

A FRESH LOOK AT GIGABIT ETHERNET IN DATA CENTRES

Mike Gilmore
Managing Director, e-Ready Building
The Cabling Partnership

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Senior Partner,
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Standards Activities



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

Convenor:
ISO/IEC JTC1 SC25 WG3 IPTG: Industrial Premises Cabling



Convenor:
CENELEC TC215 WG1: IT Cabling
CENELEC TC215 WG1 PT Industrial Premises Cabling
Secretary:
CENELEC TC215 WG1 PT Data Centre Cabling



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

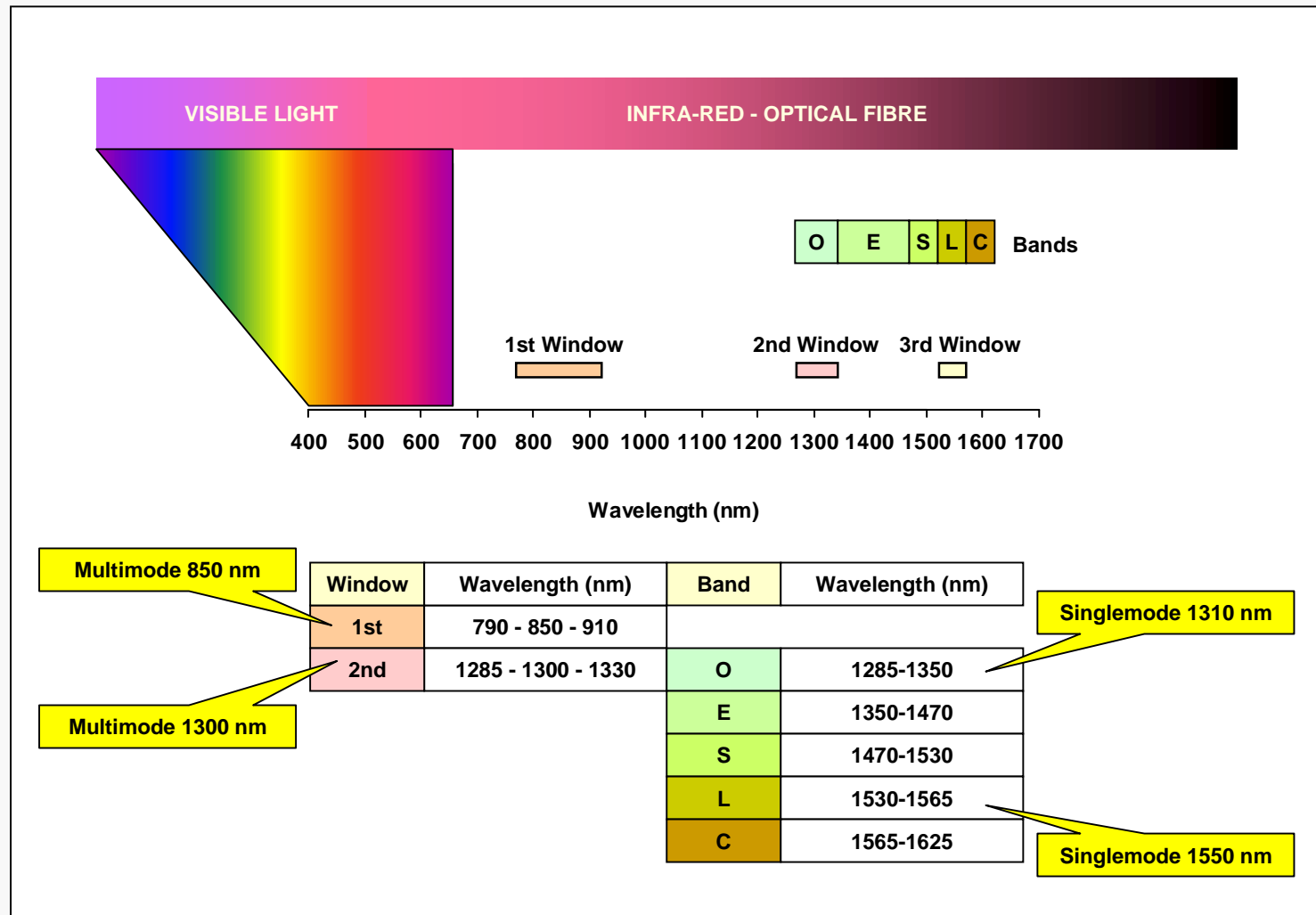
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Fibreoptic Industry Association

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Optical Fibre Transmission Wavelengths

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MMF: Attenuation and Modal Bandwidth

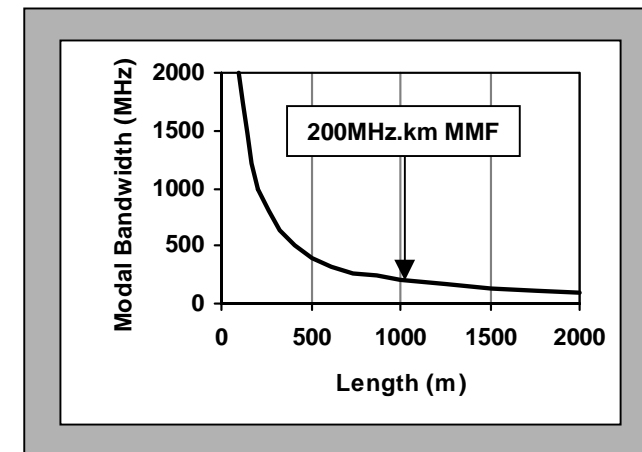
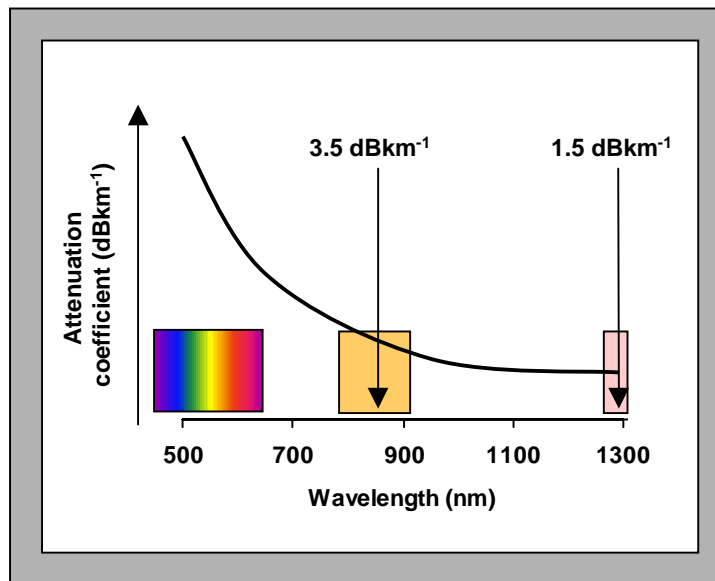
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Optical fibre geometry (standardized)

	50/125	62.5/125
Core diameter (μm)	50 ± 3	62.5 ± 3
Cladding diameter (μm)	125 ± 3	125 ± 3
NA	0.20 ± 0.015	0.275 ± 0.015

Optical fibre performance (options)

Attenuation coefficient dBkm^{-1} max.		Modal bandwidth MHz.km min.	
850nm	1300nm	850nm	1300nm
?	?	?	?



Optical Fibre Categories

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CABLED OPTICAL FIBRE	Wavelength	MMF			SMF					
		50/125 or 62.5/125		50/125	Wavelength	OS1	OS2*			
		OM1	OM2	OM3						
Attenuation coefficient (dBkm ⁻¹ max)	850nm	3,5			1310nm	1,0	0,4			
	1300nm	1,5			1550nm	1,0	0,4			
Modal bandwidth OFL ¹ (MHz.km min)	850nm	200	500	1500						
	1300nm	500	500	500						
Modal bandwidth LL ² (MHz.km min)	850nm	-	-	2000						
	1300nm	-	-	-						
Propagation delay (ns.m ⁻¹ max)	850nm	5						1310nm	5	5
	1300nm									

NOTE 1: OFL = OverFilled Launch (LED-like)
NOTE 2: LL (or RL) = LASER Launch (or Restricted Launch)

* standard in development

Optical Fibre Applications

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Mbs ⁻¹	NETWORK NAME	WAVELENGTHS AND MODAL GROUPS			
		MMF		SMF	
		850 nm	1300 nm	1310 nm	1550 nm
10	ISO/IEC 8802-3: FOIRL	●			
10	ISO/IEC 8802-3: 10BASE-FL/FB	●			
4/16	ISO/IEC TR 11802-4: 4 & 16 Mb/s Token Ring	●			
52	ATM		●	●	
100	ISO/IEC 8802-12: Demand priority	●	●		
100	ISO/IEC 9314-3: FDDI PMD		●		
100	ISO/IEC 9314-4: FDDI SMF-PMD			●	
100	ISO/IEC 9314-9: FDDI LCF-PMD		●		
100	ISO/IEC 8802-3: 100BASE-FX		●		
133	ISO/IEC 14165: FibreChannel		●	●	
155	ATM	●	●	●	
266	ISO/IEC 14165: FibreChannel	●	●	●	
531	ISO/IEC 14165: FibreChannel	●		●	
622	ATM	●	●	●	
1000	IEEE 802.3ab: 1000BASE: Ethernet	1000BASE -SX	1000BASE -LX	1000BASE -LX	
1062	ISO/IEC 14165: FibreChannel	●			
10000	IEEE 802.3ae: 10GBASE-xyz: Ethernet	-SR/SW	-LX4*	-LX4* /LR/LW	-ER/EW

* 10GBASE-LX4 uses Coarse WDM (CWDM)
 • $\lambda_1 = 1270 \pm 10$ (Lane 1)
 • $\lambda_2 = 1300 \pm 6$ (Lane 2)
 • $\lambda_3 = 1325 \pm 6$ (Lane 3)
 • $\lambda_4 = 1349 \pm 10$ (Lane 4)

MMF Applications

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		WAVELENGTHS	
		MMF	
Mbs ⁻¹	NETWORK NAME	850 nm	1300 nm
10	ISO/IEC 8802-3: 10BASE-FL/FB	●	
100	ISO/IEC 8802-3: 100BASE-FX		●
1000	IEEE 802.3ab: 1000BASE: Ethernet	1000BASE -SX	1000BASE -LX
10000	IEEE 802.3ae: 10GBASE-xyz: Ethernet	-SR/SW	-LX4

		MAXIMUM CHANNEL LENGTH (CHANNEL INSERTION LOSS AT MAX. LENGTH)		
		MMF		
Mbs ⁻¹	NETWORK NAME	OM1	OM2	OM3
10	ISO/IEC 8802-3: 10BASE-FL/FB	2000 m (12.5 dB)	2000 m (6.8 dB)	2000 m (6.8 dB)
100	ISO/IEC 8802-3: 100BASE-FX	2000 m (11.0 dB)	2000 m (6.3 dB)	2000 m (6.3 dB)
1000	IEEE 802.3ab: 1000BASE-SX: Ethernet	275 m (2.6 dB)	550 m (3.56 dB)	900 m* (4.44 dB*)
	IEEE 802.3ab: 1000BASE-LX: Ethernet	550 m (2.35 dB)		
10000	IEEE 802.3ae: 10GBASE-SR/SW: Ethernet	33 m (1.62 dB)	82 m (1.80 dB)	300 m (2.59 dB)
	IEEE 802.3ae: 10GBASE-LX4: Ethernet	300 m (1.96 dB)	300 m (1.96 dB)	

* Inferred values

Connecting Hardware

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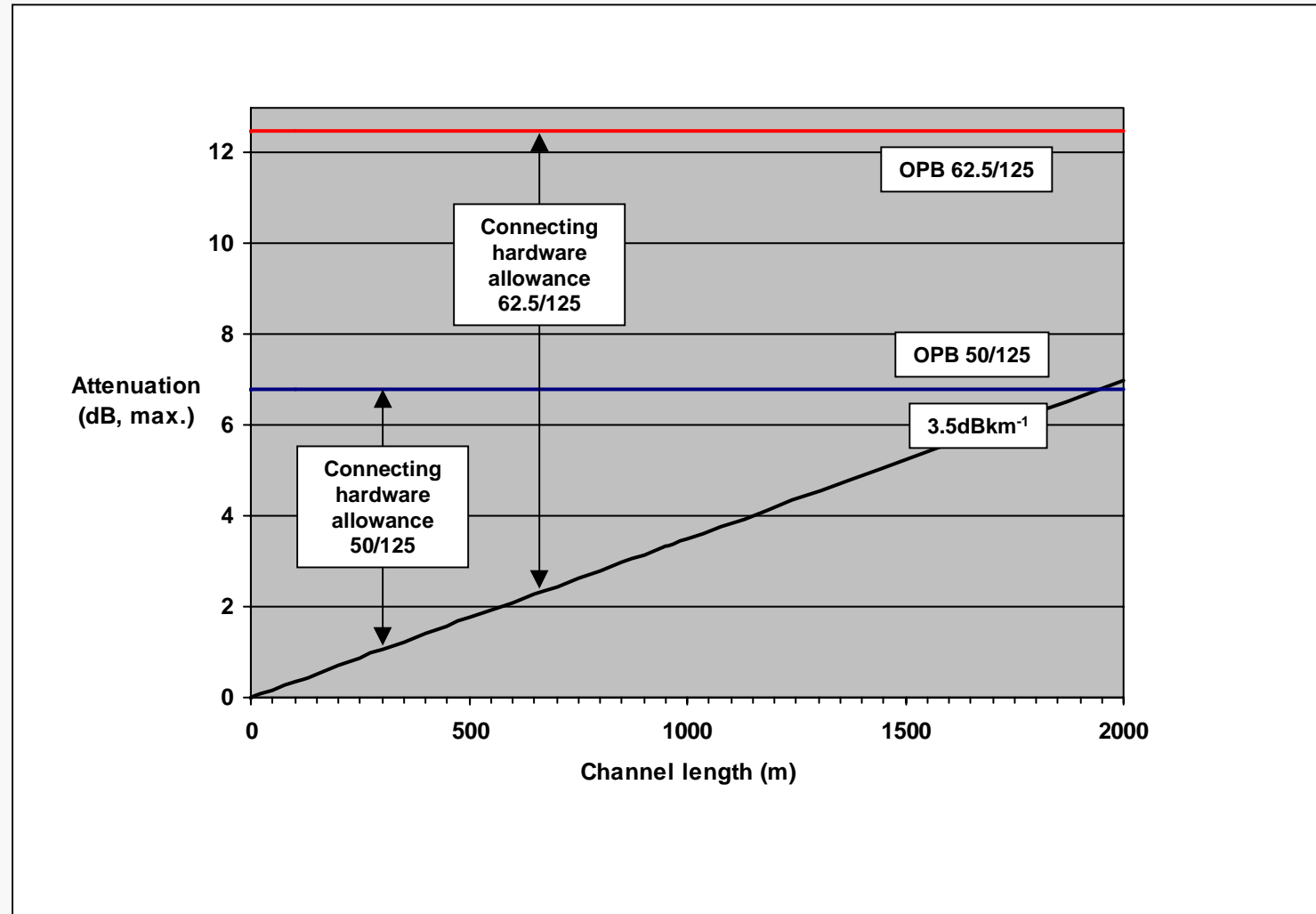
CONNECTING HARDWARE	MMF			SMF		
	Wavelength	OM1, OM2, OM3		Wavelength	OS1, OS2	
		Connection	Splice		Connection	Splice
Return loss (dB min)	All	20	NA	All	35	NA
Attenuation (dB max)	All	95% < 0,5 100% < 0,75	100% < 0,3	All	95% < 0,5 100% < 0,75	100% < 0,3

CONNECTING HARDWARE EQUIVALENT LENGTH			
MMF			
850 nm		1300 nm	
Mated connection	Splice	Mated connection	Splice
0,75 dB	0,3 dB	0,75 dB	0,3 dB
215 m	85 m	500 m	200 m

SMF			
1310 nm		1550 nm	
Mated connection	Splice	Mated connection	Splice
0,75 dB	0,3 dB	0,75 dB	0,3 dB
1875 m	750 m	1875 m	750 m

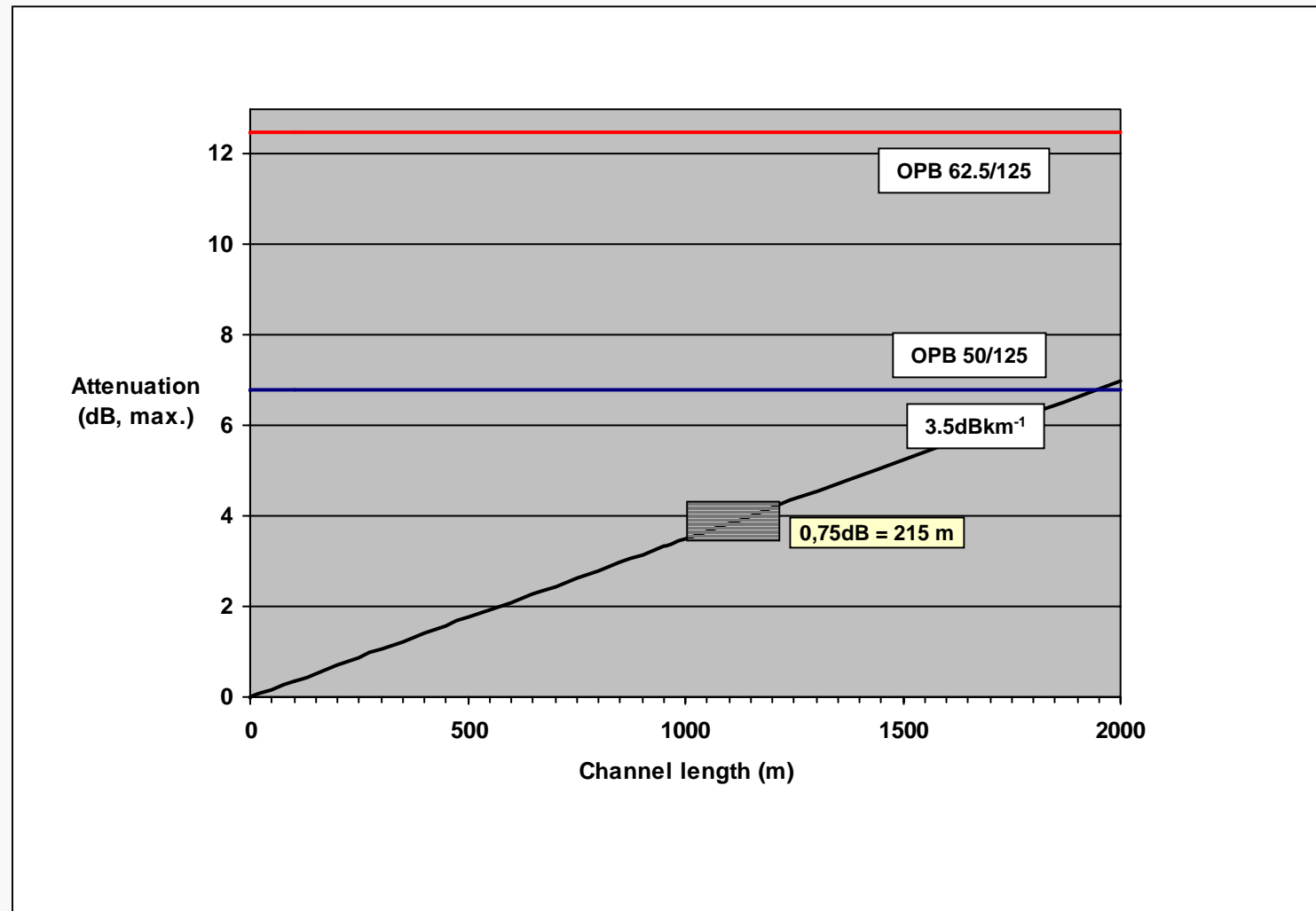
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10BASE-FL/FB



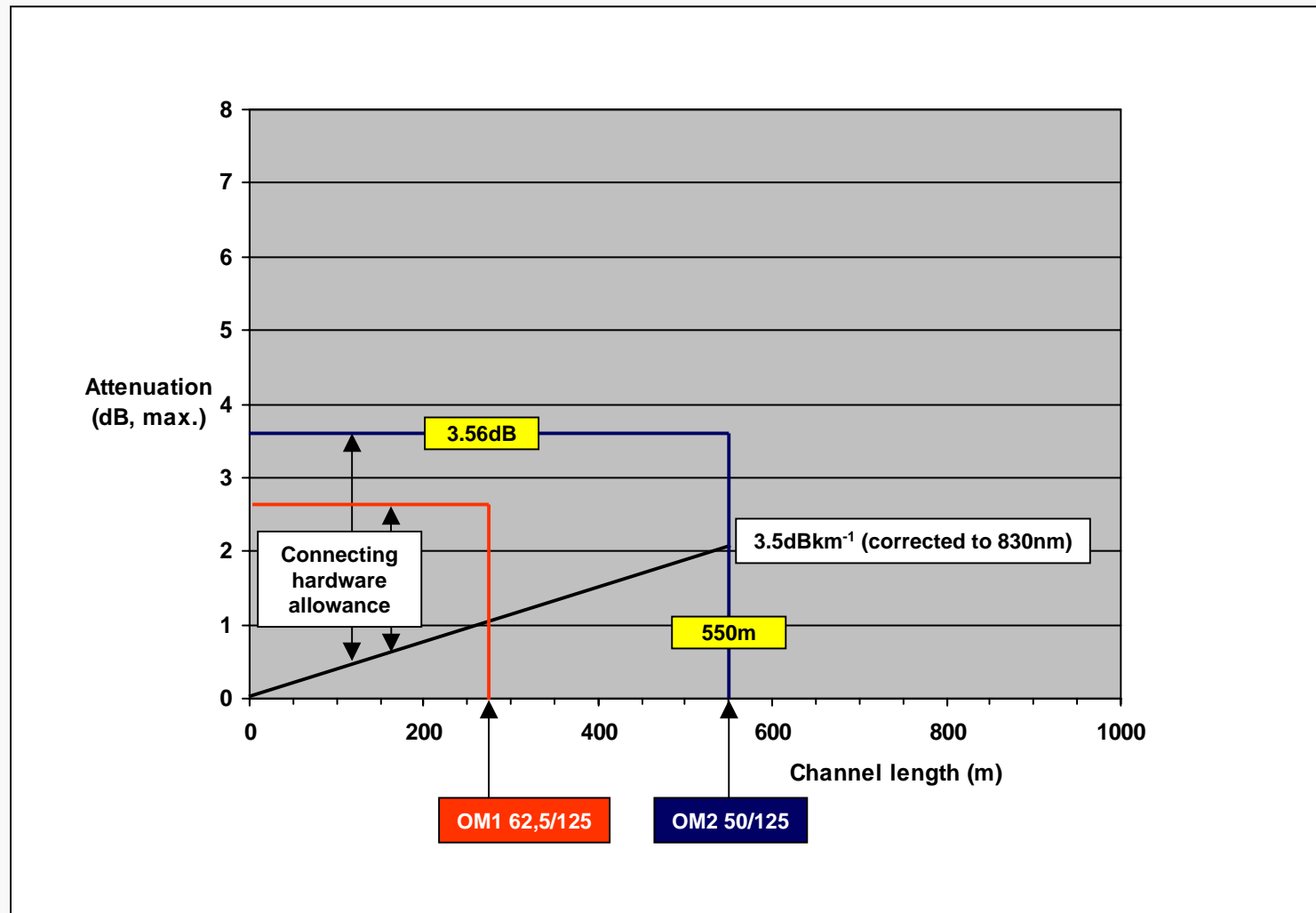
10BASE-FL/FB

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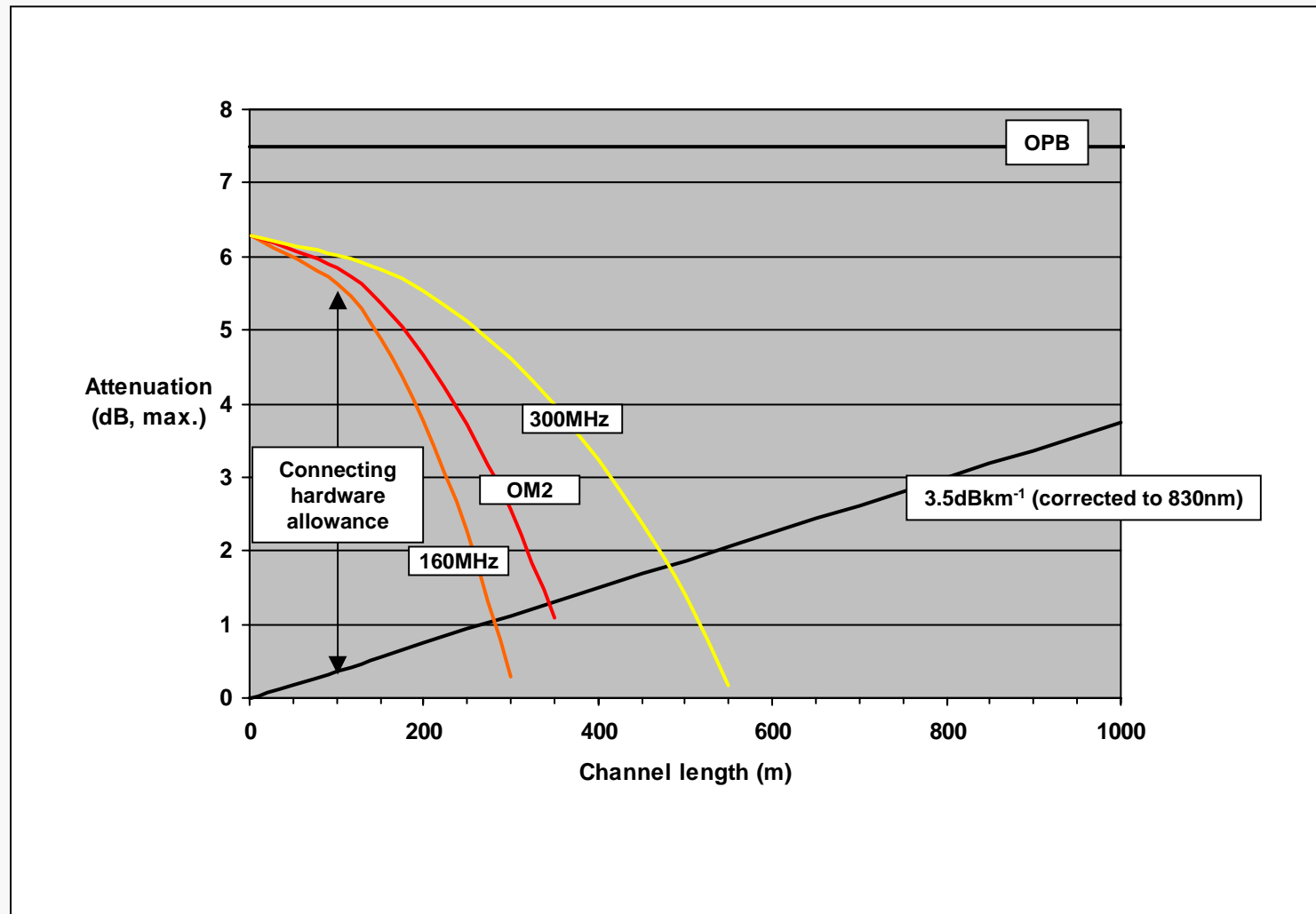
1000BASE-SX - The Big Misconception

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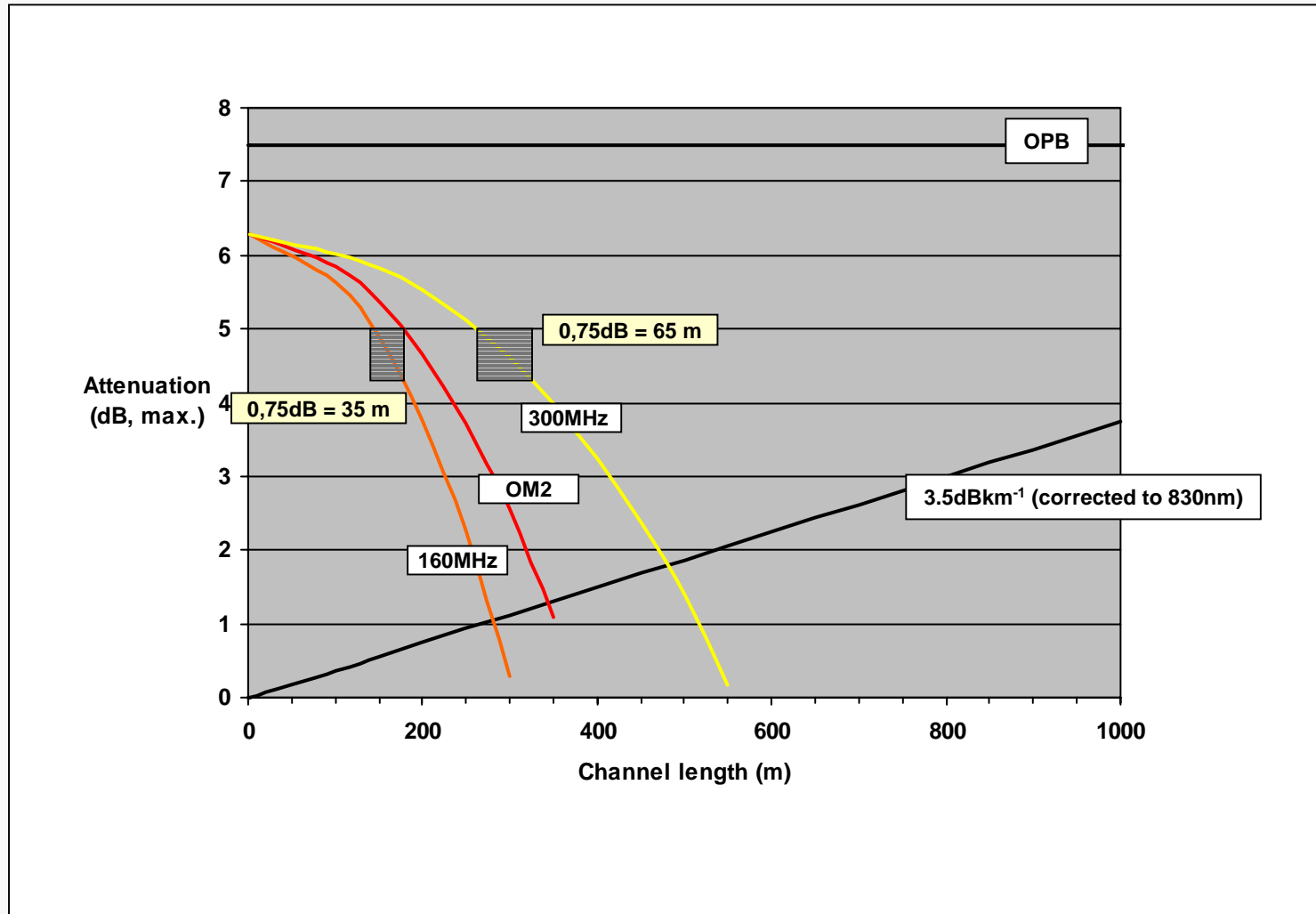
1000BASE-SX and 62.5/125

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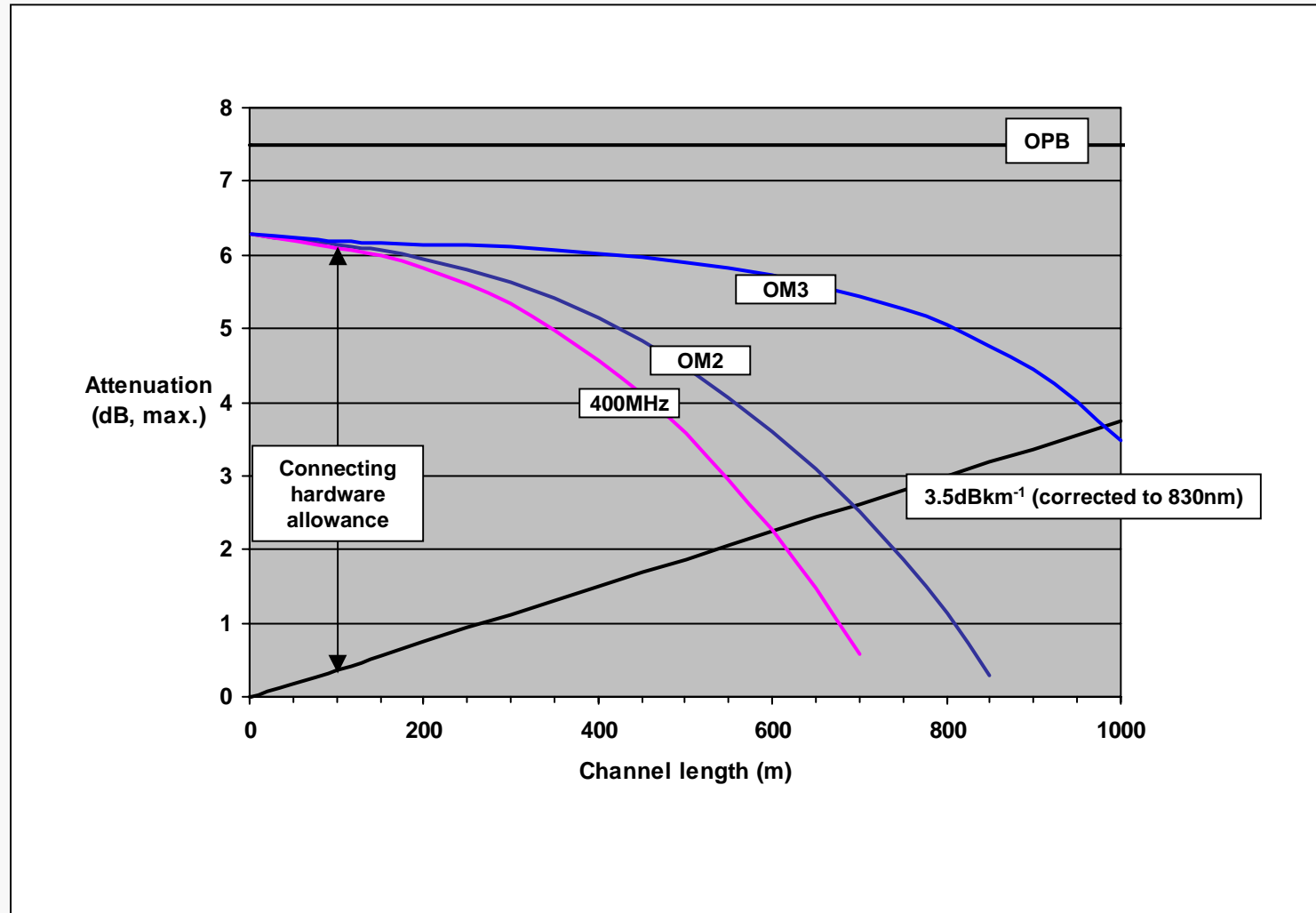
1000BASE-SX and 62.5/125

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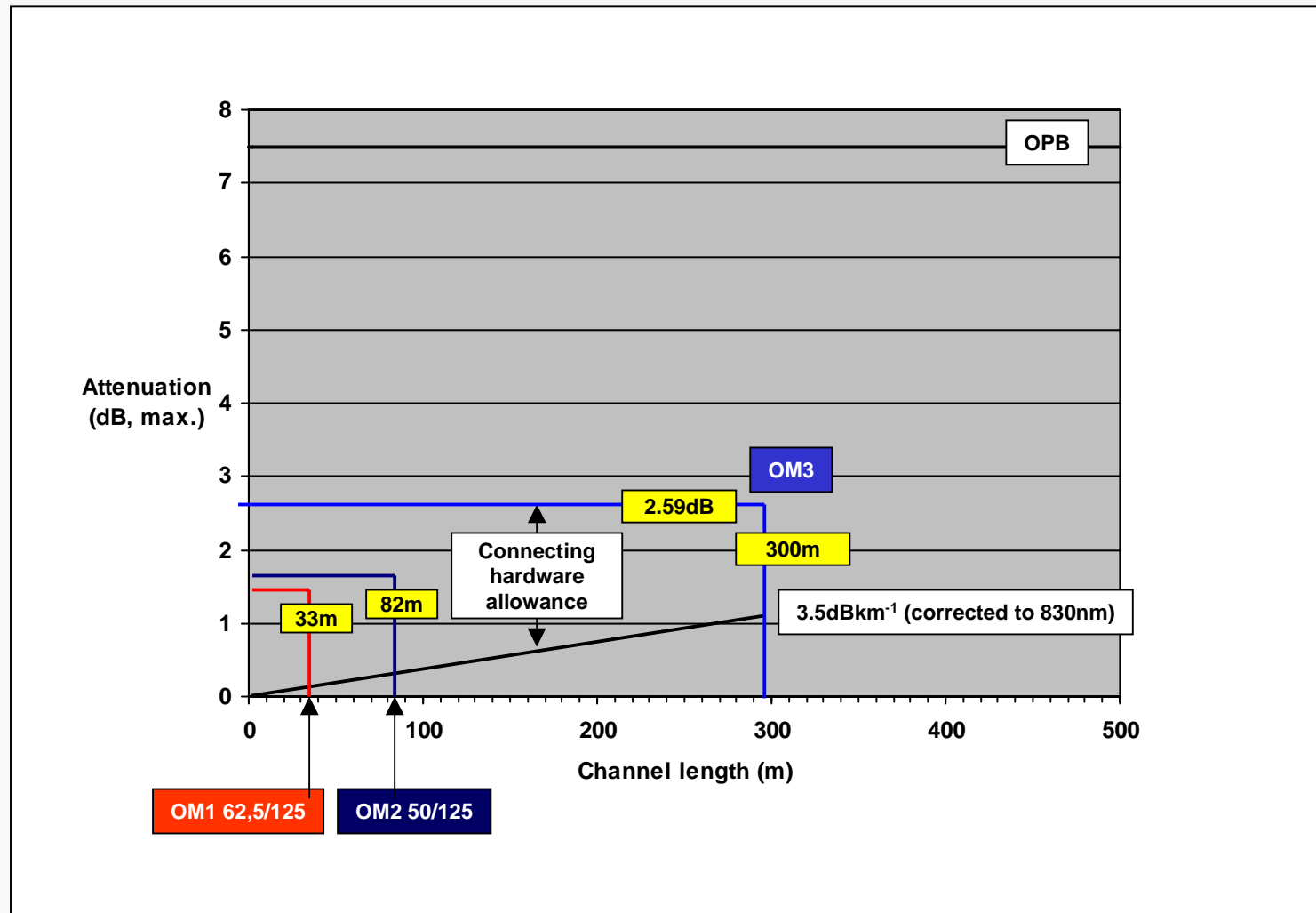
1000BASE-SX and 50/125

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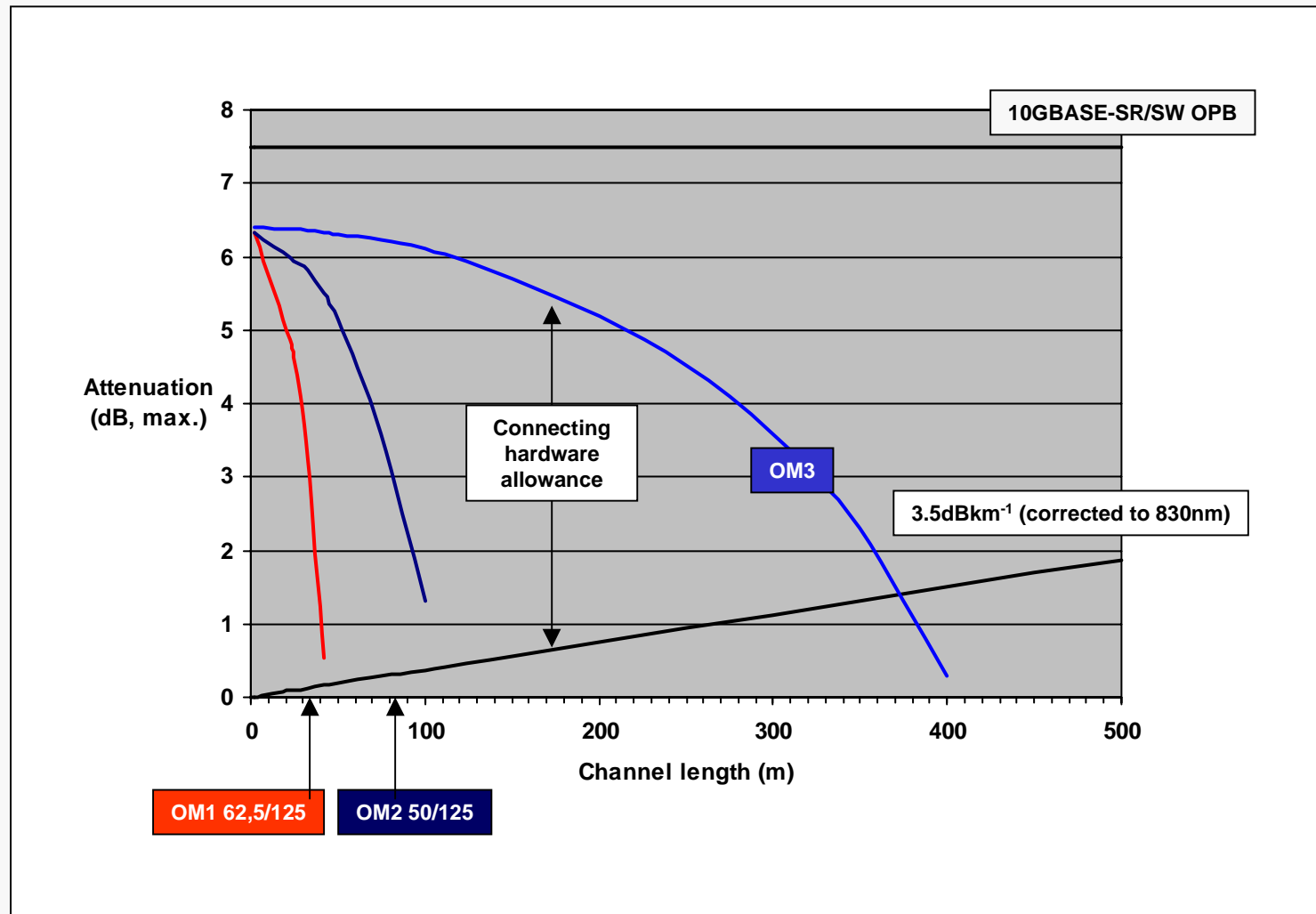
10GBASE-SR/SW - Misconception

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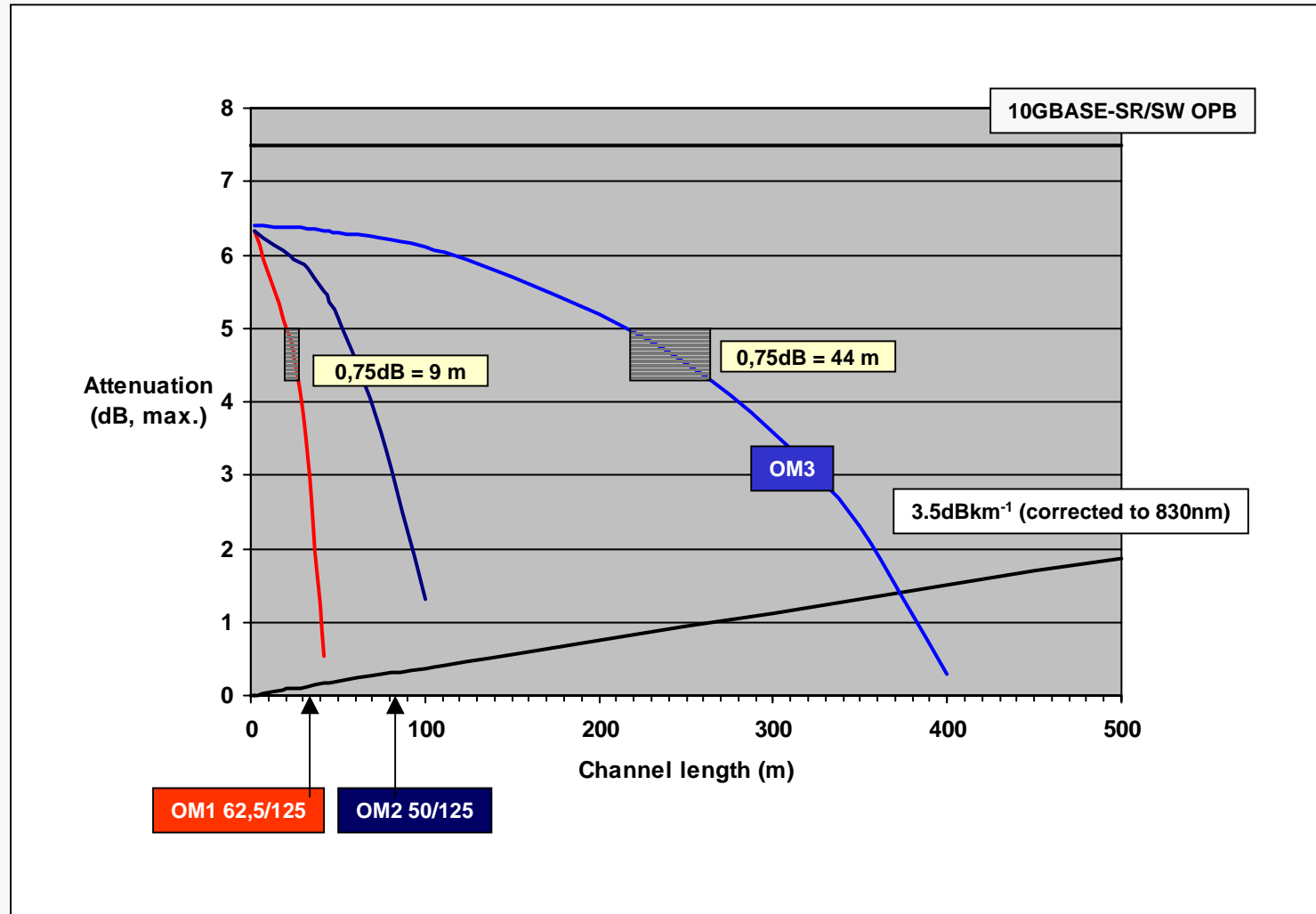
10GBASE-SR/SW and OMx

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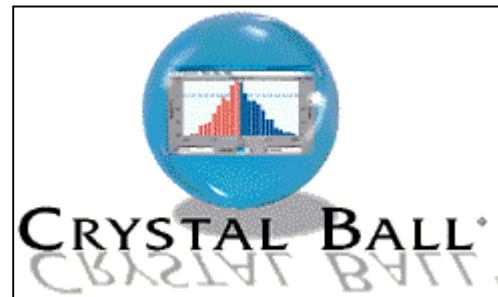
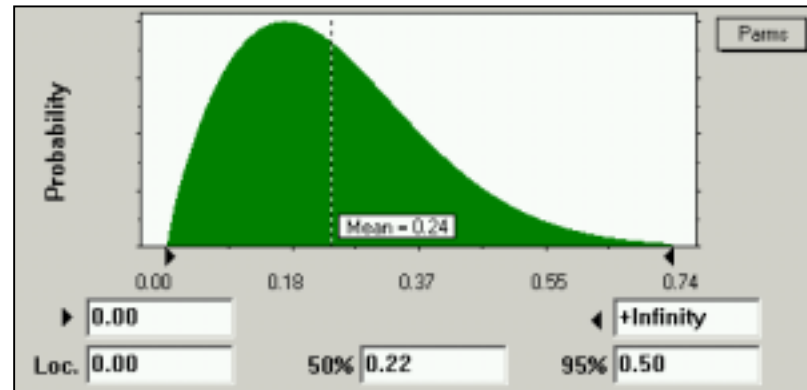
10GBASE-SR/SW and OMx

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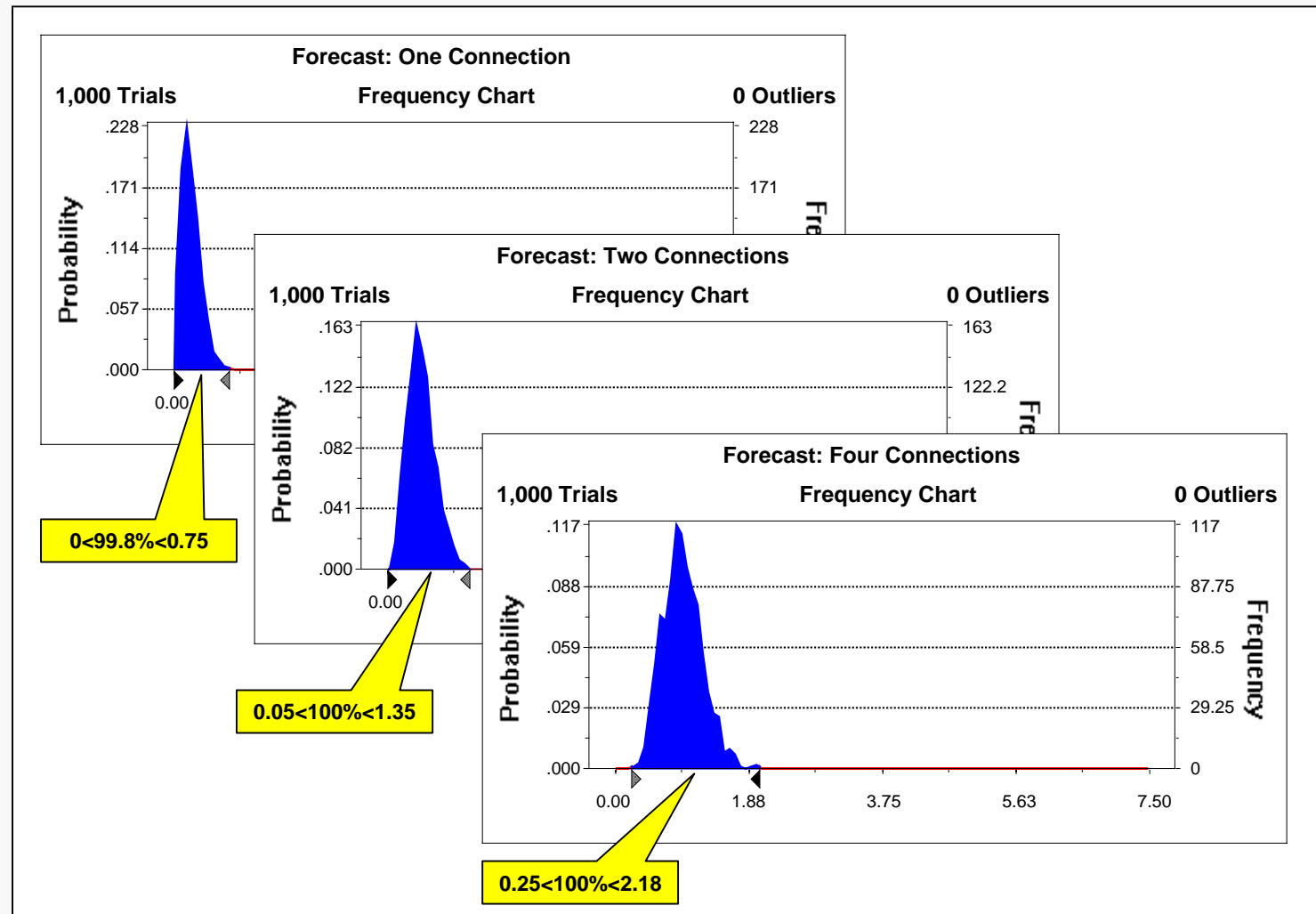
Statistical Modelling

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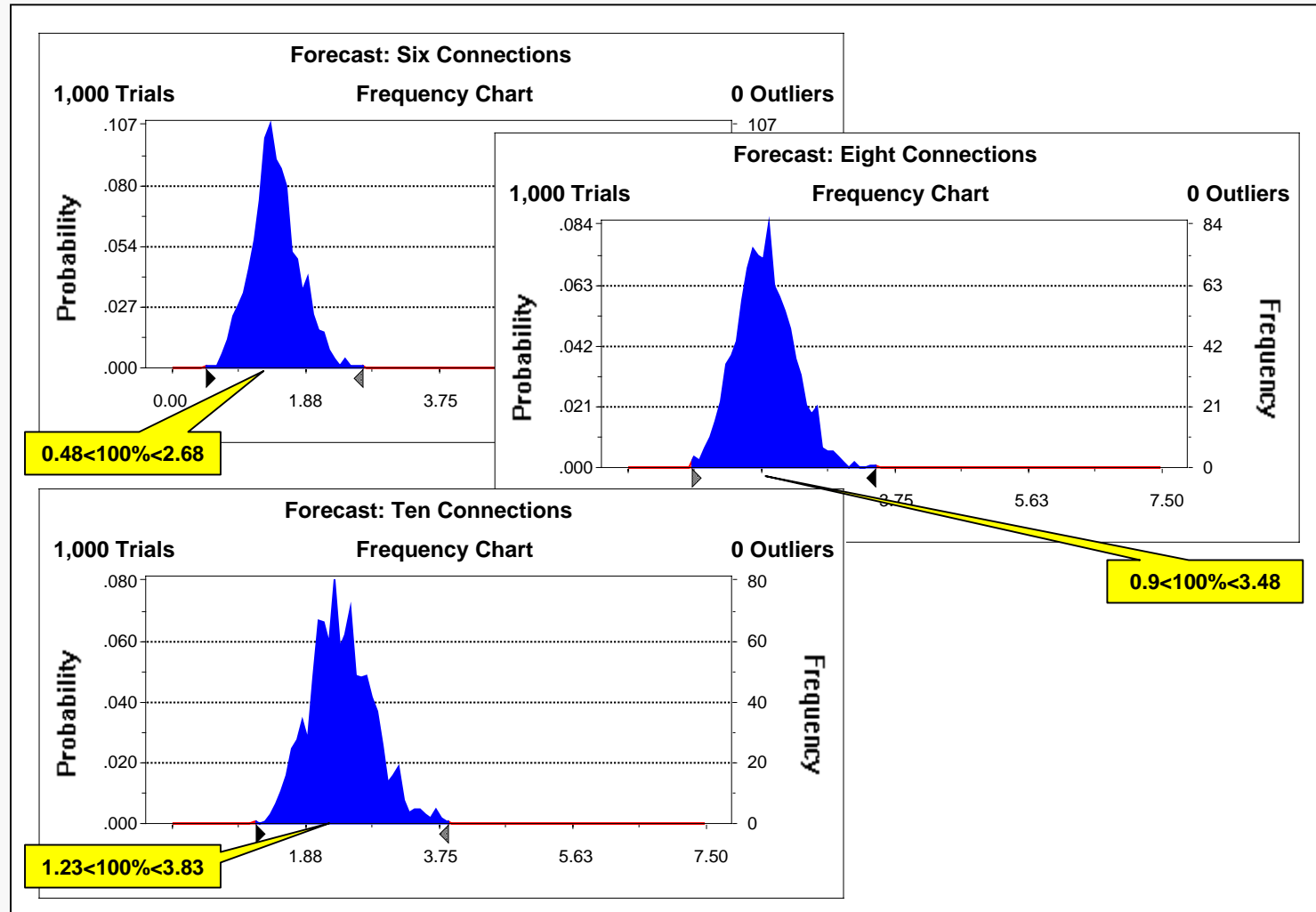
The Impact of Multiple Connections - I

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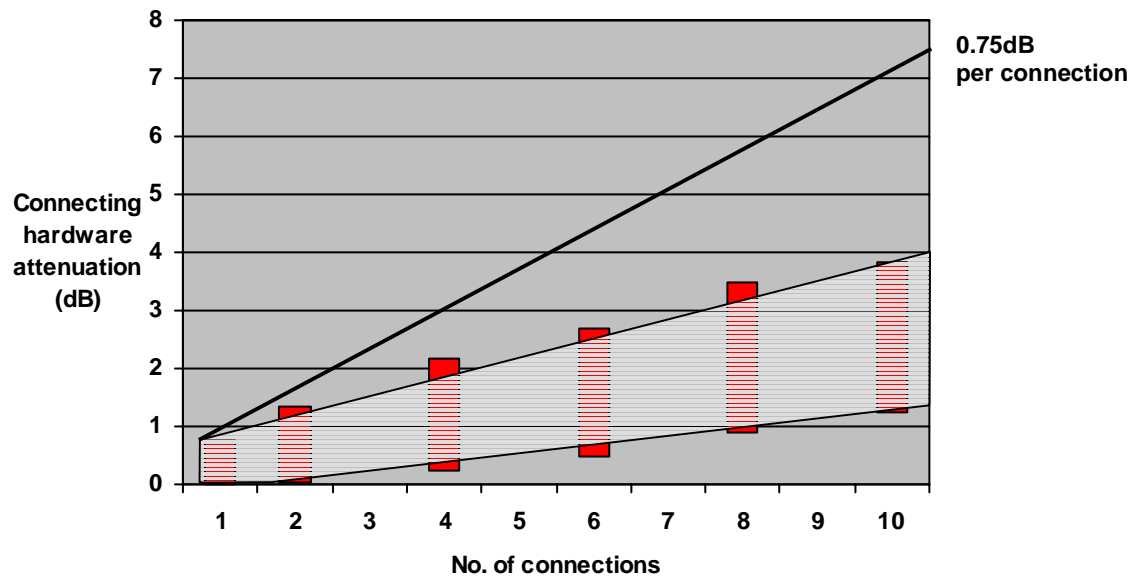
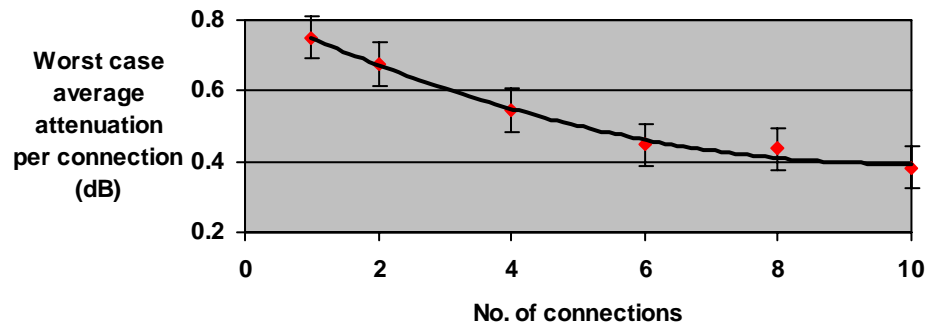
The Impact of Multiple Connections - II

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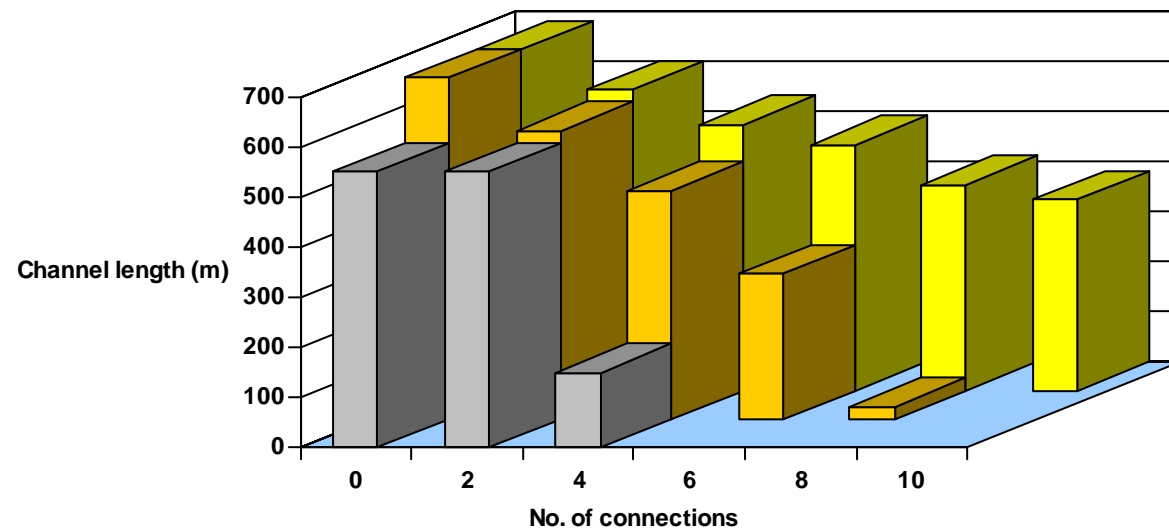
Average Attenuation and Spread

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1000BASE-SX and OM2

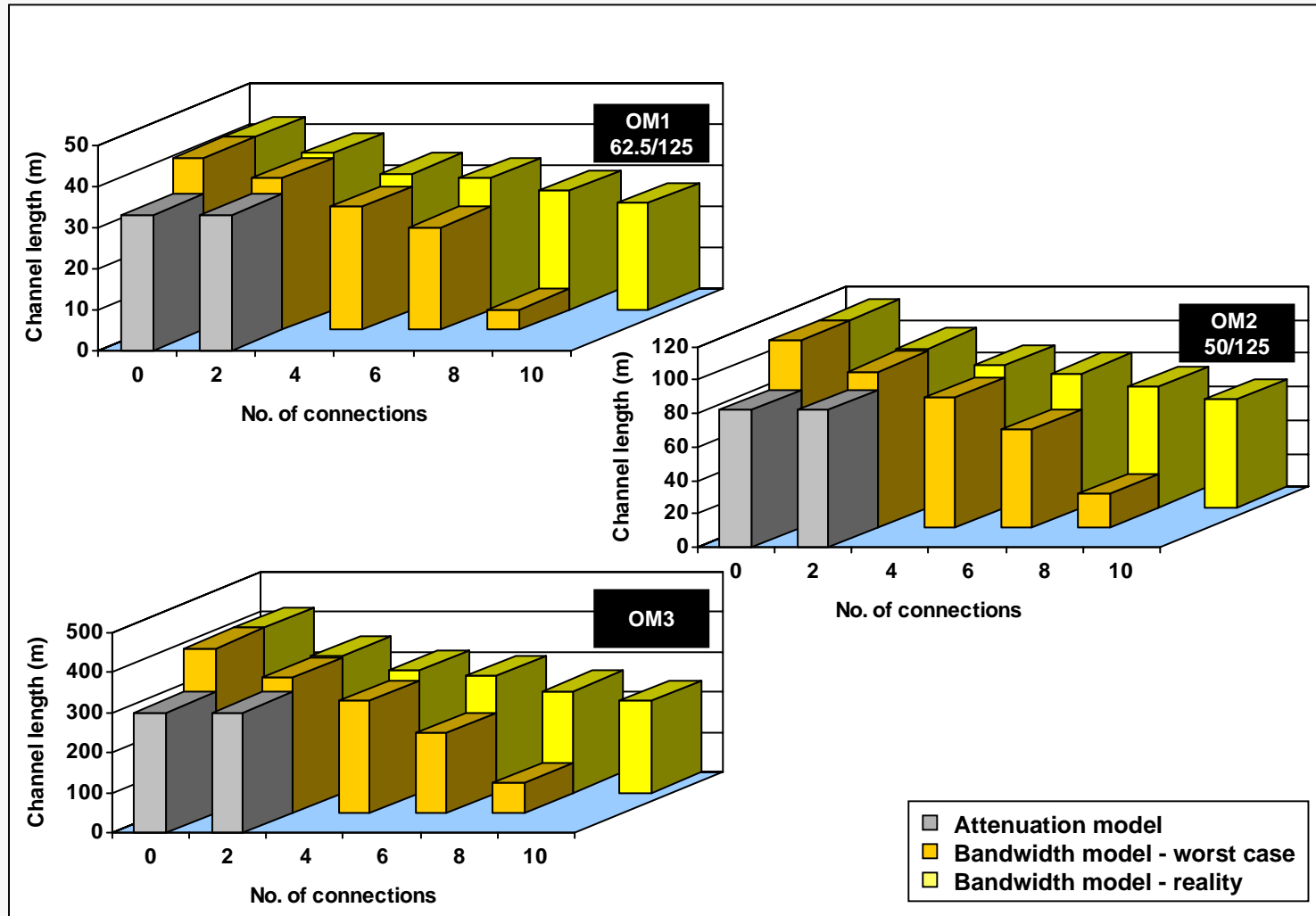
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Attenuation model
 Bandwidth model - worst case
 Bandwidth model - reality

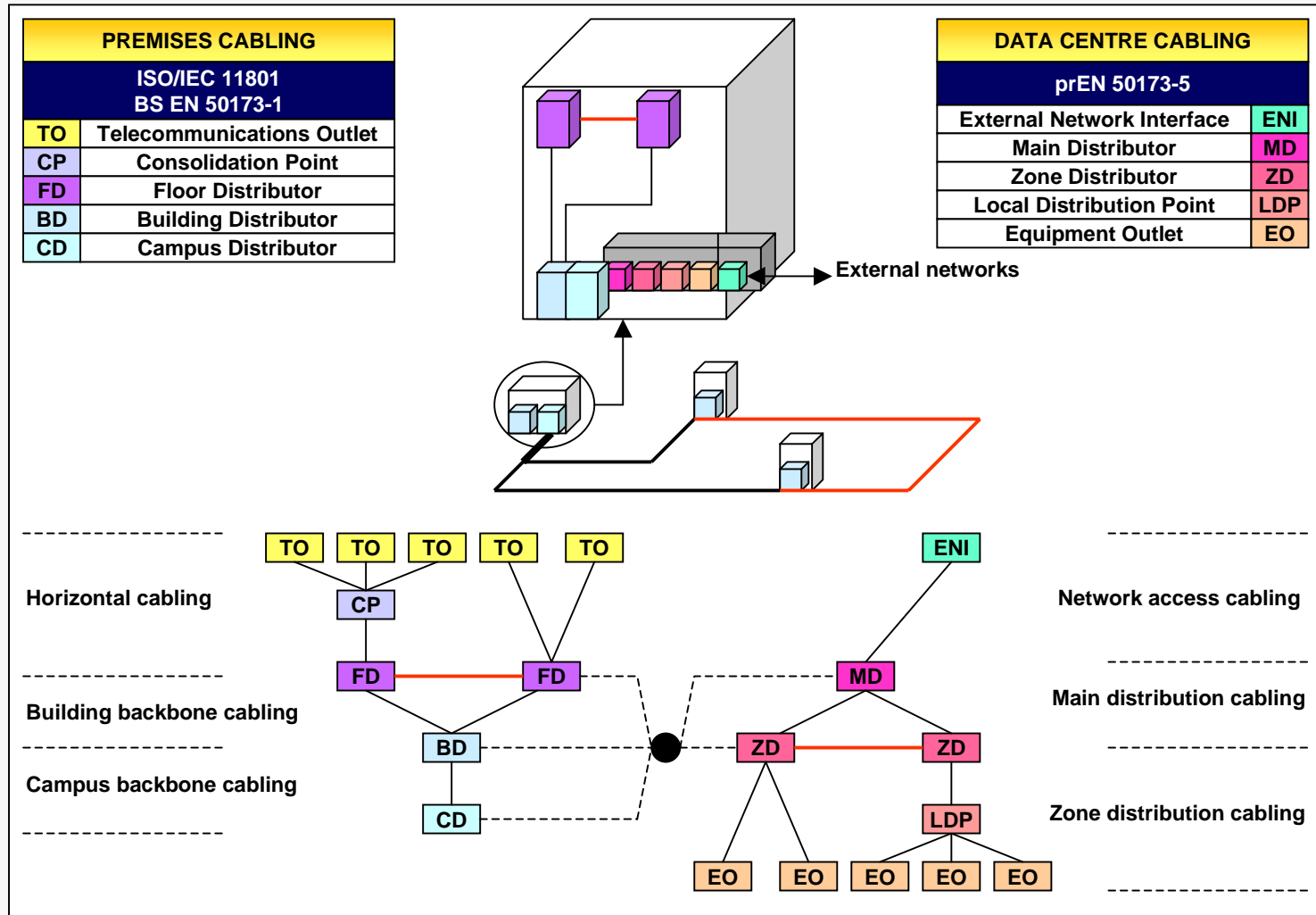
10GBASE-SR/SW: OM1, OM2 and OM3

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Data Centre Cabling Standards

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EN 50173-5: 2005?

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