ISO/IEC TR 11801-99-1 Guidance on 40GBASE-T Cabling

- a tutorial -

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Contribution to IEEE 802.3bq Task Force; 16+17 May 2013, Victoria, BC

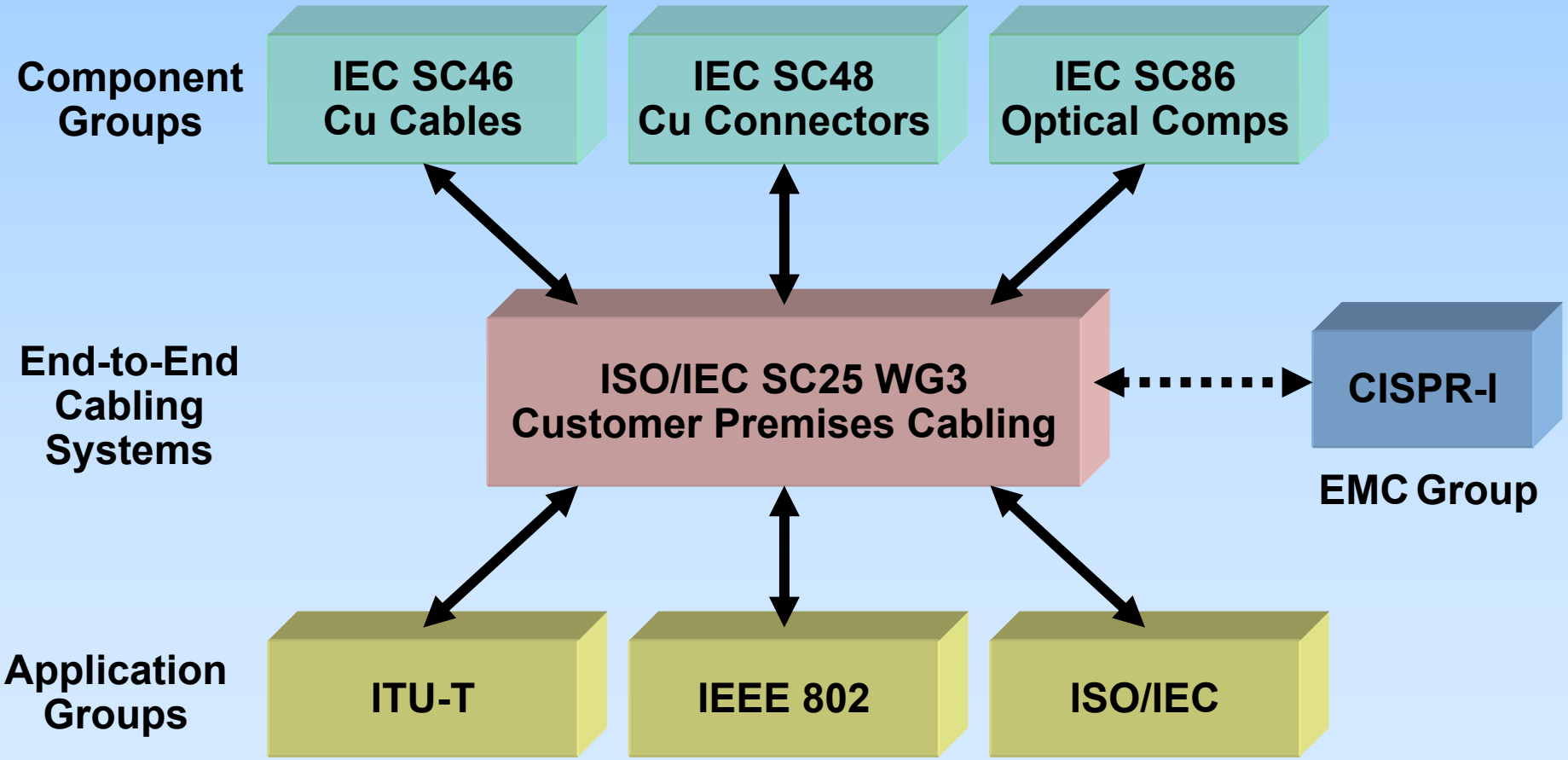
Content

1. introduction to ISO/IEC SC25 WG3
2. overview of ISO/IEC TR 11801-99-1
3. motivation for this technical report
4. comparison of new/existing cabling
5. plan for completion and next steps

Who are ISO/IEC SC25 WG3?

- International cabling systems group
- SC25: Interconnection of IT Equipment
- WG3: Customer Premises Cabling
- active participation by 20+ nations
- information flow with TIA via US NB
- WG3 meets twice a year on average

ISO/IEC SC25 WG3 Process Model



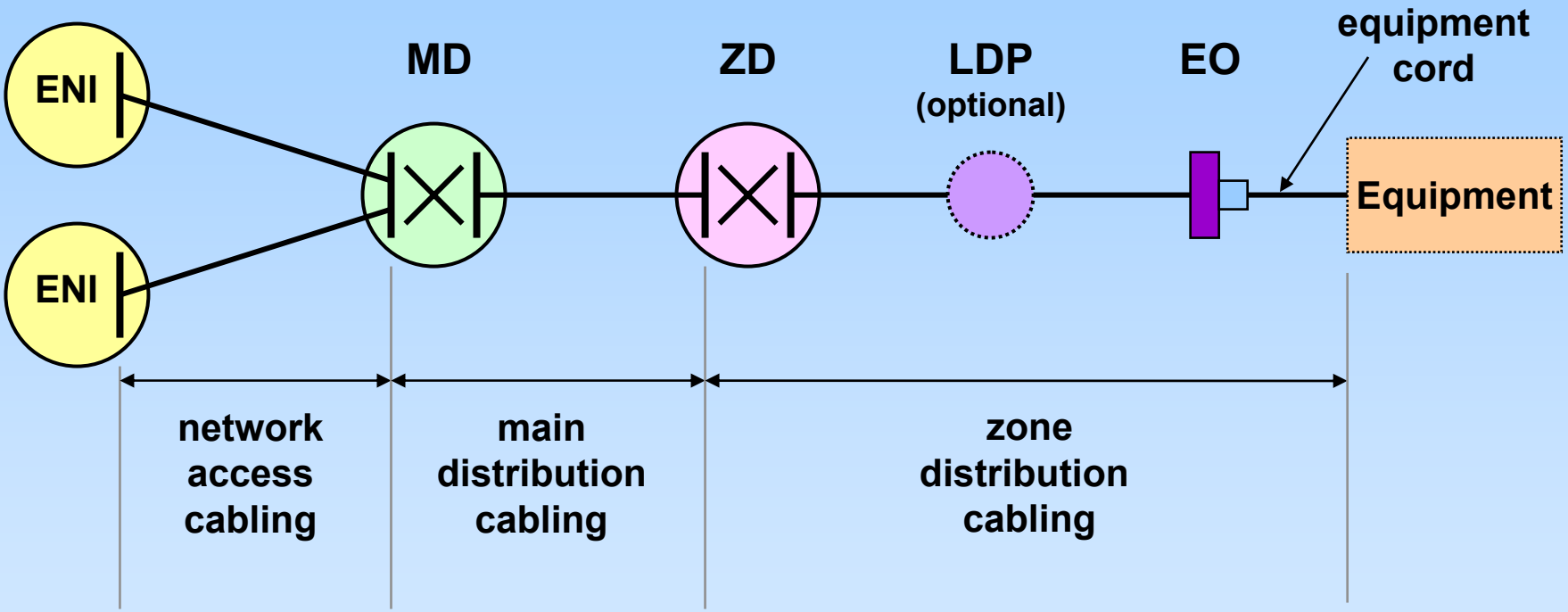
ISO/IEC SC25 WG3 Recent Deliverables

Reference	Title	Status
ISO/IEC TR 24750	Supporting 10GBASE-T with Cat 6	approved 2007
ISO/IEC TR 29106	MICE Environmental Classification	approved 2008
ISO/IEC 24702 Am.1	Industrial Cabling	approved 2009
ISO/IEC 15018 Am.1	Home Cabling	approved 2009
ISO/IEC 11801 Ed.2 Amendment 1	Customer Premises Cabling: Addition of Class E_A & F_A channels with Electromagnetic Performance	approved 2008
ISO/IEC 11801 Ed.2 Amendment 2	Customer Premises Cabling: Addition of Cat 6_A & 7_A components	approved 2010
ISO/IEC 24764	Data Centre Cabling	approved 2010
ISO/IEC TR 29125	Guidelines on Remote Powering	approved 2010
ISO/IEC 14763-2	Cabling Planning & Installation	approved 2011

Re-structuring of ISO/IEC Cabling Design Standards

- ISO/IEC cabling standards have been re-structured into single family:
  - ISO/IEC 11801-1 General Requirements (structure, dimensioning, channel)
  - ISO/IEC 11801-2 Commercial Office Environment (unique aspects)
  - ISO/IEC 11801-3 Industrial Environment (unique aspects)
  - ISO/IEC 11801-4 Residential Environment (unique aspects)
  - ISO/IEC 11801-5 Data Centre (unique aspects)
  - ISO/IEC 11801-6 *for future use*
- re-structuring exercise now complete with no technical changes
- will be used as the basis to develop ISO/IEC 11801 3rd Edition

ISO/IEC 24764 Data Centre Cabling Model

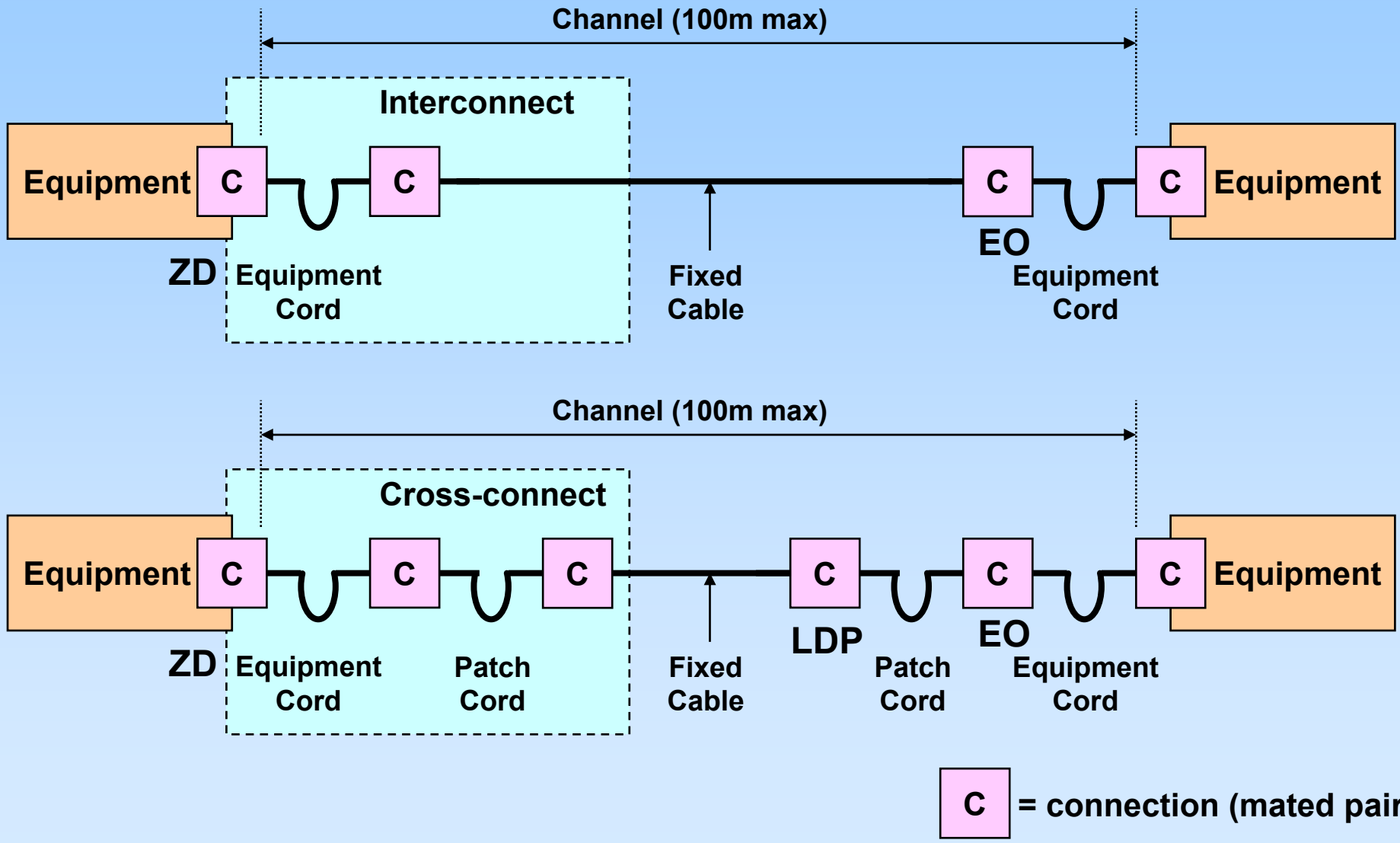


ENI = Equipment Network Interface
MD = Main Distributor
ZD = Zone Distributor
LDP = Local Distribution Point
EO = Equipment Outlet

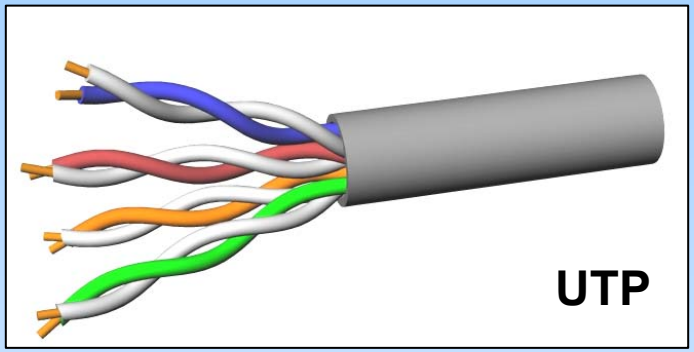
Data Centre Cabling Media & Connectors

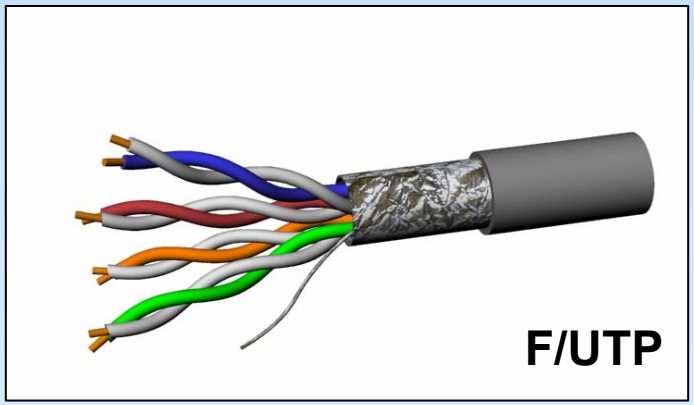
- channel length is determined by media choice
- Class E_A min. performance for copper channel
- 2, 3 or 4 mated connectors per copper channel
- OM3 min performance per MMF optical channel
- duplex LC connector specified at EO for 2 fibres
- MPO connector specified at EO when > 2 fibres

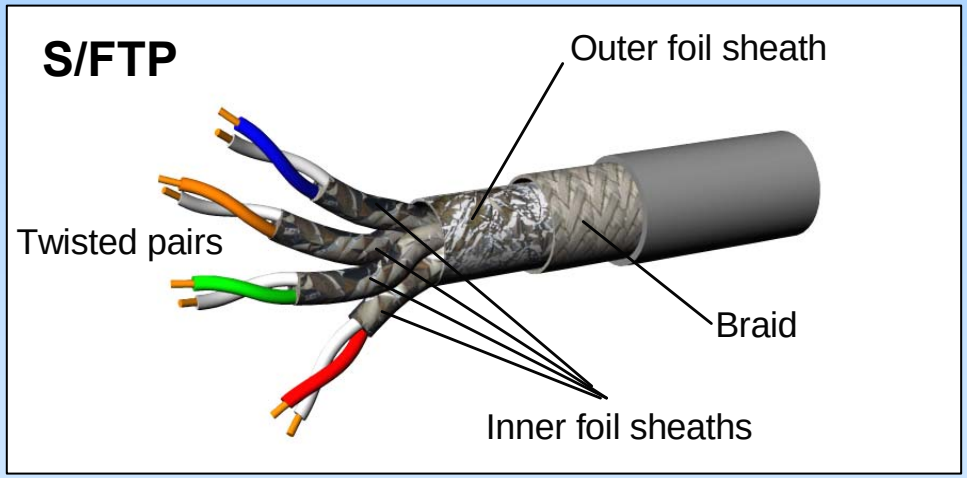
ISO/IEC 24764 Zone Distribution Models (Copper)



Cable Construction







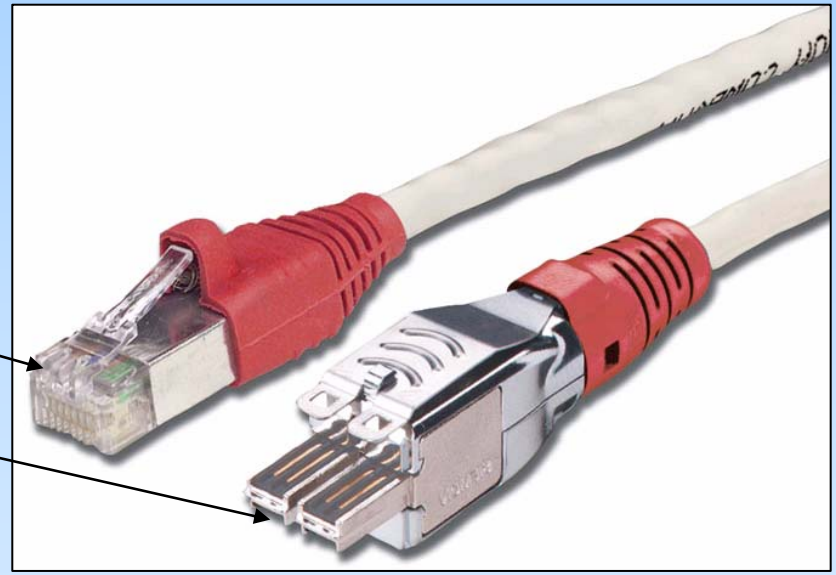
Note: ISO/IEC 11801 & IEC 61156 do not specify cable construction

Connectors

ISO/IEC 11801 cabling standard makes reference to:

IEC 60603-7-x (RJ45 type) for Cat 3 - 7_A

IEC 61076-3-104 *alternative* for Cat $7/7_A$



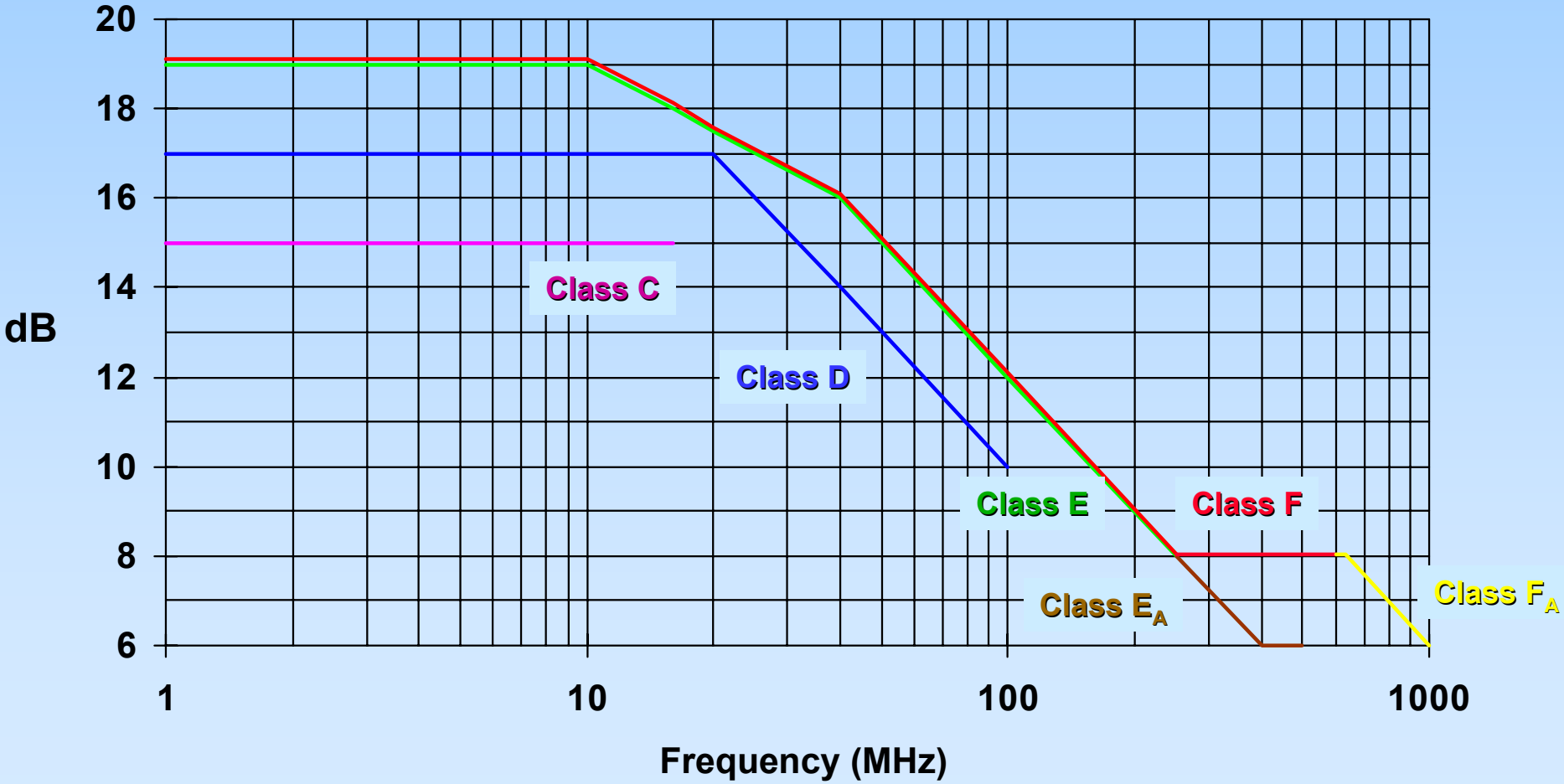
Copper Cabling Classes

Class A	link or channel specified up to	100 kHz
Class B	link or channel specified up to	1 MHz
Class C	link or channel specified up to	16 MHz
Class D	link or channel specified up to	100 MHz
Class E	link or channel specified up to	250 MHz
Class E_A	link or channel specified up to	500 MHz
Class F	link or channel specified up to	600 MHz
Class F_A	link or channel specified up to	1000 MHz

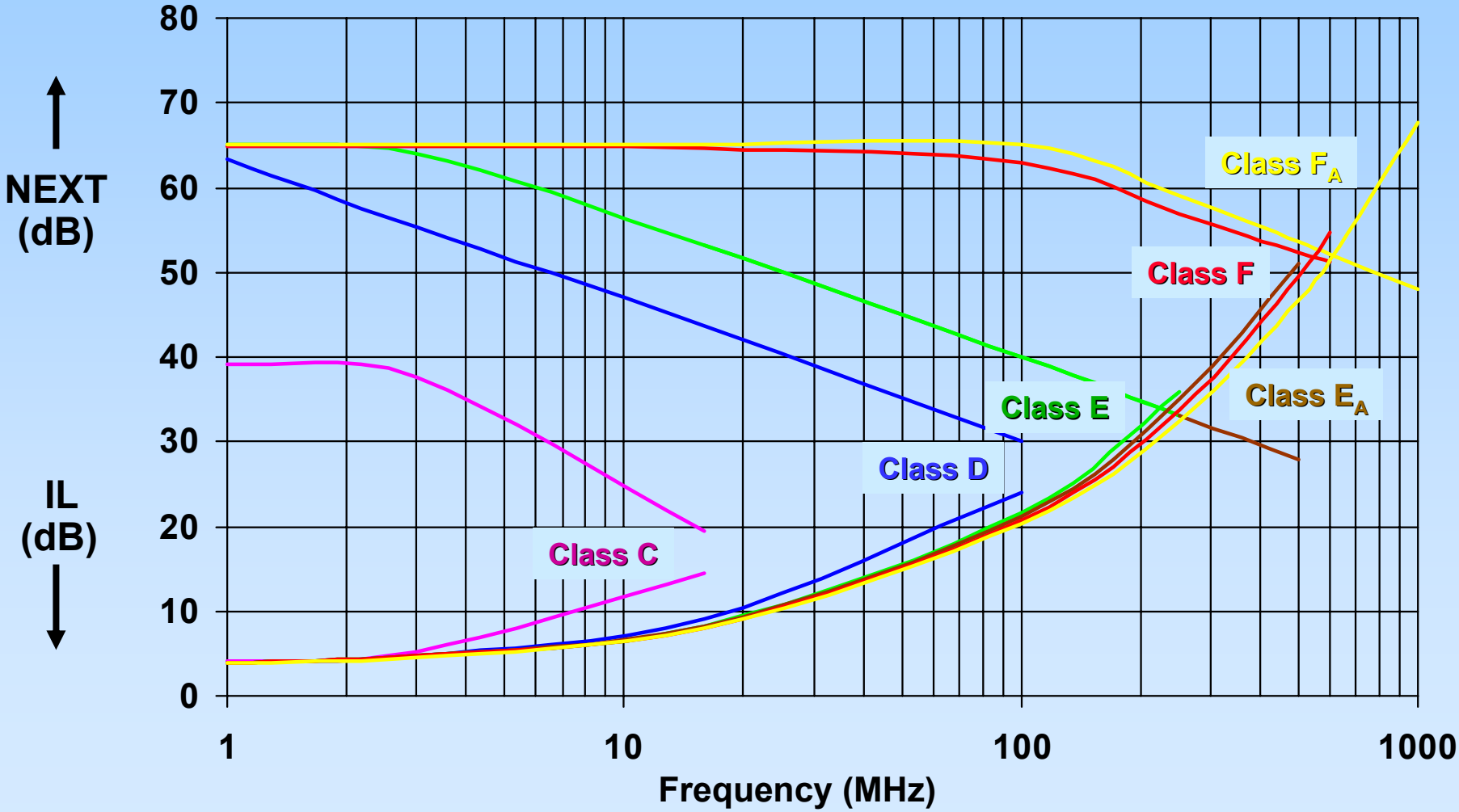
Copper Cabling Categories

Category 3	cable, connector and cord specified up to	16 MHz
Category 5	cable, connector and cord specified up to	100 MHz
Category 6	cable, connector and cord specified up to	250 MHz
Category 6_A	cable, connector and cord specified up to	500 MHz
Category 7	cable, connector and cord specified up to	600 MHz
Category 7_A	cable, connector and cord specified up to	1000 MHz

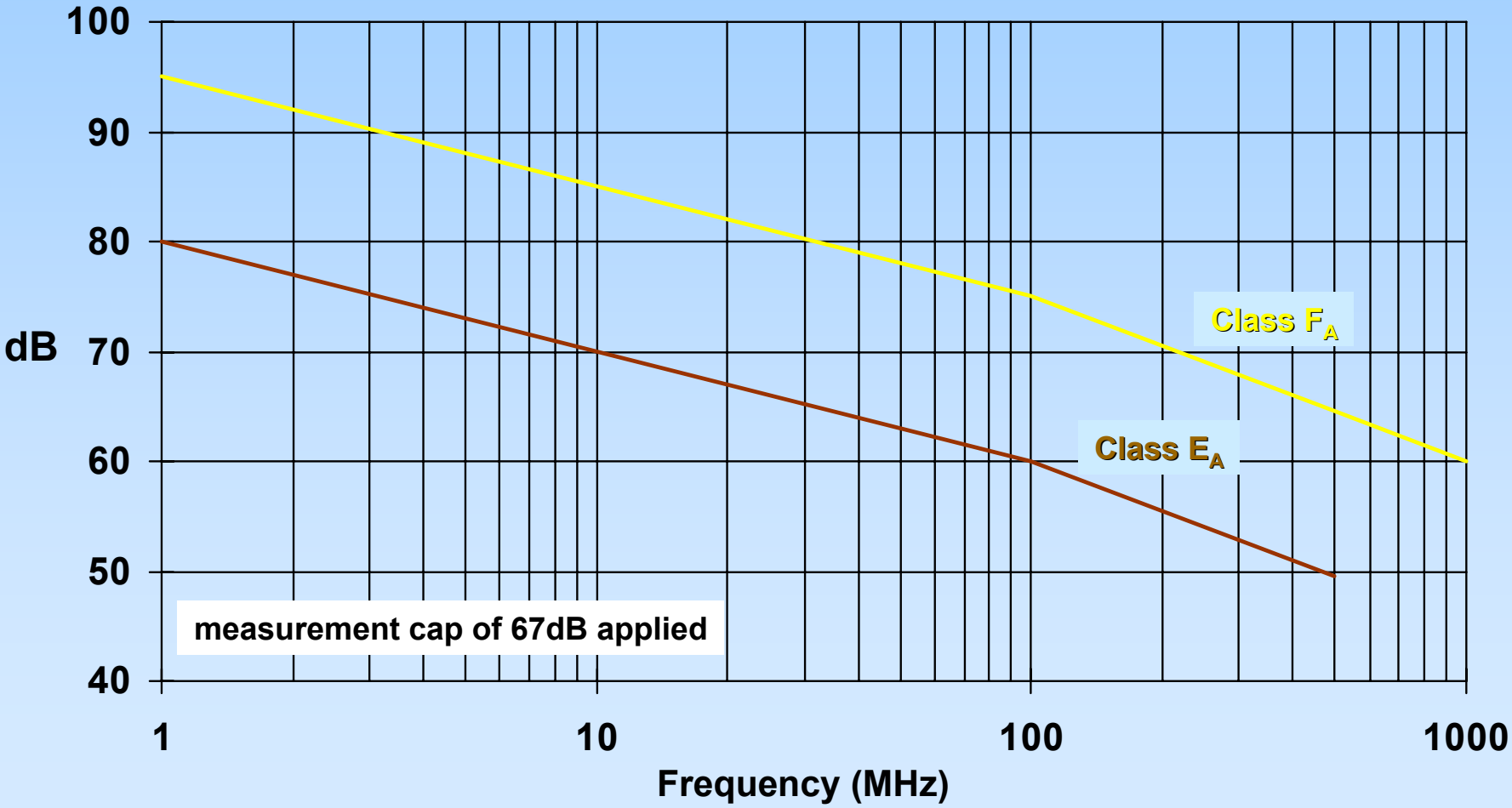
Channel RL Performance



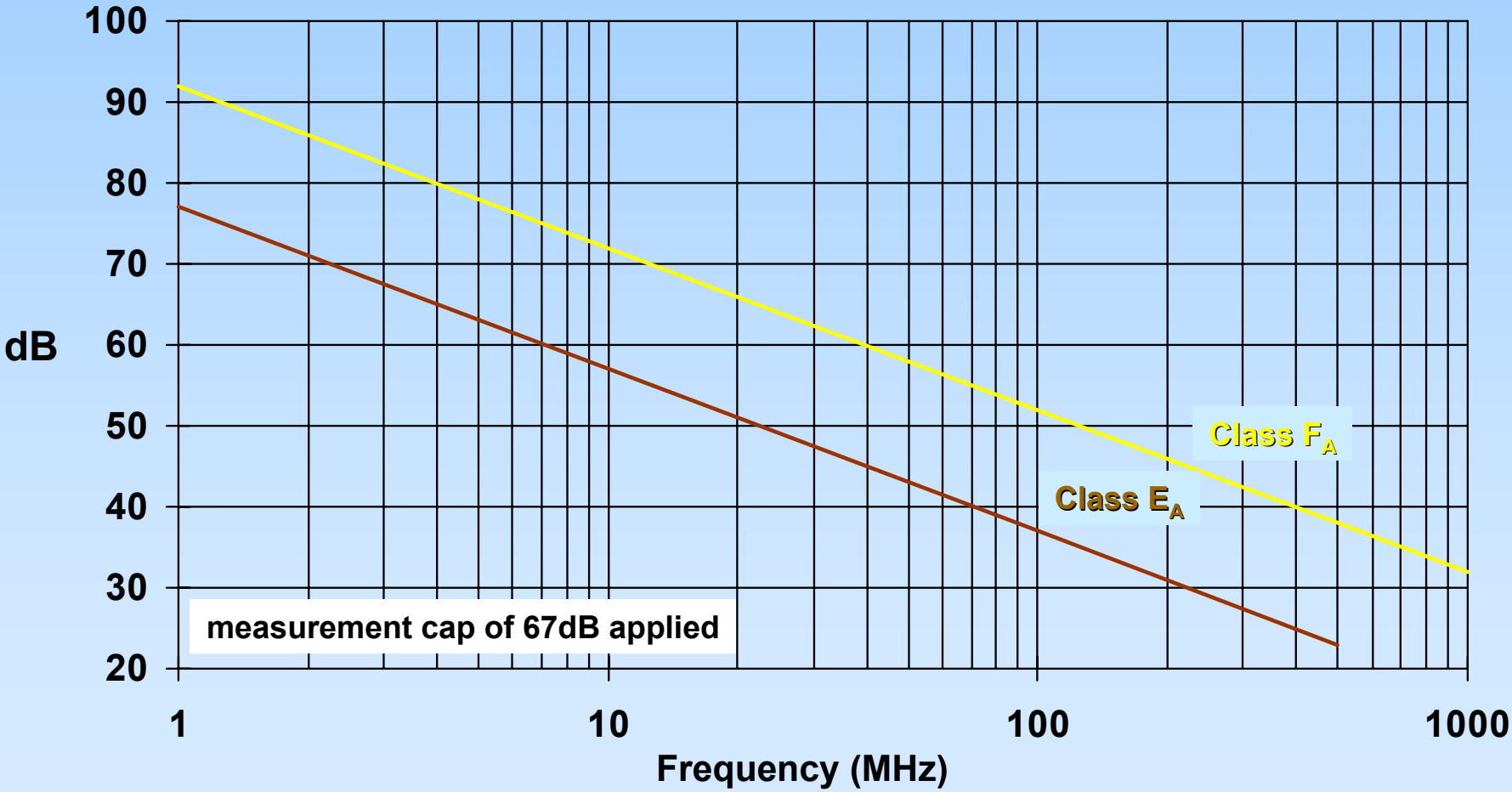
Channel IL & NEXT Performance



Channel PSANEXT Performance



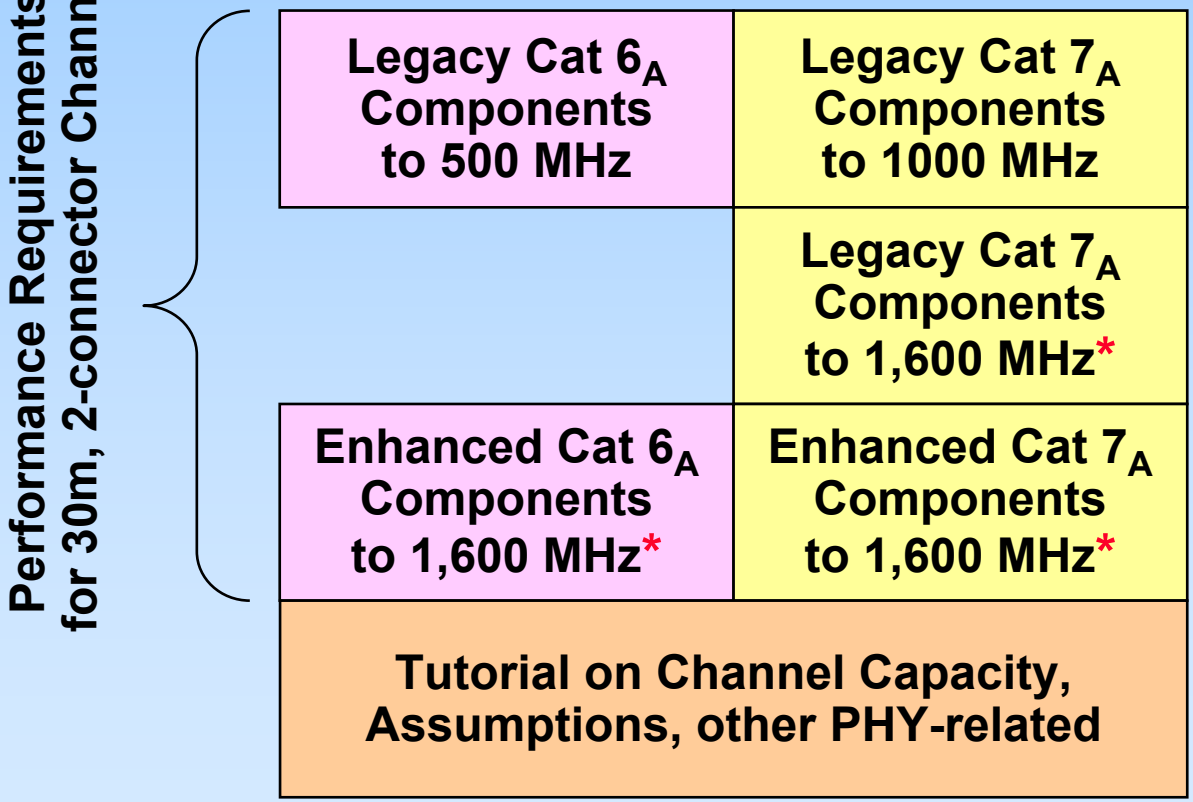
Channel PSAACR-F Performance



ISO/IEC TR 11801-99-1
40GBASE-T Cabling Guidance

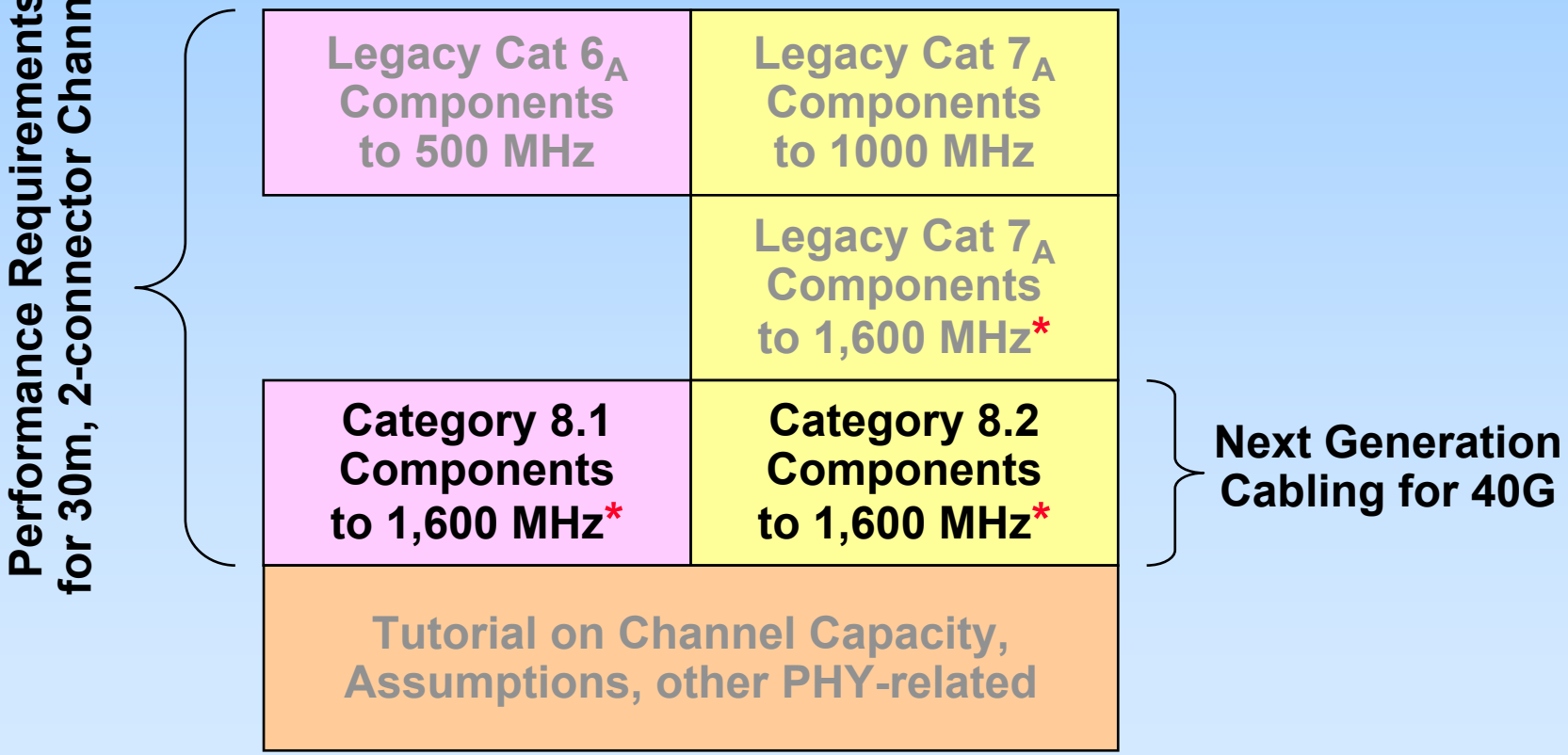
- *speculative* project approved March 2012 to support Next Gen. BASE-T initiatives underway within IEEE
  - 18 out of 18 P- members voted in favour
- motivation is to characterise *existing* and also *new* components to offer *range of options* for NGBASE-T
- PDTR had substantial support in national review
- 480 comments from national + 802.3 experts resolved
- decision to remove all 25m/50m channel lengths and adopt 30m channel only as per 40GBASE-T objective
- 2nd PDTR circulated in April 2013 for approval as DTR

ISO/IEC 11801-99-1 Deliverables



* Upper Frequency of 2 GHz For Further Study

ISO/IEC 11801-99-1 Deliverables



* Upper Frequency of 2 GHz For Further Study

Naming of New Categories & Classes

- Class I channels to be specified by a Reference Implementation using Category 8.1 components
- Class II channels to be specified by a Reference Implementation using Category 8.2 components

Comparison of Class I & Class II Channels

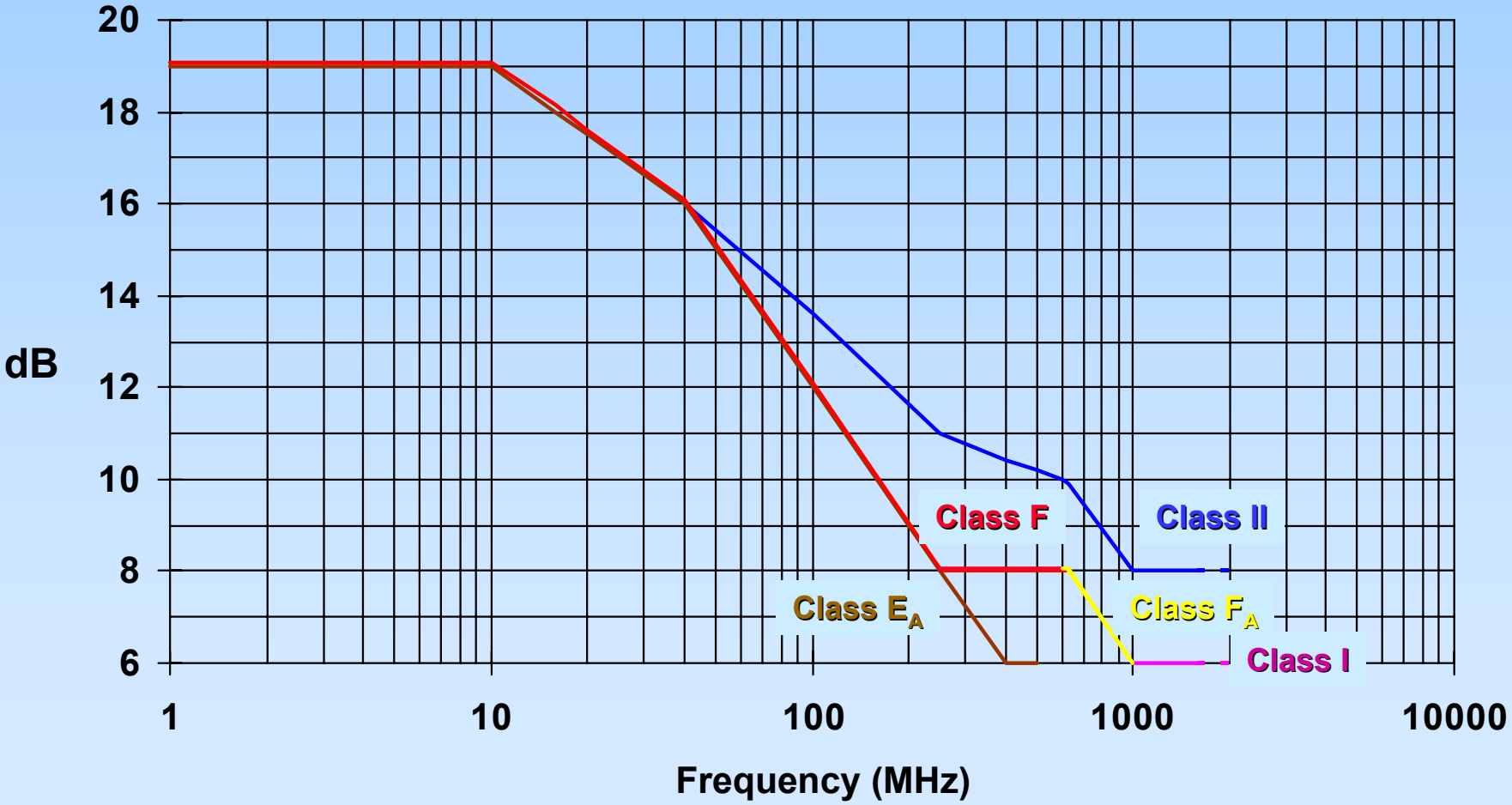
	ISO/IEC 11801-99-1 2nd PDTR Class I Channel	ISO/IEC 11801-99-1 2nd PDTR Class II Channel
RL	631≤f<1000 36-10*log(f) 1000≤f<2000 6dB	631≤f<1000 35-9*log(f) 1000≤f<2000 8dB
IL	0.32(1.8√f+0.005f+0.25/√f) + 2x0.02√f	0.32(1.8√f+0.005f+0.25/√f) + 2x0.02√f
TCL	1≤f<1600 60-17*log(f) 1600≤f<2000 40dB max	1≤f<1600 60-17*log(f) 1600≤f<2000 40dB max
ELTCTL	1≤f<79.5 38-20*log(f)	1≤f<79.5 38-20*log(f)
CA	30≤f<100 50dB 100≤f<2000 90-20*log(f)	30≤f<100 50dB 100≤f<2000 90-20*log(f)
PSANEXT	1<f<100 100-10*log(f) 100<f<2000 110-15*log(f)	1<f<100 105-10*log(f) 100<f<2000 115-15*log(f)
PSAACRF	56-20*log(f/100)	61-20*log(f/100)

Comparison of Class I & Class II Channels

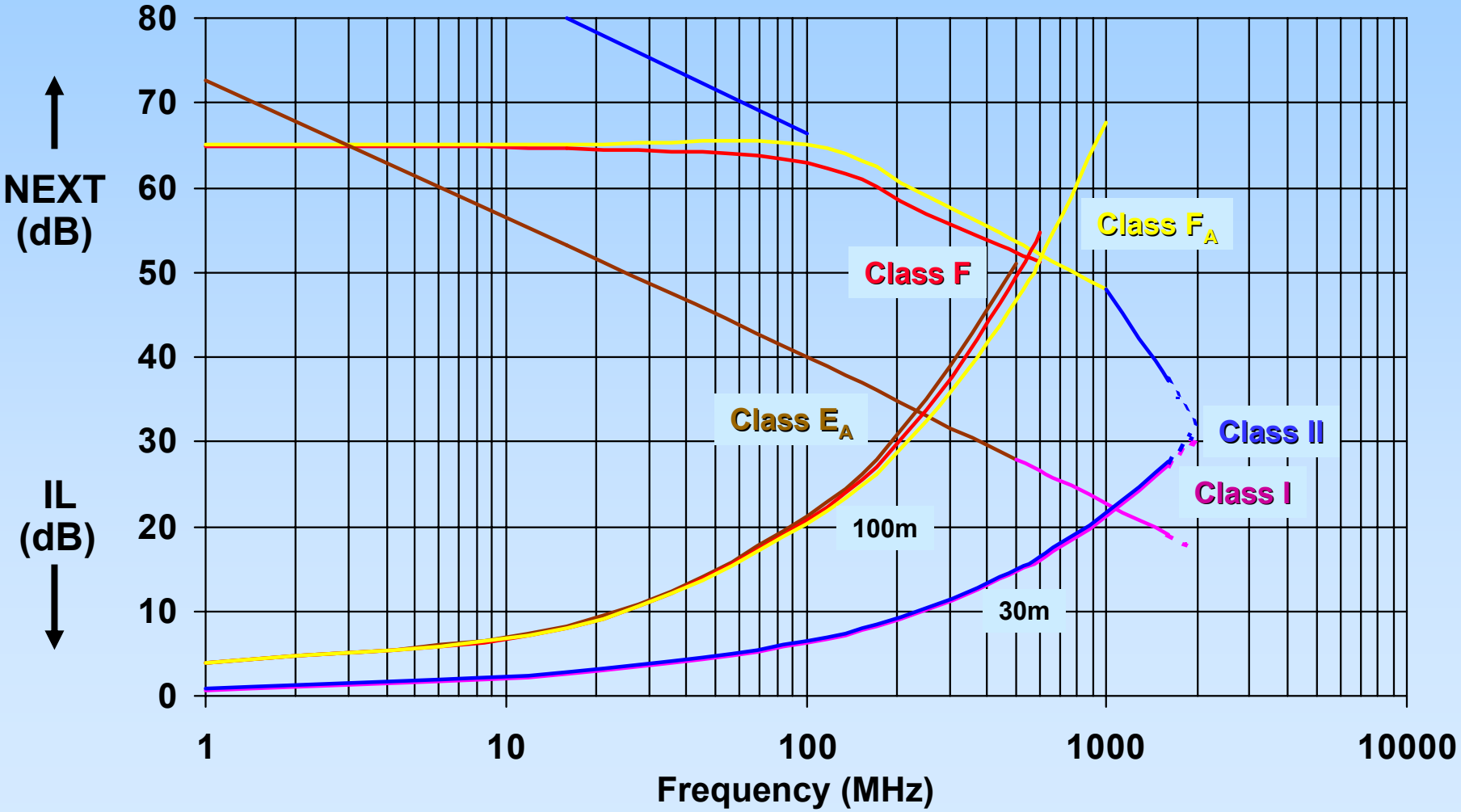
	ISO/IEC 11801-99-1 2nd PDTR Class I Channel @ 1GHz	ISO/IEC 11801-99-1 2nd PDTR Class II Channel @ 1GHz
RL	6.0dB	8.0dB
IL	21.1dB	21.1dB
NEXT	22.6dB	47.9dB
ACR-F	10.5dB	33.1dB
CA	30.0dB	30.0dB
PSANEXT	65.0dB	70.0dB
PSAACRF	36.0dB	41.0dB

Performance Advantage Highlighted

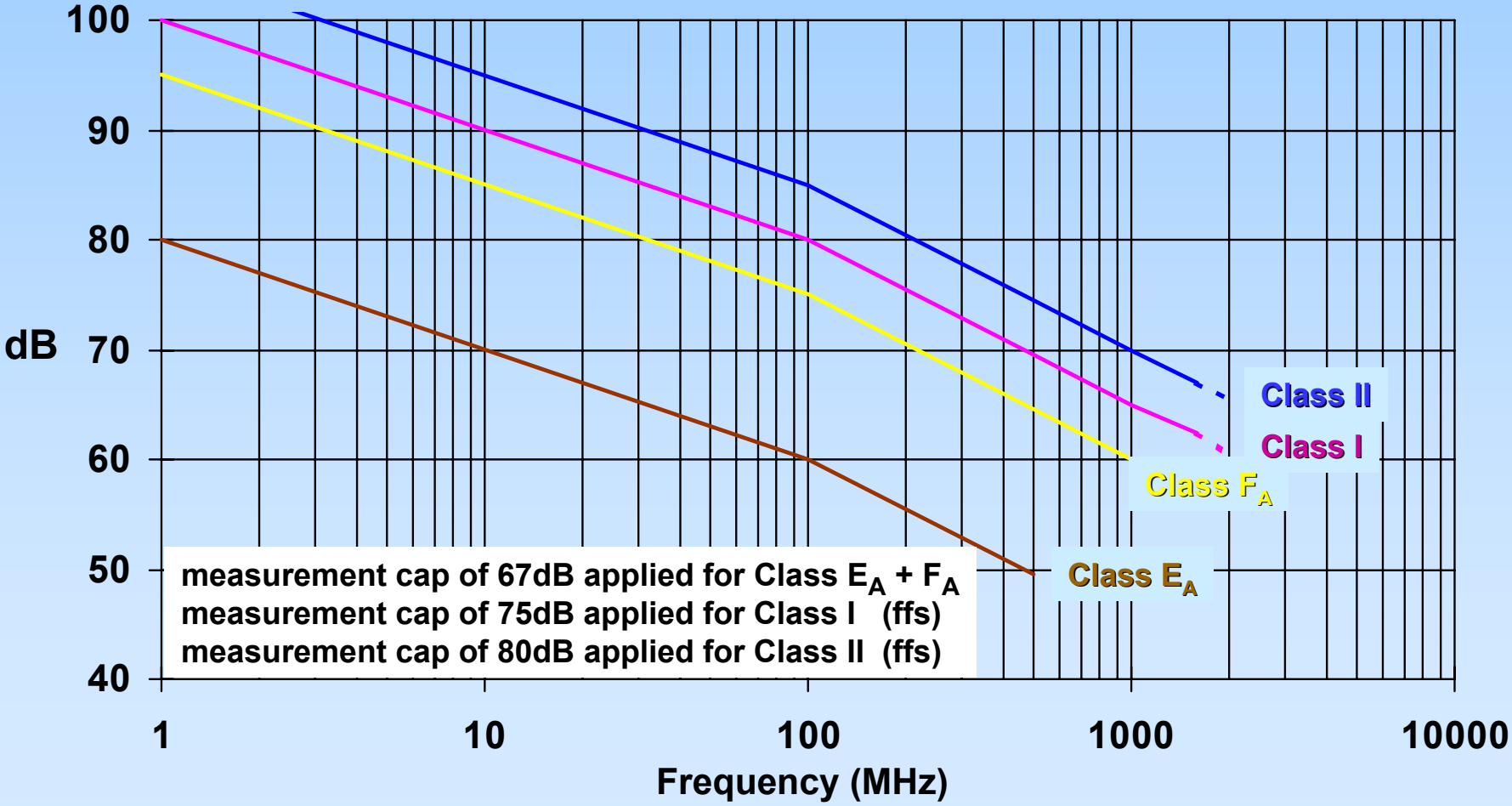
Class I/II Channel RL Performance



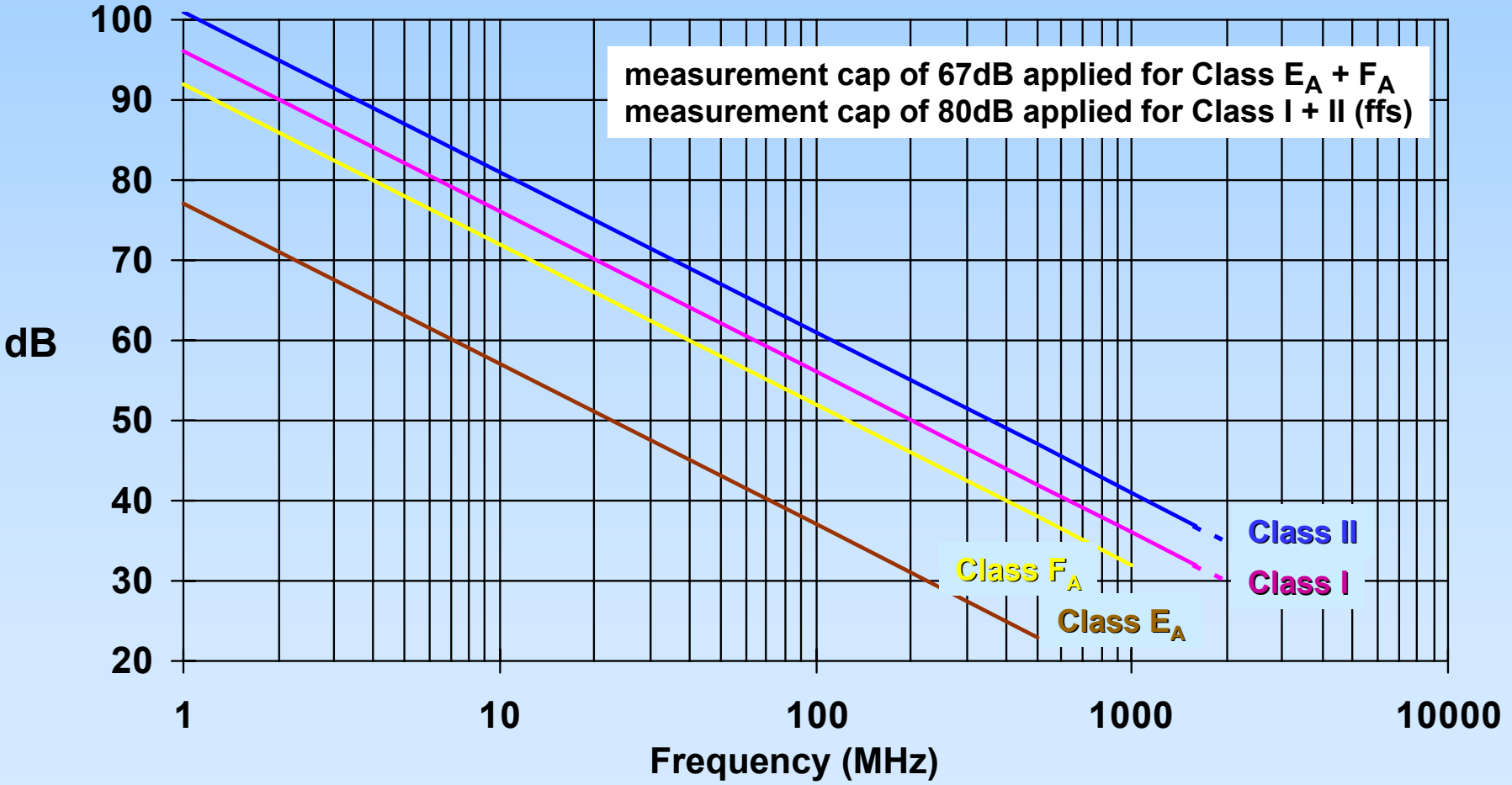
Class I/II Channel IL & NEXT Performance



Class I/II PSANEXT Performance



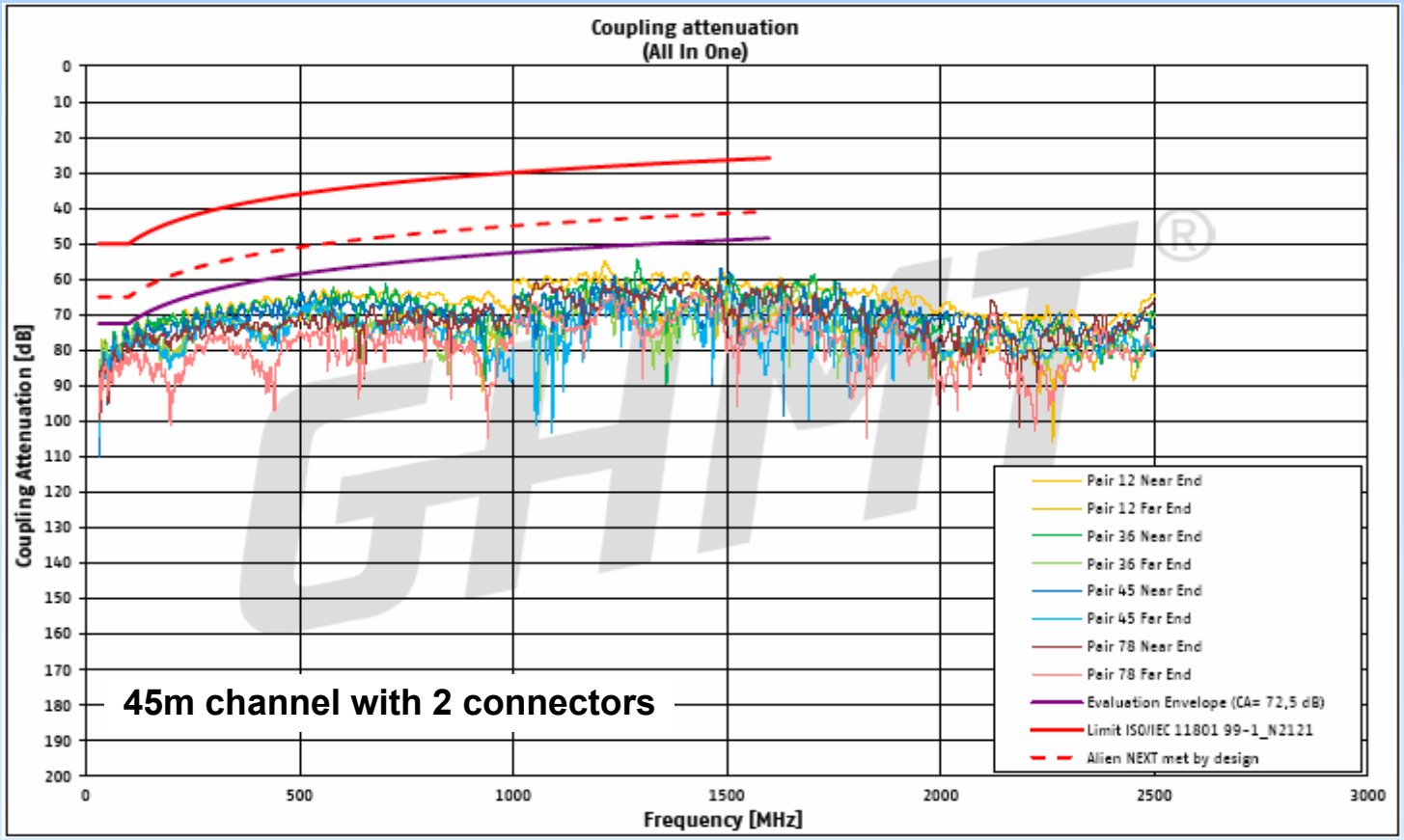
Class I/II PSAACR-F Performance



Alien Crosstalk Verification

If coupling attenuation for Class I channels is 10dB better*, or for Class II channels is 15dB better*, then the requirements for alien crosstalk are met by design.

* 90-20log(f)



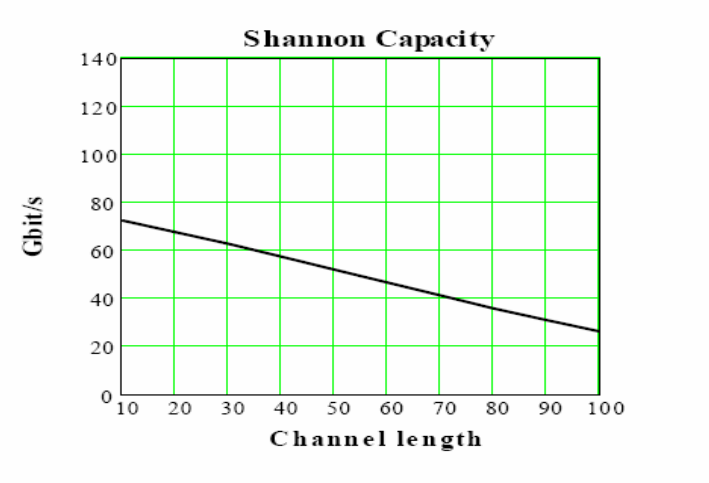
Capacity Assessment

	Case 1: Fixed Assumptions	Case 2: Variable Assumptions
NEXT Noise Suppression	CN = 40dB	CN = variable
FEXT Noise Suppression	CF = 25dB	CF = variable
Echo Noise Suppression	CR = 55dB	CR = variable
Transmit Signal Power	Tp = 3dBm	Tp = 3dBm
Background Noise PSD	BN = -150dBm/Hz	BN = -150dBm/Hz
PSANEXT Noise	ignored due to screening	ignored due to screening
PSAACRF Noise	ignored due to screening	ignored due to screening

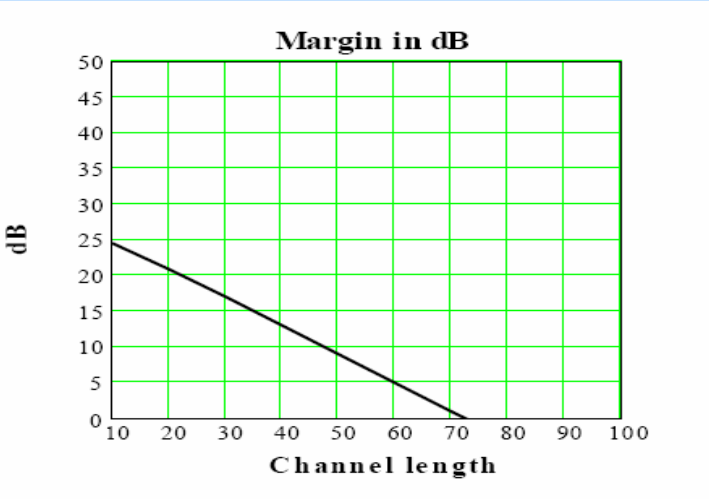
Legacy Cat 6_A to 500 MHz

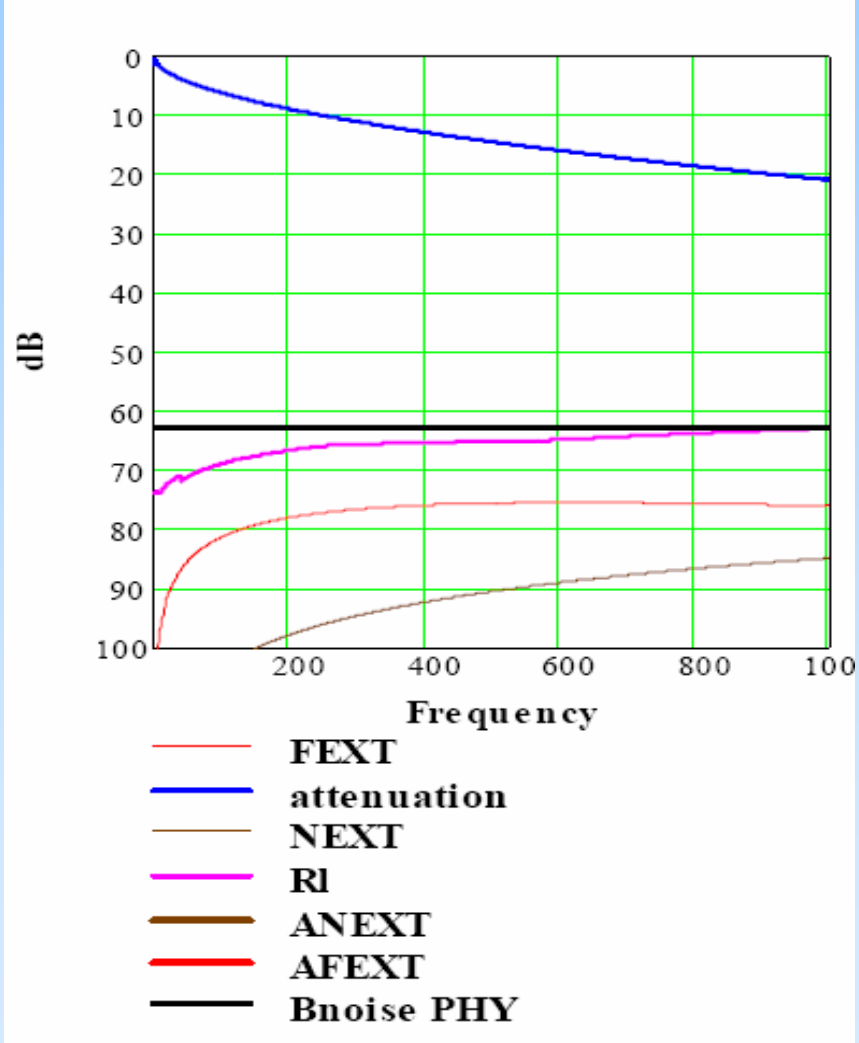
Insufficient capacity to support 40G!

Legacy Cat 7_A to 1000 MHz (Case 1)

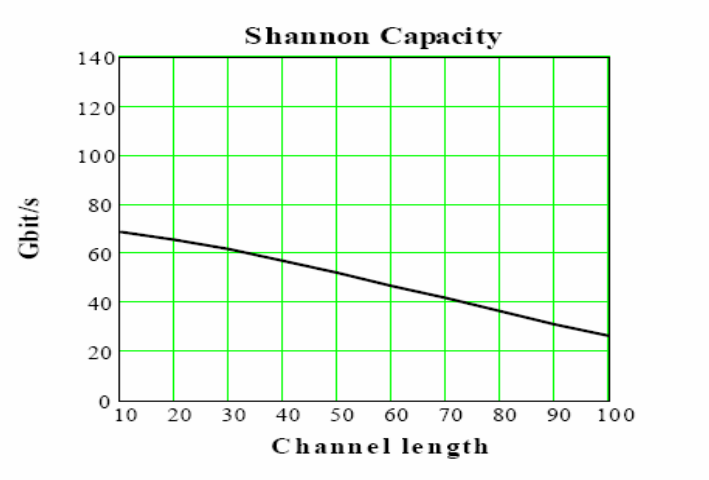


CN = 40 CF = 25 CR = 55

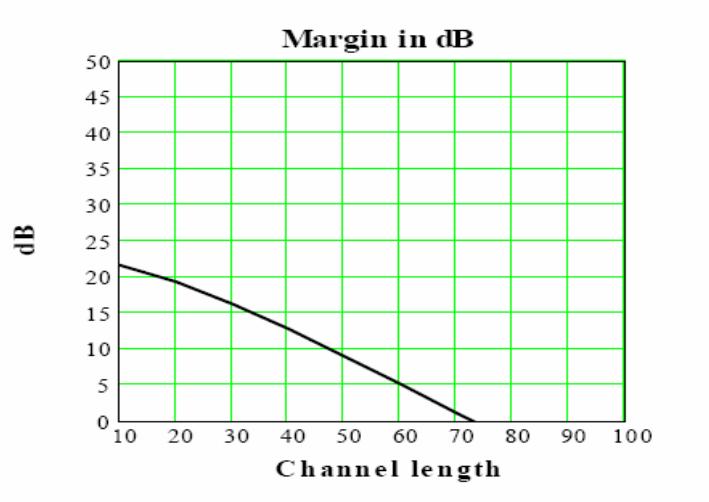


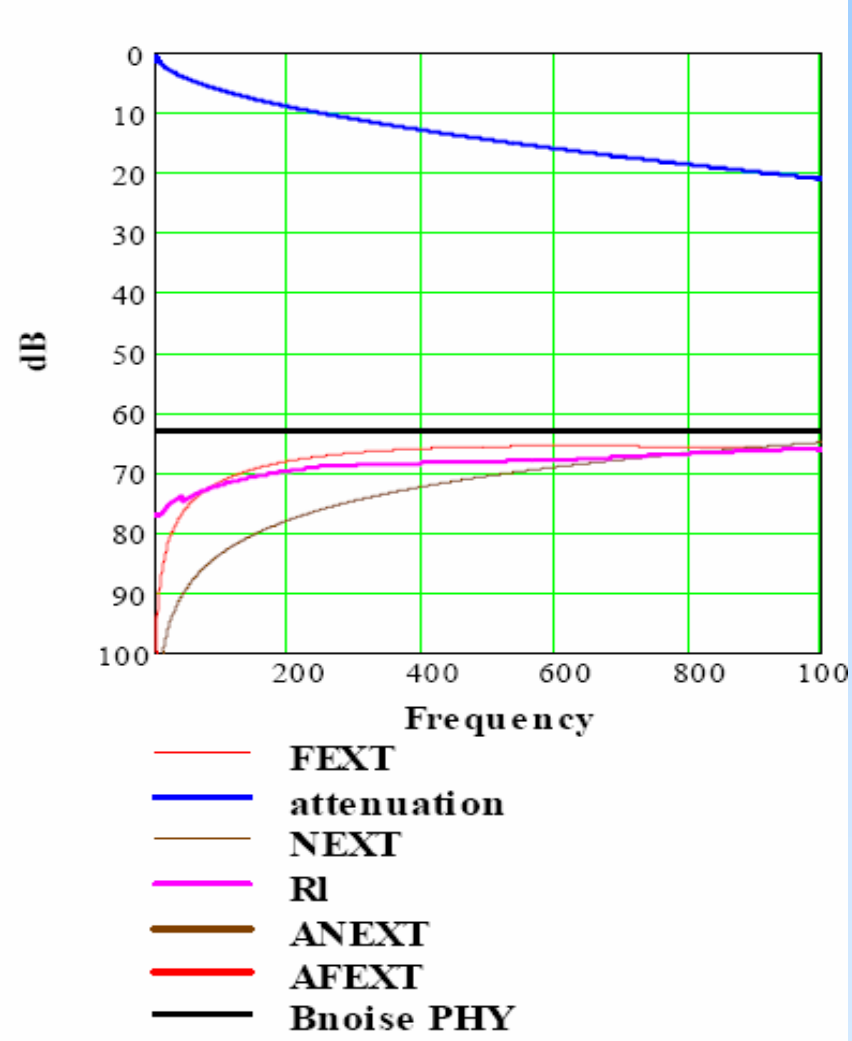


Legacy Cat 7_A to 1000 MHz (Case 2)



CN = 20 CF = 15 CR = 58





Legacy Cat 7_A to 1600 MHz

Assessment similar to Class II cabling

Class I/II to 2000 MHz (Case 1)

Parameter	Class I			Class II		
Max frequency GHz	1,2	1,6	2,0	1,2	1,6	2,0
Background noise level dB	62	61	60	62	61	60
CN dB	40	40	40	40	40	40
CF dB	25	25	25	25	25	25
CR dB	55	55	55	55	55	55
Comment	*FEXT limited f < 1,6 GHz* *NEXT limits at higher frequencies f > 1,6 GHz*			*NEXT and FEXT cancellation could be lower*		
Margin at 30 m dB	13	16	17	20	23	23

Background noise level = Tp – BN – 10log(f)

Margin to Capacity based on bliss_01_0912_NGBT

Class I/II to 2000 MHz (Case 2)

Parameter	Class I			Class II		
Max frequency GHz	1,2	1,6	2,0	1,2	1,6	2,0
Background noise level dB	62	61	60	62	61	60
CN dB	51	50	49	31	30	29
CF dB	36	35	34	15	14	13
CR dB	59	58	57	57	56	55
Margin at 30 m dB	20	22	22	20	22	22

ISO/IEC TR 11801-99-1
Plan for Completion & Next Steps

- 2nd PDTR circulated in April for approval as DTR
- ISO/IEC 11801-99-1 planned to be published 1Q14
- definition of 30m, 2-connector channels underway
- guide to be provided on use of cords as channels
- new Cats/Classes to be part of ISO/IEC 11801 Ed.3
  - will be influenced by preferences within 802.3bq
  - close liaison activity will continue to be essential