Yes	F/UTP or S/FTP Cat.8	“RJ45” Cat.8
ISO Class I	2 GHz	Yes	yes	Cat 8.1 = TIA Cat8	“RJ45” Cat.8.1 = TIA Cat.8
ISO Class II	2 GHz	Yes	Yes	S/FTP Cat.8.2	“Non-RJ45”



Cat.8, Class I and Class II

What distance?



	Cords	PL	Total
ANSI/TIA	4.8 to 7.2m	24m	28.8 to 31.2m
ISO/IEC Class I	4m	26m	30m
ISO/IEC Class II	4m	26m	30m

Equipment cord de-rating factor (%)	length of cordage allowed (m)
0	7.2
20	6
50	4.8

ANSI/TIA 568.2-D, Table 4

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

ISO/IEC 11801-5, Table 2

Alternatives

So Category 8 was designed for 40Gbase-T for 30m

- Since 25G base-T requires lower performance than 40Gbase-T, could it work on “less than” Category 8?
- Or could it work for longer distance than 30m on Category 8?

ISO / IEC TR 11801-9905

Guidelines for the use of installed cabling to support 25GBASE-T application

If you have existing cabling, can you use it for 25Gbase-T and how to verify compliance to the application.

Same as TIA TSB 95 for 1000Base-T on Cat.5

Same as TIA TSB 155-A and ISO/IEC TR 24750 for 10Base-T on Cat.6

- "Component requirements are not provided in this document and should not be inferred from the channel limits provided."
- "...design goals for 25GBASE-T ...frequency signal range up to 1250 MHz..."

manufacturers are not allowed to cite this document for product compliance

All channels must be re-qualified for 1250MHz.

Internal parameters
from 1 to 1250Mhz:
Field test.

Coupling attenuation
from 1 to 1250Mhz:
Field test or manufacturer test report

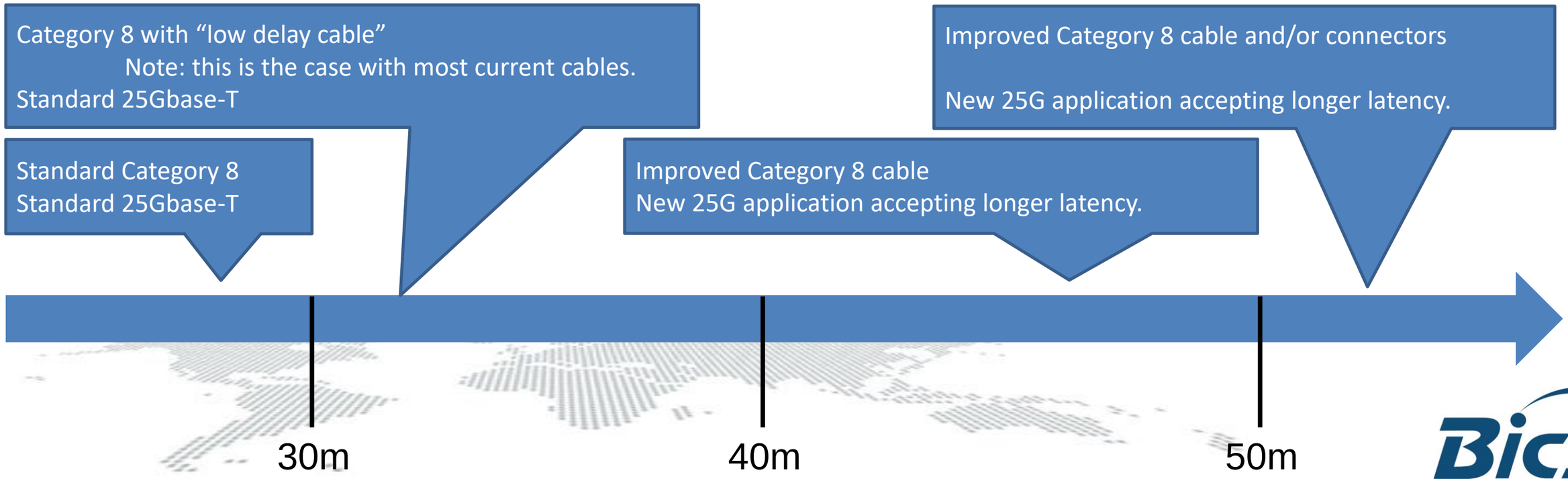
Alien crosstalk
from 1 to 1250Mhz:
Field test or manufacturer test report

ISO / IEC TR 11801-9909 DRAFT

Evaluation of balanced cabling in support of 25 Gb/s, with reach higher than 30m.

- Objective is to extend the reach of Category 8 (Classes I and II) from 30m to 50m…or more

Caution: IEEE is NOT interested in developing an new 25G application for longer latency



Agenda

1. Structure of ISO/IEC 11801 Series
2. Update of 25G Ethernet
3. Single Pair Ethernet: ISO vs. TIA
4. Fiber Optic Testing ISO/IEC 14763-3
5. “Unstructured” Cabling topologies
6. ISO/IEC 11801-99xx TRs

Needs

Major Uses Cases ISO/IEC 11801-6 Distributed Services

Use Case	Application Data Rate (Mb/s)	In-Building Range of Reach (m)	Remote power (watts)	Remote Termination
IoT	< 10	15 - 100	< 5	NCP/device
BAS	< 10	15 - 100	15 - 30	NCP/device
WIFI (ac)	1000 – 10 G	< 15	15 - 50	NCP/AP
Lighting	< 10	15 - 100	10 - 50	NCP/device
Surveillance	100 - 1000	15 - 100	10 - 30	NCP/camera
VoIP phone	< 10	15 - 100	40	phones
Fire/smoke alarm	< 10	15 - 100	5 - 10	Console/speakers
Audio/speakers	< 10	15 - 100	5 - 10	speakers

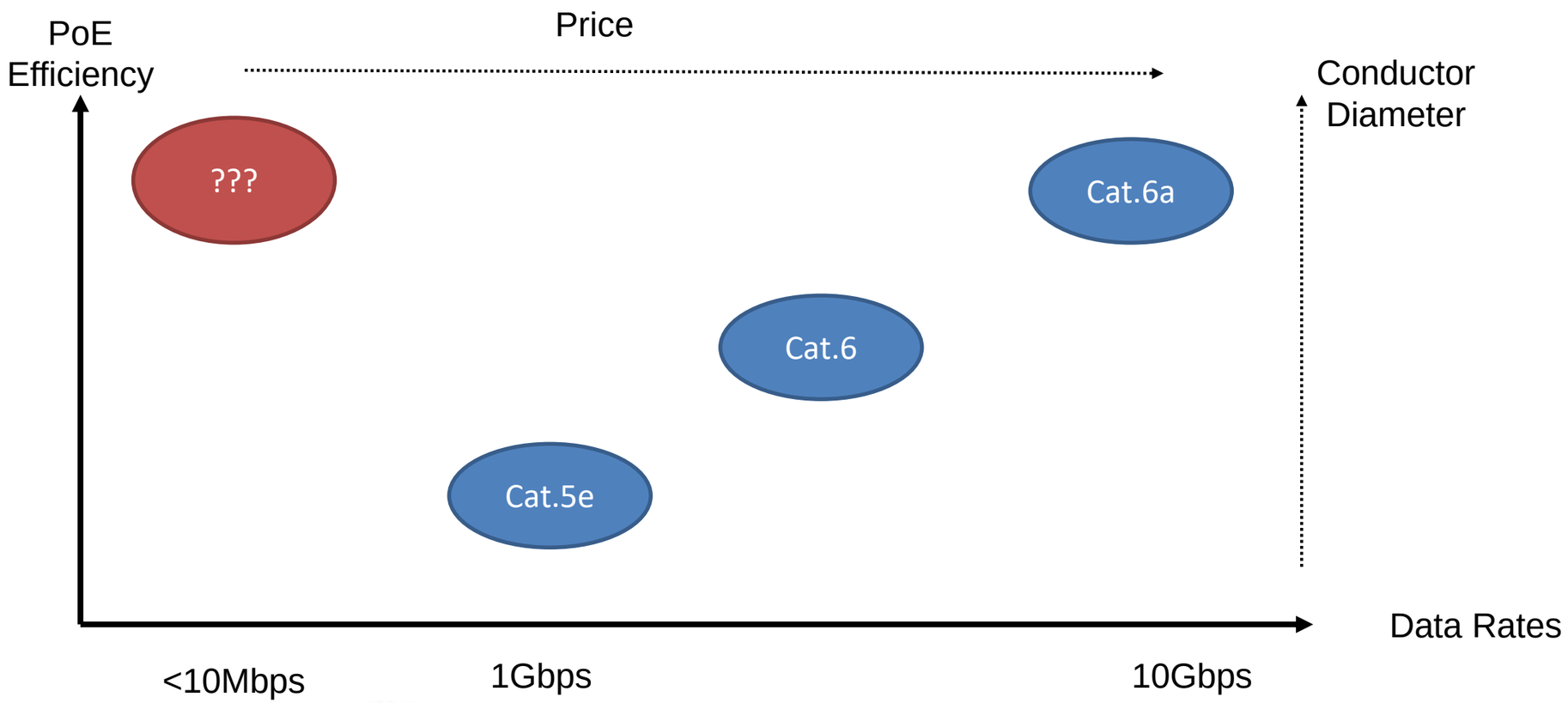
Building Controls Protocols

- BACnet: Physical Interface can be RS-485 (MS/TP), RS-232, LONTalk, Ethernet,
- LONTalk: Physical interface is twisted pair or Power Line
- MODBus: Physical Interface is RS-485 or RS-232
- Profibus/Fieldbus/ControlNet: Physical Interface is RS-485 or RS-232
- KNX (formerly EIB & BatiBus & EHS): Physical Interface is twisted pair, RF or Power Line
- DALI: Physical Interface for control signal is RS-485
- OPC (Open Platform Communications): can interface with LONTalk, BACnet or DALI

A new solution?

Our Current options

What we need



List of SPE Options

- IEEE Single Pair Ethernet

Standard	Content	Target	Distance	Specifics	Status
802.3bw	100mbps	Automotive	30m		Ratified
802.3bp (Type A)	1Gbps	Automotive	30m	4 connectors	Ratified
802.3bp (Type B)	1Gbps	Transport / industrial	40m		Ratified
802.3bu	PoDL	802.3 bw / bp	All	50V, 1.36Amp	Ratified
802.3cg (Short and Long)	10mbps + Power	Industrial / Commercial	S < 15m L < 1km	Up to 10 connectors	Expected end 2019.
802.3ch Multi Gig	2.5G, 5G, 10G	Automotive	15m		Draft Expected 2020

Bicsi®

ISO / IEC TR 11801-9906

Balanced 1-pair cabling channels up to 600MHz for single pair Ethernet (SPE)

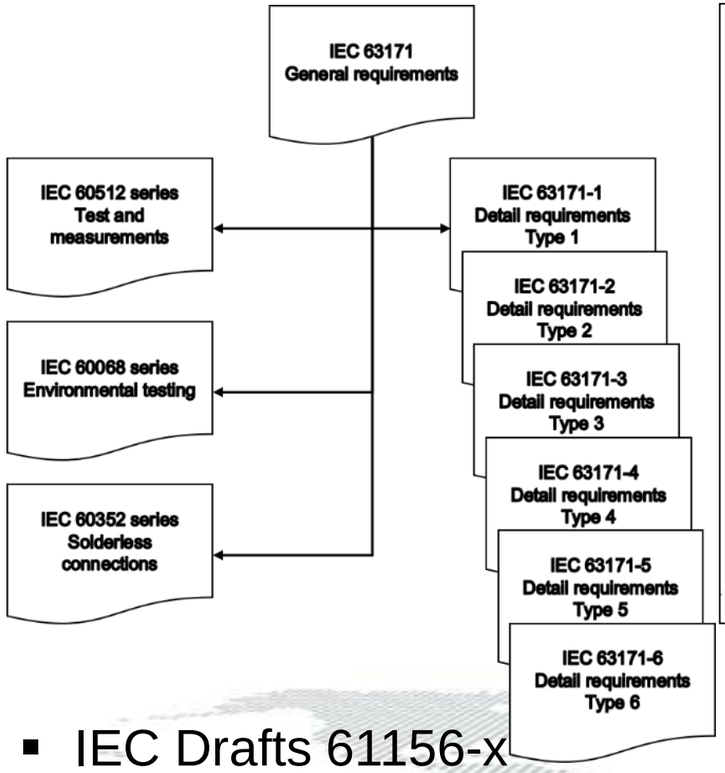
- Application specific TR to define cabling that can support the IEEE 802.3bp, IEEE 802.3bw, IEEE 802.3cg
- Defines Channels and as informative, Connectors, cables,

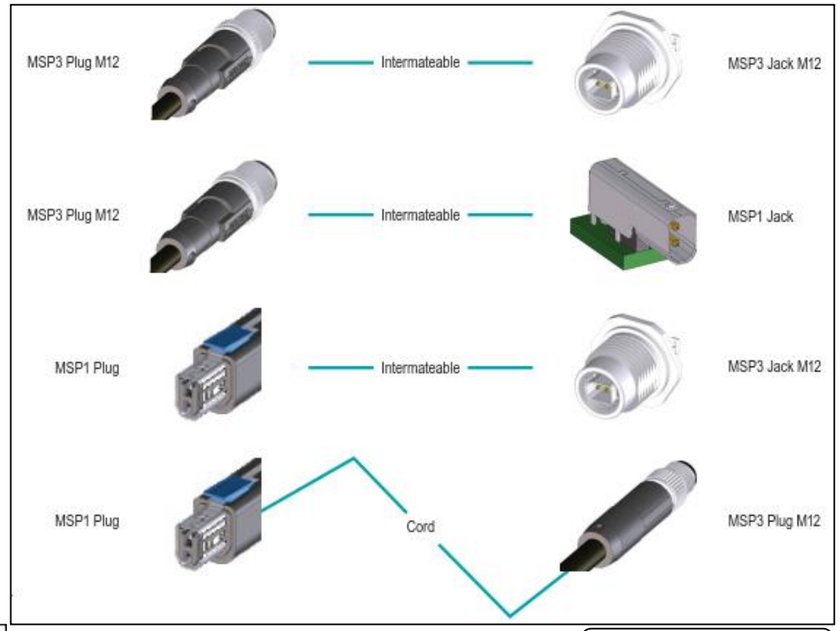
IEEE standard	Application	Distance (m)	Frequency Range (MHz)
802.3bp	1000Base-T1 A	15	1 ≤ f ≤ 600
	1000Base-T1 B	40	1 ≤ f ≤ 600
802.3bw	100Base-T1	15	0,3 ≤ f ≤ 66
802.3 cg	10Base-T1S	15	0,1 ≤ f ≤ 20
	10Base-T1L	1000	0,1 ≤ f ≤ 20

Approved in October 2019

IEC Components for 1-pair

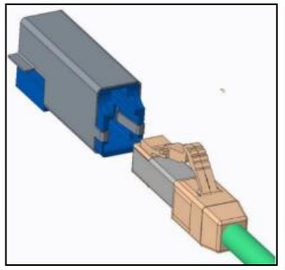
- IEC - Drafts 63171-x
  - Connectors for single pair (not limited to Ethernet)
  - All 6 variant will be defined



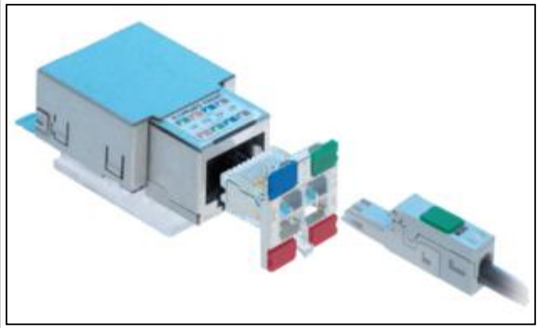


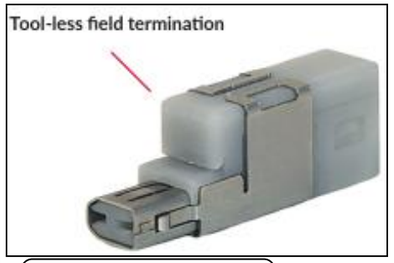
63171-5

63171-1



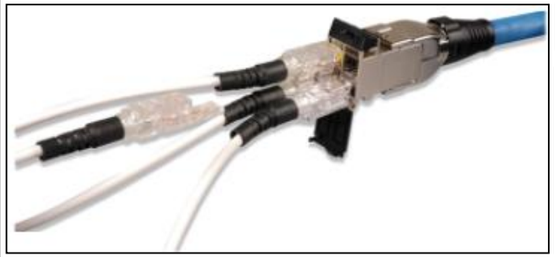
61076-3-25
-> 63171-6

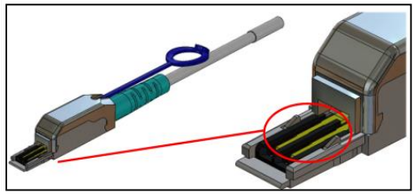




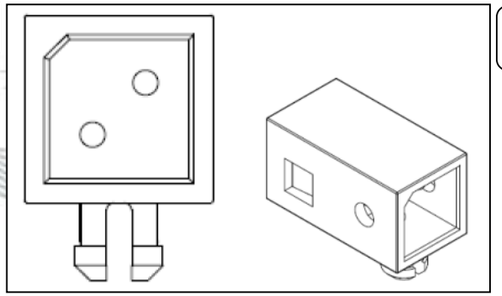
63171-2

63171-3





63171-4



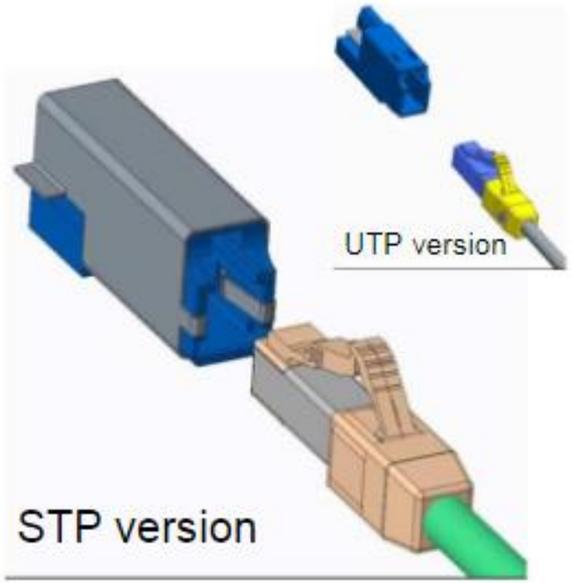
- IEC Drafts 61156-x
  - Cables for 20Mhz channels (x=13, 14)
  - Cables for 600 MHz channels (x=11, 12)

SPE Structured Cabling - Connectors

ISO/IEC 11801-1 Amendment 1 Draft and ANSI/TIA 568.5 Draft have chosen:

Both cover generic single pair cabling.

Variant 1 – LC style for $M_1I_1C_1E_1$ acc. IEC 63171-1



Variant 2 – Industrial style for $M_2I_2C_2E_2$ and $M_3I_3C_3E_3$ acc. IEC 61076-3-125

Renamed 63171-6

IP20

M8 IP65/67

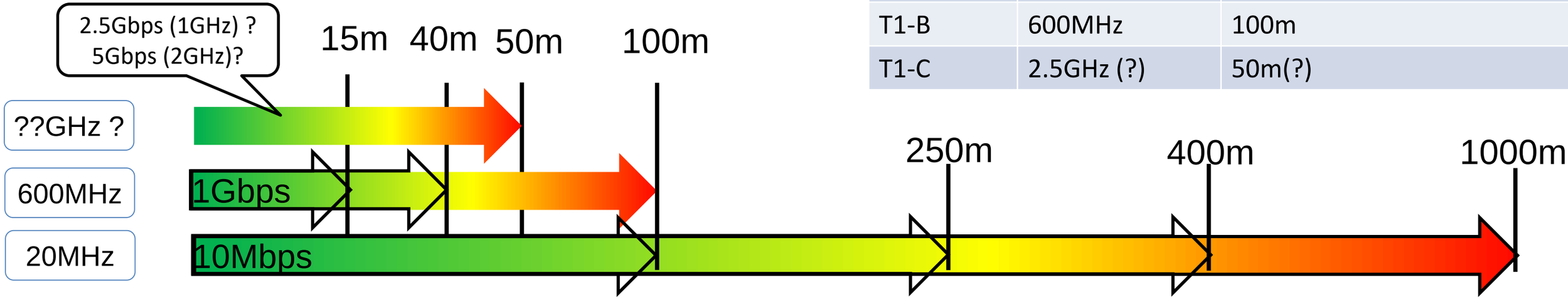
M12 IP65/67

SPE Structured Cabling - Channels

ISO/IEC 11801-1 Amd. Draft

- Cables will be 18AWG to 26AWG

Channel	Frequency	Length(s)
T1-A	20MHz	100m, 250m, 400m, 1000m
T1-B	600MHz	100m
T1-C	2.5GHz (?)	50m(?)



ANSI/TIA 568 Draft

- The 20MHz channel is divided into 2 options according to distance.
- The 600MHz channel is moved to annex.

Category (TBD)	Wire Size	Channel reach	IEEE 802.3	Data Speeds
SP1 Version B	18 AWG	1000m	802.3cg	10Mbps
SP1 Version A	23 AWG	400m	802.3cg	10Mbps

Agenda

1. Structure of ISO/IEC 11801 Series
2. Update of 25G Ethernet
3. Single Pair Ethernet: ISO vs. TIA
4. Fiber Optic Testing ISO/IEC 14763-3
5. “Unstructured” Cabling topologies
6. ISO/IEC 11801-99xx TRs

ISO / IEC 14763-3 DRAFT

Testing of Optical Fiber Cabling.

- Amendment 1 of Edition 2 had:
  - Revision of test cords,
  - Enhanced-three-test-cords method added,
  - Other improvements
- But the document is too complex for installers.
- Edition 3 is about
  - Correcting inconsistencies
  - Ensuring that the document corresponds to the needs of the installer.
  - Providing testing for the cabling according to ISO/IEC 11801 series.

ISO / IEC 14763-3 DRAFT

Some key information:

- Certification Tests are Permanent Link and Channel.
- They are done in LSPM (Light Source and Power Meter)
- Reference grade cords are mandatory for testing. (Using reference connectors)
- Reference cord performance must be verified before all measurement.
- Change in IL for connectors:
- RL values (reminder)
- Currently uni-directional for single fixed cable and connectors, by directional for more complex. Always 2 wavelengths.
- Cleaning and visual inspection are mandatory

Maximum IL (dB)	MM	SM (PC)	SM (APC)
Ref. / Ref.	0.10		
Ref. / Standard	0.45	0.60*	0.60
Standard / Standard	0.75		

** IL is 0.40dB if connector is center tuned*

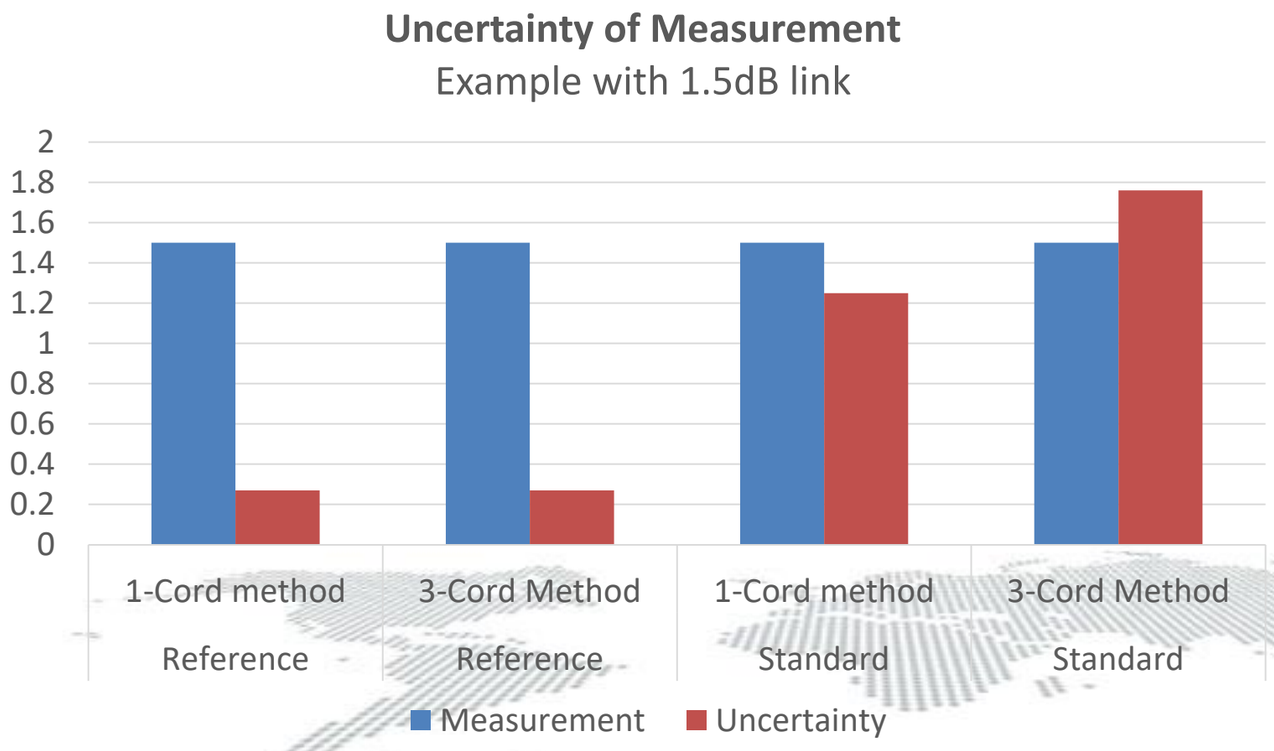
Minimum RL (dB)	MM	SM (PC)	SM (APC)
LC	20	35	60
LC (Reference)	35	45	60*
MPO	20	N/A	60

** RL is 0.55dB if connector is unmated*

ISO / IEC 14763-3 DRAFT

Uncertainties

- The concept of measurement uncertainty is introduced.
- This clarifies why the Reference grade connectors are needed for testing.



Uncertainty of test measurement using reference grade connectors

Uncertainty (dB)	MM	SM
1 and 3 cord methods	0.27(1)	0.24(2)

(1) 0.14 if the measure IL is more than 1.9dB
(2) Assuming the total length is less than 2km

Uncertainty of test measurement using standard grade connectors
Extract of IEC 61280-4-1

Uncertainty (dB)	1-Cord	3-Cord
Multimode	1.25	1.76

(1) For measured cabling attenuation of 1.5dB

Agenda

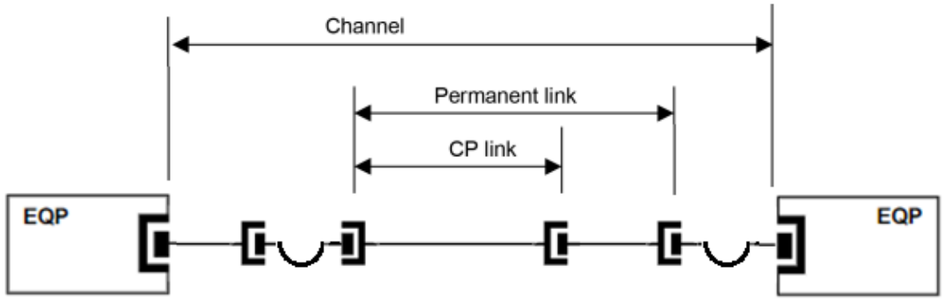
1. Structure of ISO/IEC 11801 Series
2. Update of 25G Ethernet
3. Single Pair Ethernet: ISO vs. TIA
4. Fiber Optic Testing ISO/IEC 14763-3
5. “Unstructured” Cabling topologies
6. ISO/IEC 11801-99xx TRs

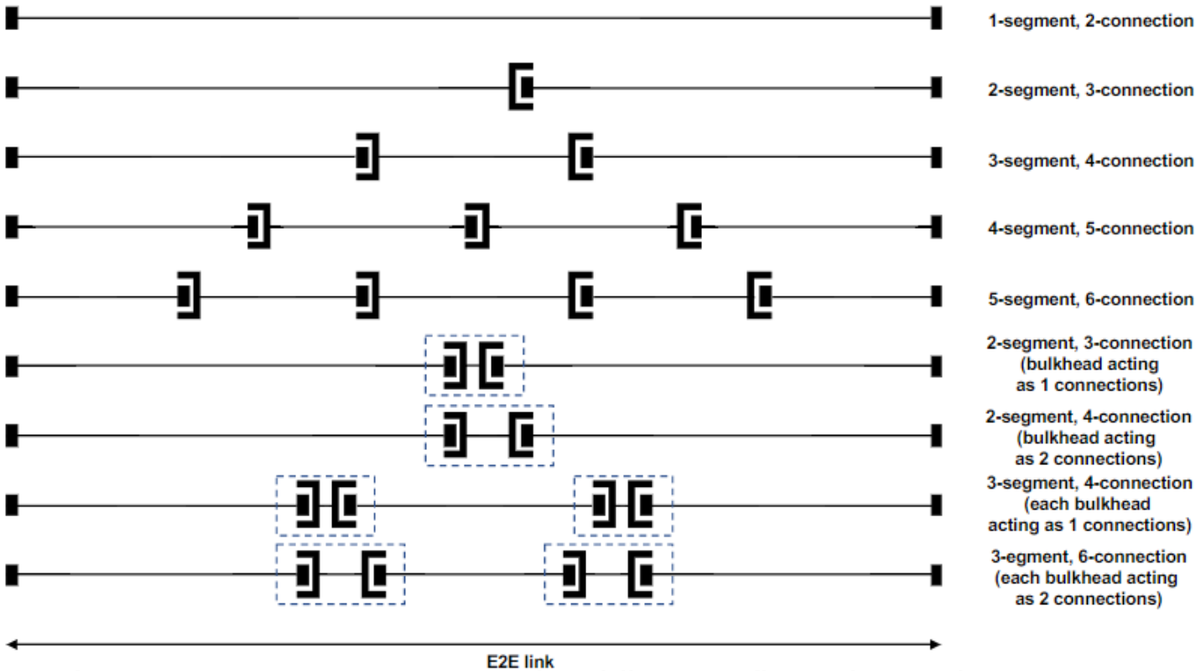
Credit to Mike Gilmore

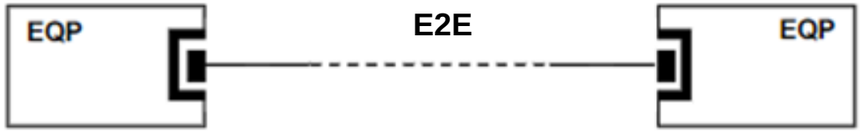
End to End (E2E): ISO/IEC TR 11801-9902

Problem:

- This is a Channel:
  - It allows a Permanent link and 4 connection points
  - What if you wanted different configurations?
- Make just about anything you want and call it an End-to-End link.
  - This cannot be certified, so any change requires to re-test.





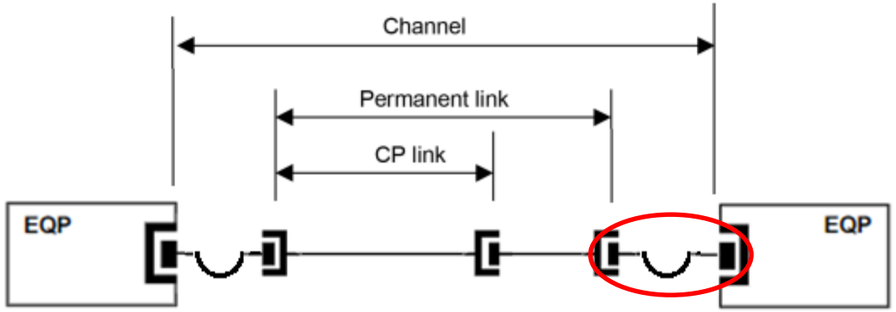


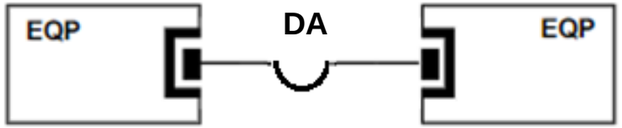
Draft EN 50173-XX, Unstructured Cabling Configurations, Figure 3

Direct Attach (DA): ISO/IEC TR 11801-9907

Problem:

- This is a Channel:
  - It’s tested to many parameters
- This is a cord:
  - The cord connects the PL to the equipment
  - It’s only tested for RL and NEXT.
- What if I make a long cord to connect equipment's directly?
  - Then it’s not a cord, it’s a Direct Attach.
  - Test it to all PL limits



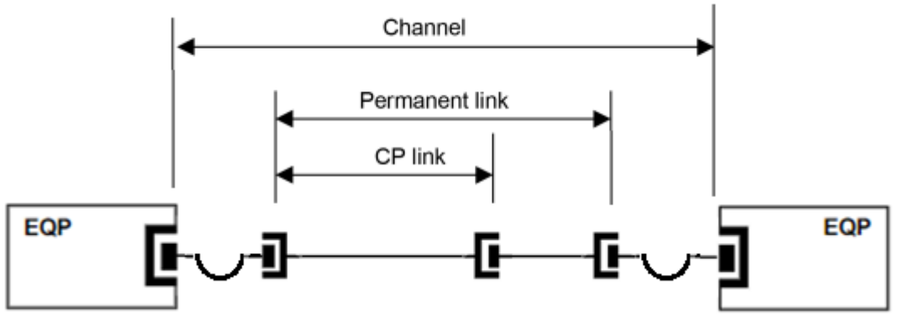


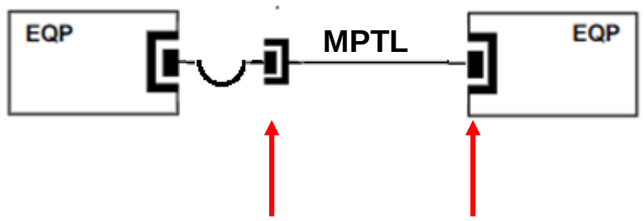
Transmission parameter [a]
Return loss
Insertion loss
Pair-to-pair NEXT
PS NEXT
Pair-to-pair ACR-N
PS ACR-N
Pair-to-pair ACR-F
PS ACR-F
Direct current (DC) loop resistance
Direct current (DC) resistance unbalance within pairs
Direct current (DC) resistance unbalance between pairs
Propagation delay
Delay skew
Unbalance attenuation, near-end (TCL)
Unbalance attenuation, far-end (ELTCTL)
Coupling attenuation
PS ANEXT
PS $ANEXT_{avg}$
PS AACR-F
PS $AACR\text{-}F_{avg}$
Wire-map
Continuity: • signal conductors; • screen conductors (if present); • short circuits; • open circuits.
Length [b]

Modular Plug Terminated Link (MPTL): ISO/IEC TR 11801-9910 DRAFT

Problem:

- This is a Channel:
  - What if I want to put a plug at the end of the cable instead of using an outlet? (think camera or wifi access point connection)
- Then its not a channel (Wrong connector panel side)
- And it's not a Permanent Link (wrong connector device side)
- This is an MPTL

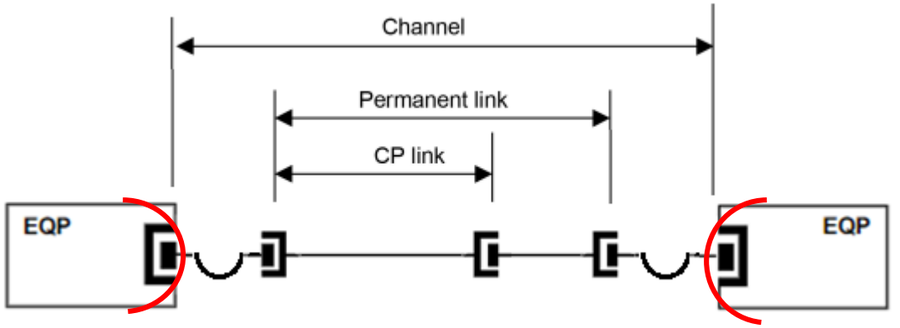


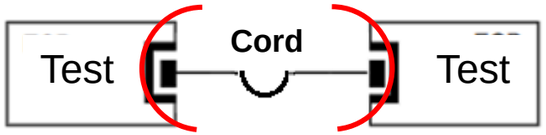


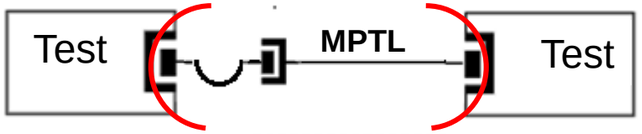
Testing Unstructured Cabling Configurations: ISO/IEC 14763-4 DRAFT

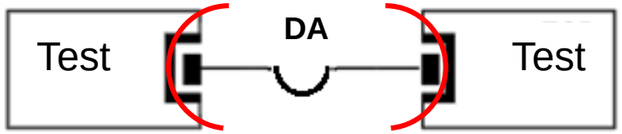
Problem:

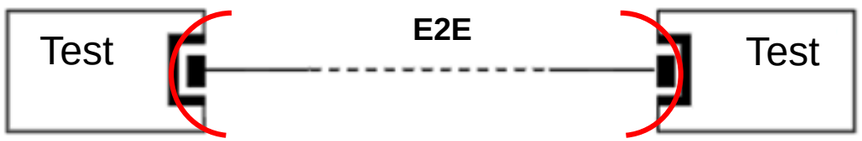
- This is a Channel:
  - The test excludes the connectors on both ends because it assumes the use of compliant cords.
  - But all “unstructured” configurations require to measure including the connectors at both ends because the connectors could be field installed.
- These tests are in the draft ISO/IEC 14763-4.
  - They require patch cord adapters on the testers.
  - Do **not** use Channel adapter.
  - All limits used are the PL values.











Agenda

1. Structure of ISO/IEC 11801 Series
2. Update of 25G Ethernet
3. Single Pair Ethernet: ISO vs. TIA
4. Fiber Optic Testing ISO/IEC 14763-3
5. “Unstructured” Cabling topologies
6. ISO/IEC 11801-99xx TRs

All the ISO/IEC TR 11801-99xx

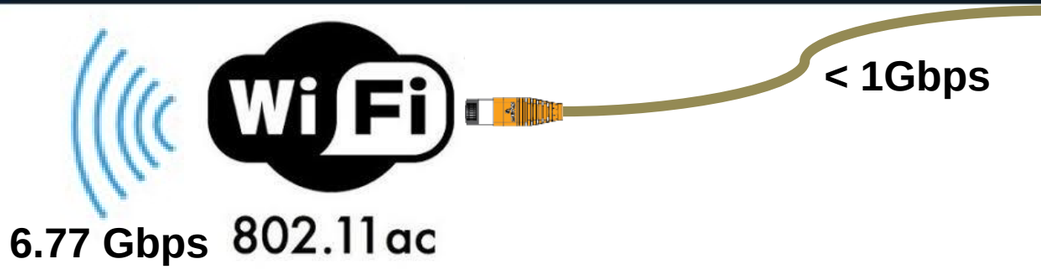
Before Category 8 was ratified

To support calculations in the 11801-1

Name	Date	Comments
Part 9901: Guidance for balanced cabling in support of ast 40 Gbit/s data transmission	2014	
Part 9902: End-to-End link configurations	2017	
Part 9903: Matrix modelling of channels and links	2015	Edition 2 in Draft
Part 9904: Assessment and mitigation of installed balanced cabling channels to support 2,5GBASE-T and 5GBASE-T	2017	
Part 9905: Guidelines for the use of installed cabling to support 25GBASE-T application	2018	
Part 9906 - TECHNICAL REPORT: Balanced 1-pair cabling channels up to 600 MHz	2019	
Part 9907: Specifications for direct attach cabling	2019	
Part 9908 High-speed applications over multimode channels	Draft	
Part 9909: Balanced cabling in support of 25 Gb/s, extended reach, up to at least 50 m	Draft	
Part 9910: Specifications for MPT-Link	Draft	
Part 99xx: Physical network security for the accommodation of customer premises cabling infrastructure and information technology equipment	Draft	

ISO/IEC TR 11801-9904

- 802.11ac and 802.11ad, existing since 2013, offer 6.75Gbps wireless.
- Only Cat6a offers more than 1Gbps on cable.
- The NBase-T alliance developed the 2.5G and 5G for existing cabling, along with a probability table. (Nbase-T merged with IEEE in 2019 and this is now 802.3bz)
- ISO/TR 11801-9909 explains how to test existing Cat.5 and Cat.6 for implementation of 2.5G and 5GBase-T.
- This is the same method from TR 24750 for implementation of 10GBase-T on existing cat.6.
  - Re-Test to higher frequency
  - Test Alien noise
  - If it fails..
    - Un-bundle cables
    - Change cords
    - Changer connectors
    - Change cables



Bundled cabling length 0m to 50m	Category 5e	Category 6	Category 6A
2.5GBASE-T			Assured
5GBASE-T Assured			Assured

Bundled cabling length 50m to 75m	Category 5e	Category 6	Category 6A
2.5GBASE-T			Assured
5GBASE-T Assured			Assured

Bundled cabling length 75m to 100m	Category 5e	Category 6	Category 6A
2.5GBASE-T			Assured
5GBASE-T Assured			Assured

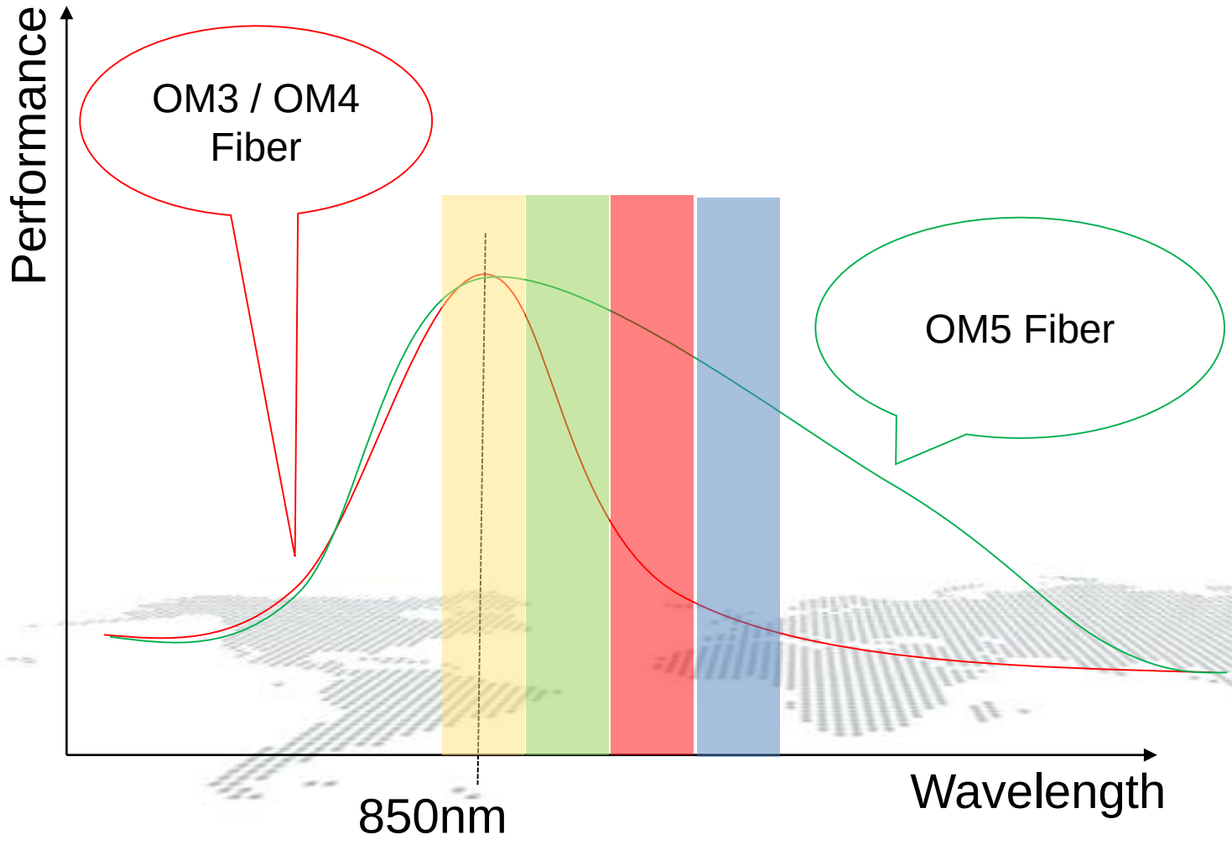
ALSNR Risk	High	Medium	Low

Disturbed Cable

ISO/IEC TR 11801-9908 DRAFT
High-speed applications over multimode channels

It answers the question: Why do we need OM5:

- Using Array (MPO) based cabling to support parallel and duplex channels
- How OM5 will allow longer life of the cabling



Data Rate (Gbps)	IEEE Standard Status	Fiber Pairs	Wavelengths
25	Ratified	1	1
40	Ratified	4	1
	Non-Standard	1	2
		1	4
50	Draft	1	1
100	Ratified	10	1
		4	1
	Non-Standard	1	4
	Draft	1	2
400	Draft	4	2
		4	*4*
	Ratified	16	1
800	Draft	*4*	*4*

ISO/IEC TR 11801-99xx DRAFT
Physical network security

Companies and Administration must protect their customers' data

- Everyone is aware of software protection (antivirus, firewall, etc..)
- What about the physical security of the IT equipment?

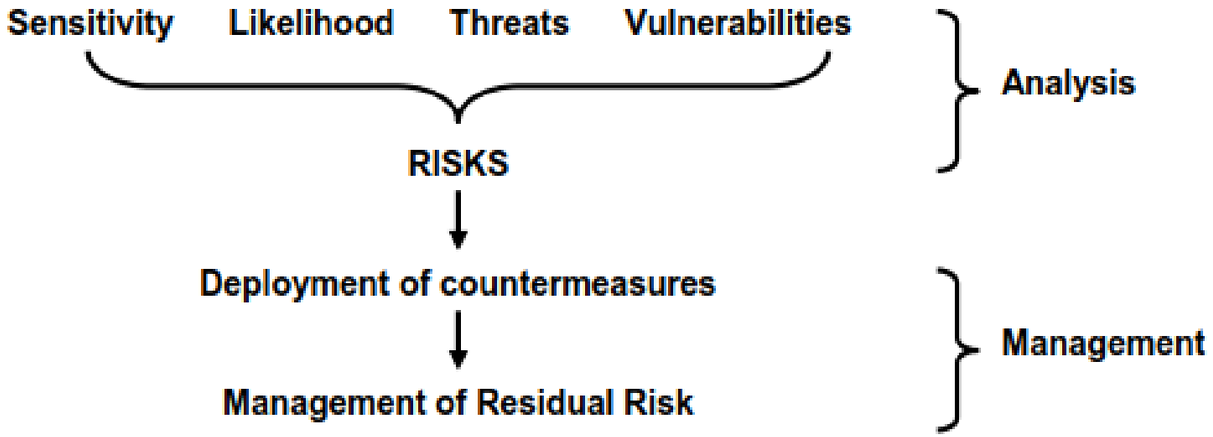
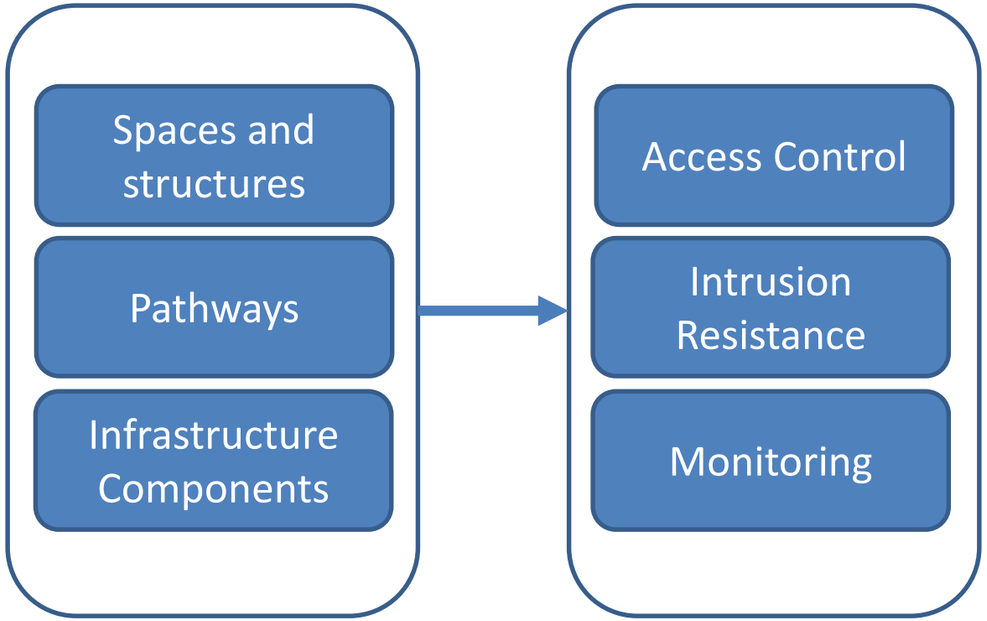


Figure 1 – Risk assessment concepts



Document is now becoming a standard under: ISO/IEC 24383

Thank You

Gautier Humbert, RCDD

Legrand Digital Infrastructures Standards Coordinator

Email: gautier.humbert@legrand.fr

BICSI District Chair– Mainland Europe

Email: Ghumbert@bicsi.org