

Class I vs. Class II Cabling

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Content

- 1. Class I vs. Class II performance**
- 2. cable & connector construction**
- 3. relative costs for a 30m channel**
- 4. standardisation status & plans**

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**
- **motivation to offer *range of options* for 40GBASE-T**
- **Technical Report route chosen to *expedite process***
- **PDTR had substantial support in 1st national review**
- **2nd PDTR circulated in April 2013 for approval as DTR**
- **ISO/IEC 11801-99-1 expected to be approved 1Q14**

ISO/IEC TR 11801-99-1 Deliverables

Performance Requirements
for 30m, 2-connector Channel

	Cat 6 _A	Cat 7 _A
Performance Requirements for 30m, 2-connector Channel	Legacy components	Legacy components
	Legacy components to higher frequency	Legacy components to higher frequency
	Enhanced components to higher frequency	Enhanced components to higher frequency
Tutorial on Channel Capacity, Assumptions, other PHY-related		

ISO/IEC TR 11801-99-1 Next Generation Cabling

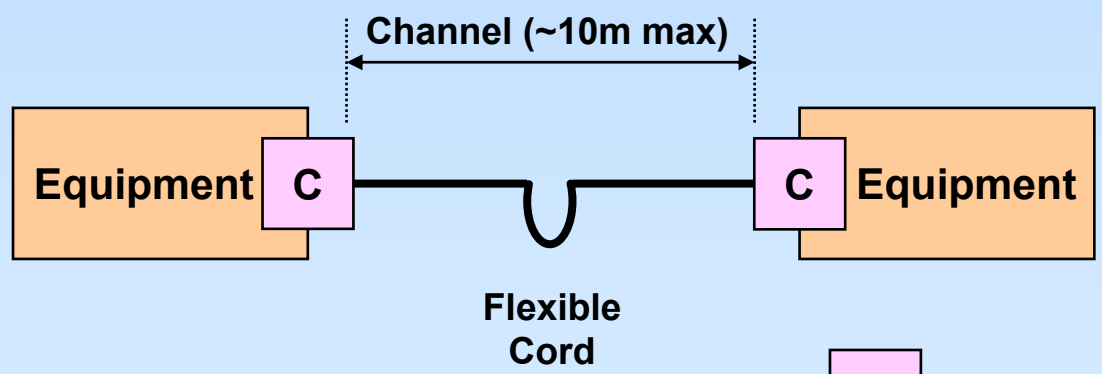
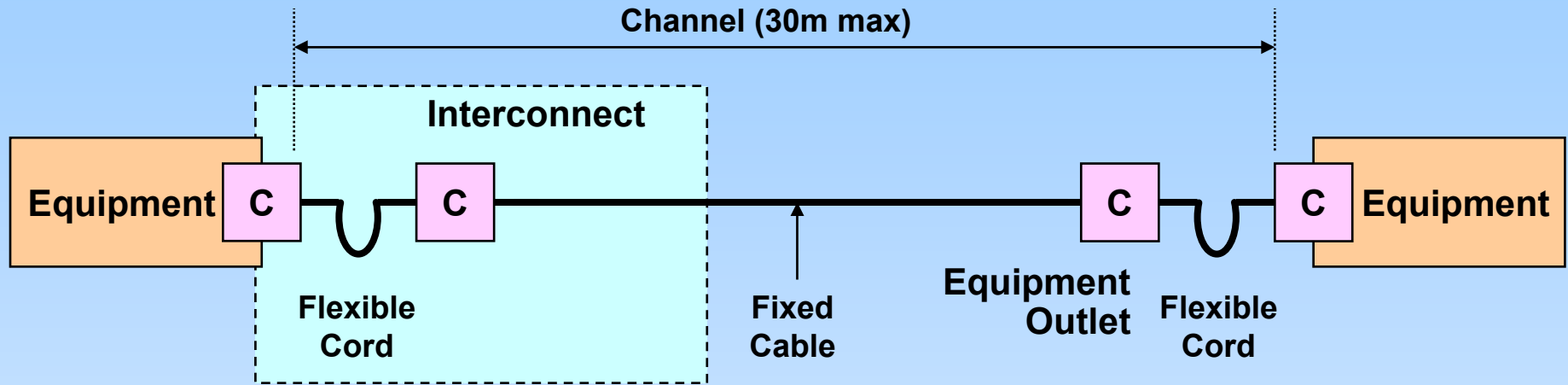
Performance Requirements
for 30m, 2-connector Channel

Legacy Cat 6 _A Components to 500 MHz	Legacy Cat 7 _A Components to 1000 MHz
	Legacy Cat 7 _A Components to 1,600 MHz*
Class I Channel with Cat 8.1 Components to 1,600 MHz*	Class II Channel with Cat 8.2 Components to 1,600 MHz*
Tutorial on Channel Capacity, Assumptions, other PHY-related	

Next Generation
Cabling for 40G

* Upper Frequency of 2 GHz For Further Study

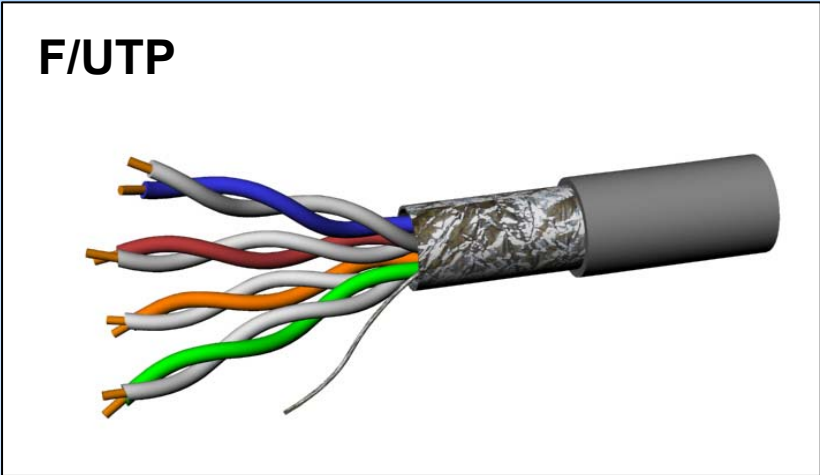
Horizontal Balanced Cabling Models



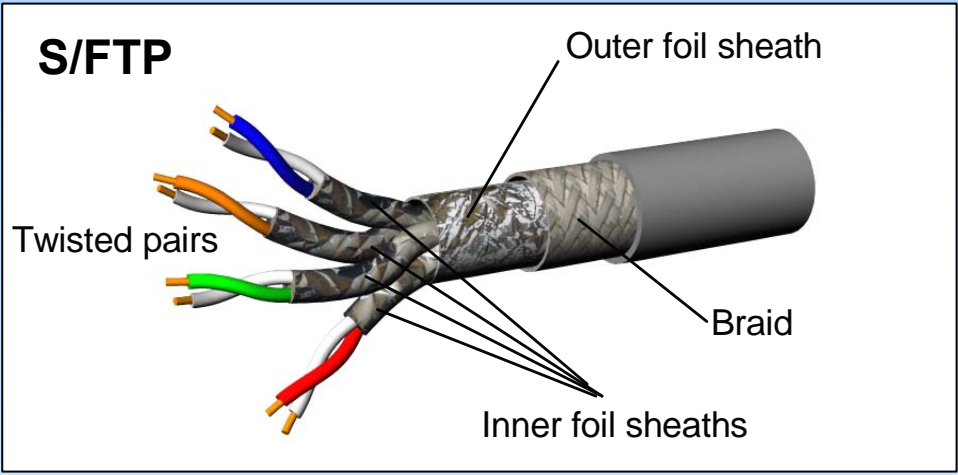
C = connection (mated pair)

Cable Construction

Typical Cat 8.1/Cat 8 Cable

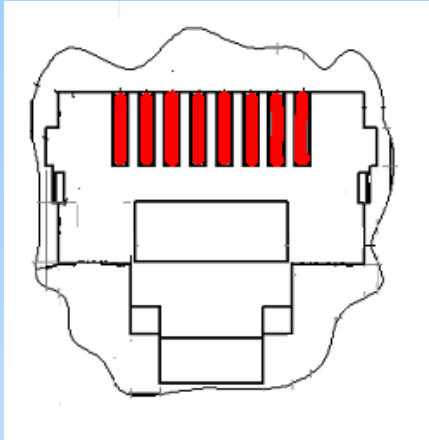


Typical Cat 8.2 Cable

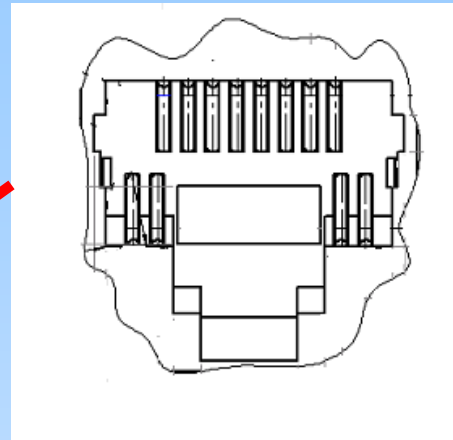


Note: ISO/IEC 11801 & IEC 61156 do not specify cable construction

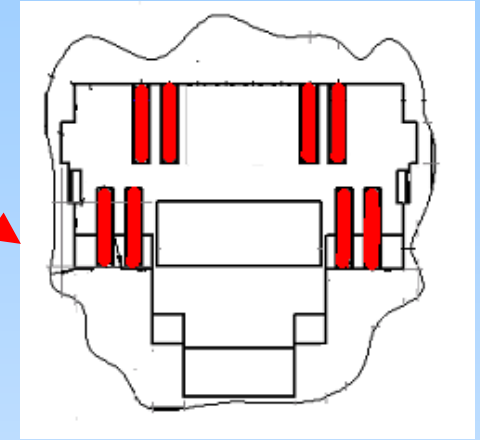
Connectors



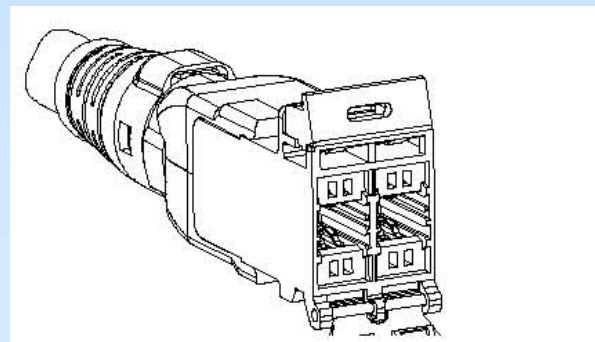
IEC 60603-7
RJ45 8-contacts
 3 - 2,000 MHz
 Cat 3 to 6_A & 8.1



IEC 60603-7-71
GG45 has a switch
 1,000 MHz
 Cat 7_A



IEC 61076-3-110
ARJ45 8-contacts
 600 - 3,000 MHz
 Cat 7_A & 8.2



IEC 61076-3-104
Tera 8-contacts
 600 - 2,000 MHz
 Cat 7_A & 8.2

Comparison of Class I & Class II Channels

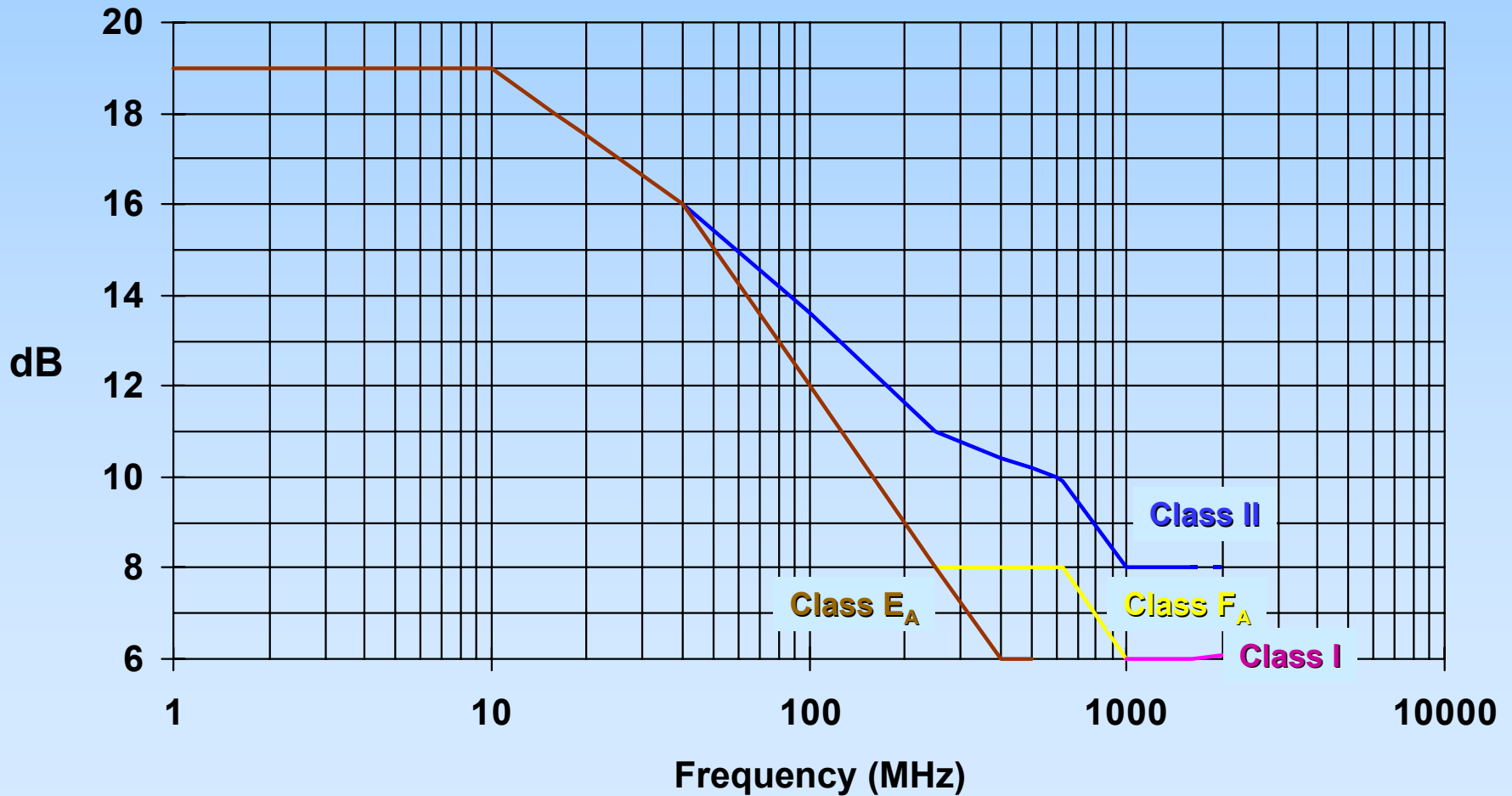
	ISO/IEC 11801-99-1 2 nd PDTR Class I Channel	ISO/IEC 11801-99-1 2 nd PDTR Class II Channel
RL	$631 \leq f < 1000$ 36-10*log(f) $1000 \leq f < 2000$ 6dB	$631 \leq f < 1000$ 35-9*log(f) $1000 \leq f < 2000$ 8dB
IL	$0.32(1.8\sqrt{f} + 0.005f + 0.25/\sqrt{f}) + 2 \times 0.02\sqrt{f}$	$0.32(1.8\sqrt{f} + 0.005f + 0.25/\sqrt{f}) + 2 \times 0.02\sqrt{f}$
TCL	$1 \leq f < 1600$ 60-17*log(f) $1600 \leq f < 2000$ 40dB max	$1 \leq f < 1600$ 60-17*log(f) $1600 \leq f < 2000$ 40dB max
ELTCTL	$1 \leq f < 79.5$ 38-20*log(f)	$1 \leq f < 79.5$ 38-20*log(f)
CA	$30 \leq f < 100$ 50dB $100 \leq f < 2000$ 90-20*log(f)	$30 \leq f < 100$ 50dB $100 \leq f < 2000$ 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	$56 - 20 \cdot \log(f/100)$	$61 - 20 \cdot \log(f/100)$

Comparison of Class I & Class II Channels

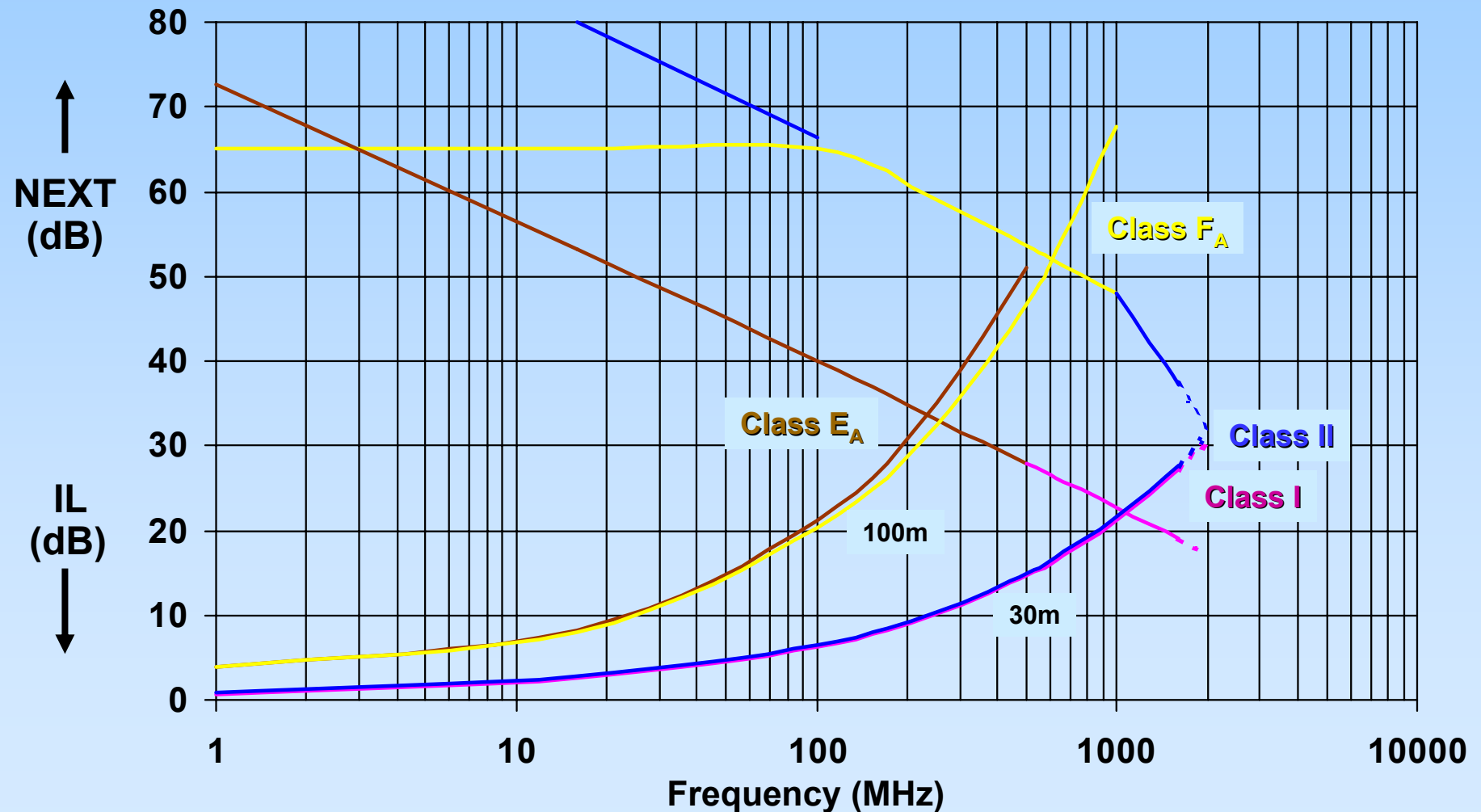
	ISO/IEC 11801-99-1 2 nd PDTR Class I Channel @ 1GHz	ISO/IEC 11801-99-1 2 nd PDTR Class II Channel @ 1GHz
RL	6.0dB	8.0dB
IL	21.1dB	21.1dB
NEXT	22.6dB	47.9dB
ACR-F	10.5dB	33.1dB
CA	30.0dB	30.0dB
PSANEXT	65.0dB	70.0dB
PSAACRF	36.0dB	41.0dB

Performance Advantage Highlighted

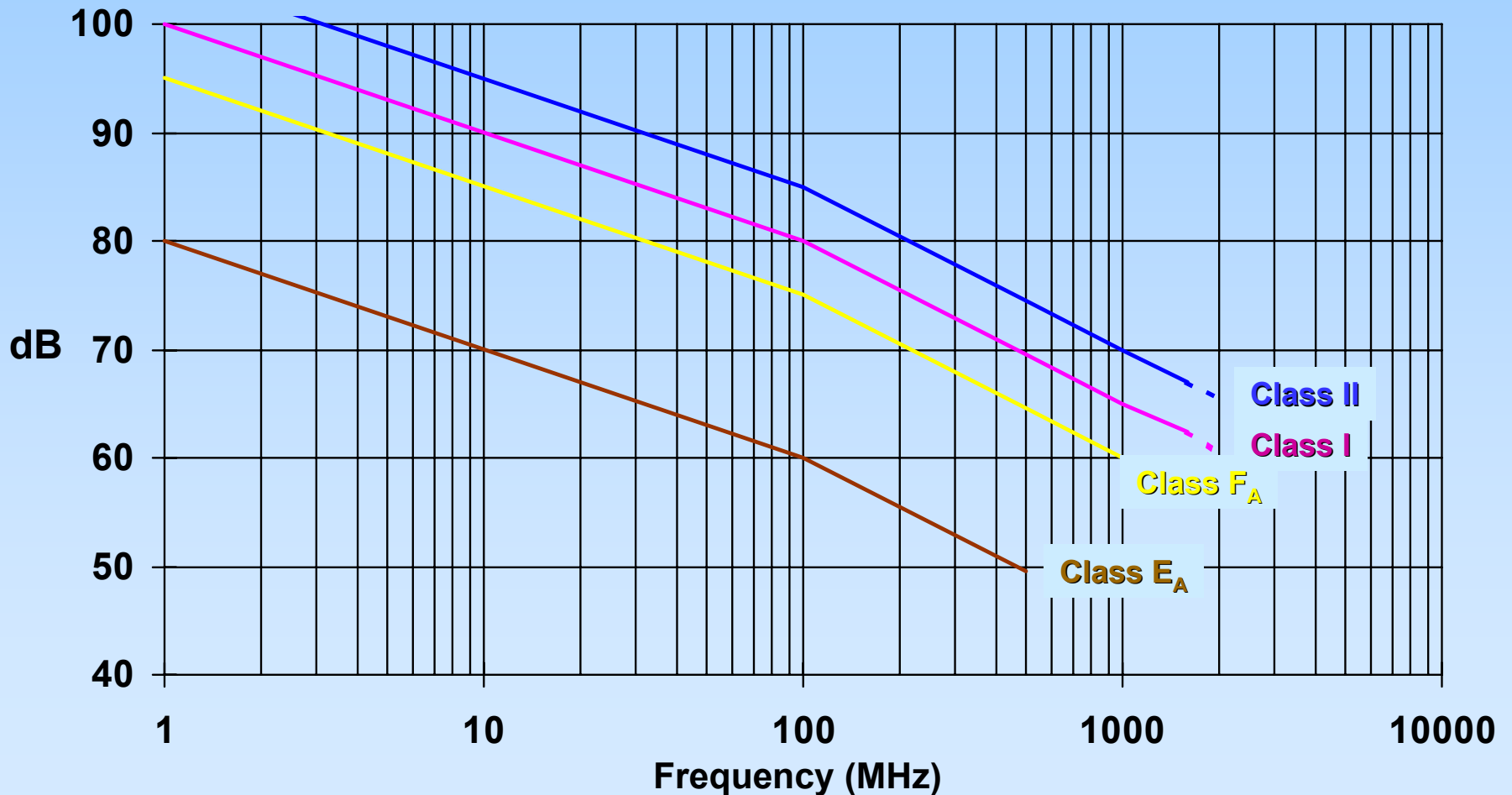
Class I/II Channel RL Performance



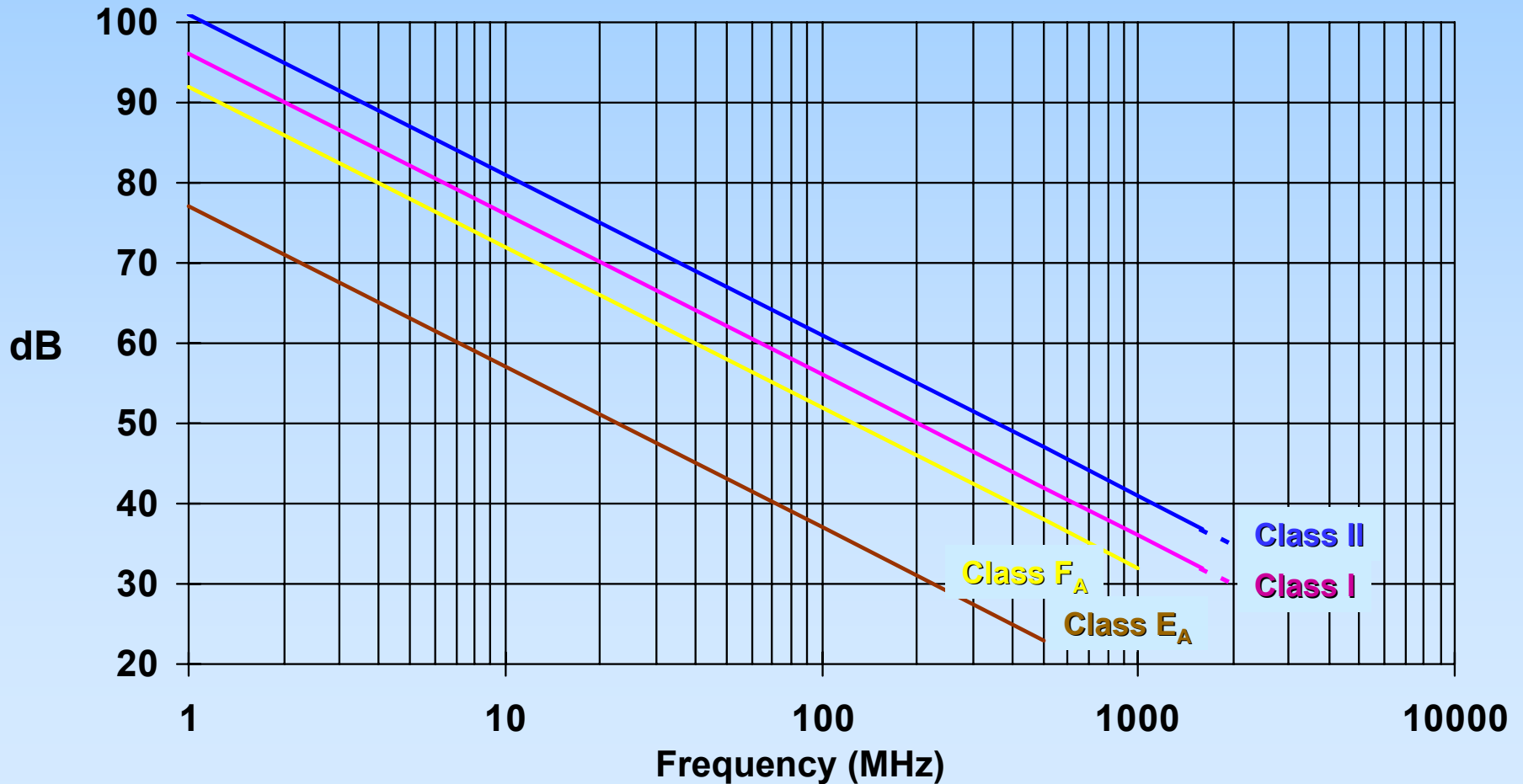
Class I/II Channel IL & NEXT Performance



Class I/II PSANEXT Performance



Class I/II PSAACR-F Performance



Capacity Assessment

**10GBASE-T
Suppression**



	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

Class I/II Capacity Assessment

Parameter	Class I			Class II		
	1,2	1,6	2,0	1,2	1,6	2,0
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	<i>FEXT limited $f < 1,6$ GHz NEXT limits at higher frequencies $f > 1,6$ GHz</i>			<i>NEXT and FEXT cancellation could be lower</i>		
Margin at 30 m dB	13	16	17	20	23	23

Background noise level = $T_p - BN - 10\log(f)$

Margin to Capacity based on bliss_01_0912_NGBT

Class I/II Capacity Assessment

reduce CN + CF for
same margin as Class I



Parameter	Class I			Class II		
	1,2	1,6	2,0	1,2	1,6	2,0
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

CN = 20dB less

CF = 20dB less

Cable Dimensions

- **8 major cabling suppliers surveyed for cable ODs**
 - suppliers produce both F/UTP & S/FTP cables
 - LSZH solid conductor cable types considered
- **Cat 8.1 cable an enhanced version of Cat 6_A F/UTP**
 - Cat 6_A F/UTP OD in range 6.8 - 7.4 mm (mean 7.1 mm)
 - Cat 8.1 F/UTP OD 7.6mm (larsen_01a_1112_NGBT)
- **Cat 8.2 cable an enhanced version of Cat 7_A S/FTP**
 - Cat 7_A S/FTP OD in range 7.2 - 7.8 mm (mean 7.5 mm)
 - Cat 8.2 S/FTP OD 8.0mm (early products)

Relative Costs

- **7 major cabling suppliers surveyed for component prices**
 - suppliers produce UTP, F/UTP and S/FTP cables
 - LSZH cable types considered (no plenum types)
 - average 2012 supplier volume EMEA selling prices
- **relative mean cost of 30m, 2-connector channel calculated as:**
 - 2m cord + 26m cable + 2m cord
 - 3 different Cat 7_A connector types *

Cat 6 _A			Cat 7 _A
UTP	F/UTP	S/FTP	S/FTP
126%	100%	102%	104% - 136%*

- **cost of enhancement of Cat 6_A to Cat 8.1 & Cat 7_A to Cat 8.2 considered to be similar**

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**

Class I vs. Class II Cabling Summary

Cable OD difference	~5% greater for Class II
Cable bulk difference	~10% greater for Class II
30m channel cost difference (components only)	4-36% greater for Class II
NEXT & FEXT cancellation for same margin to capacity	~20dB less for Class II

Cost & cable bulk are NOT major decision factors

Channel performance IS a major decision factor!

Inspiration from booth_01_0513_40GBT

What We Don't Want to Specify



PHY

Operating on...



Cabling

May 2013

IEEE P802.3bq Task Force Meeting

Imbalance

What We Should Try to Specify



PHY

Operating on...



Cabling

Balance

May 2013

IEEE P802.3bq Task Force Meeting

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