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Application Channel Attenuation and Supportable Distances

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Application Channel Attenuation and Supportable Distances

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1 SCOPE

This Telecommunications Systems Bulletin (TSB) provides information regarding applications support for many of the available applications across media types recognized in ANSI/TIA-568. This compilation allows the user to easily access enough basic information to make informed decisions about media choices and system design. With a predetermined knowledge of the required distances, the anticipated applications, and the cabling system design, the user can determine the most appropriate media for their needs. Still, this information is not intended to constitute a design guideline. Application standards and cabling system manufacturers should be consulted to establish complete requirements and capabilities of specific cabling alternatives.

> **NOTE –** Premises standards may impose distance limitations shorter than those listed.

2 INFORMATIVE REFERENCES

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For date references, only the edition cited applies. For undated references, the last edition of the referenced document (including any amendments) applies.

- ANSI/TIA-568.2, *Balanced Twisted-Pair Telecommunications Cabling and Components Standard*
- ANSI/TIA-568.3, *Optical Fiber Cabling and Components Standard*
- ANSI/TIA-568.4, *Broadband Coaxial Cabling and Components Standard*
- IEC 60793-2-50, *Optical fibres – Part 2-50: Product specifications – Sectional specification for class B single-mode fibres*
- IEEE 802.3-2022, *IEEE Standard for Ethernet*
- TIA TSB-5021, *Guidelines for the use of Installed Category 5e and Category 6 to Support 2.5GBASE-T and 5GBASE-T*
- TIA TSB-95, *Additional Transmission Performance Guidelines for 4-Pair 100 Ohm Category 5 Cabling*
- ANSI/TIA-492AAAF, *Detail Specification for Class 1a Graded-Index Multimode Optical Fibers; Modification of IEC 60793-2-10:2019, Optical Fibres- Part 2-10: Product Specifications- Sectional Specification for Category A1 Multimode Fibres*
- ANSI/TIA-492CAAC, *Sectional Specification for Class B Single-Mode Optical Fibres*
- ITU-T G.984, *Gigabit-capable Passive Optical Networks (GPON)*
- ITU-T G.987, *10-Gigabit-capable Passive Optical Networks (XG-PON)*

3 BALANCED TWISTED-PAIR CABLING SUPPORTABLE DISTANCES

Table 1 lists maximum supportable distances for applications using balanced twisted-pair cabling. The table is based on the minimum performance requirements of specific balanced twisted-pair cabling established by ANSI/TIA-568.2. Applications are identified using both industry standard and common names.

Table 1 - Maximum supportable distances for balanced twisted-pair cabling applications

Application	Media	Distance m (ft)	Comments
Ethernet 10BASE-T	category 3, 5e[4], 6, 6A[1], 8	100 (328)	
Ethernet 10BASE-Te	category 5e[4], 6, 6A[1], 8	100 (328)	
Ethernet 100BASE-TX	category 5e[4], 6, 6A[1], 8	100 (328)	
Ethernet 1000BASE-T	category 5e[5], 6, 6A[1], 8	100 (328)	
Ethernet 2.5GBASE-T	category 6A[1,2], 8	100 (328)	
Ethernet 5GBASE-T	category 6A[1,2], 8	100 (328)	
Ethernet 10GBASE-T	category 6A[1,3], 8	100 (328)	
Ethernet 25GBASE-T	category 8	30 (98)	
Ethernet 40GBASE-T	category 8	30 (98)	
IEEE Std 802.3™ Type 1 PoE	category 3, 5e[4], 6, 6A[1], 8	100 (328)	
IEEE Std 802.3™ Type 2 PoE	category 5e[4], 6, 6A[1], 8	100 (328)	
IEEE Std 802.3bt™ Type 3 PoE	category 5e[4], 6, 6A[1], 8	100 (328)	
IEEE Std 802.3bt™ Type 4 PoE	category 5e, 6, 6A[1], 8	100 (328)	
HDBaseT	category 6A[1], 8	100 (328)	
ADSL	category 3, 5e, 6, 6A, 8	5000 (16 000)	1.5 Mb/s to 9 Mb/s
VDSL	category 3, 5e, 6, 6A, 8	5000 (16 000)	1500 m (4900 ft) for 12.9 Mb/s; 300 m (1000 ft) for 52.8 Mb/s
Analog Phone	category 3, 5e, 6, 6A, 8	800 (2625)	
FAX	category 3, 5e, 6, 6A, 8	5000 (16 000)	
ATM 25.6	category 3, 5e, 6, 6A[1], 8	100 (328)	
ATM 51.84	category 3, 5e, 6, 6A[1], 8	100 (328)	
ATM 155.52	category 5e, 6, 6A[1], 8	100 (328)	

ATM 1.2G	category 6, 6A[1], 8	100 (328)	
ISDN BRI	category 3, 5e, 6, 6A, 8	5000 (16 000)	128 kb/s
ISDN PRI	category 3, 5e, 6, 6A, 8	5000 (16 000)	1.472 Mb/s

NOTES

1 – Category 8 components can be used to construct category 6A 100 m (328 ft) channels. See TIA TSB-184 for power delivery efficiency achievable with category 8 components.

2 – Installed category 5e and category 6 cabling qualified in accordance with TIA TSB-5021 can support 2.5GBASE-T and 5GBASE-T.

3 – Installed category 6 cabling qualified in accordance with TIA TSB-155 can support 10GBASE-T for maximum distances between 37 m (121 ft) and 55 m (180 ft) depending on the alien crosstalk environment.

4 – Supported on legacy category 5 cabling, formerly supported as a TIA medium which may be found in installed cabling.

5 – Installed category 5 cabling, formerly supported as a TIA medium, qualified in accordance with TIA TSB-95 can support 1000BASE-T.

4 OPTICAL FIBER CABLING SUPPORTABLE DISTANCES

4.1 Multimode Ethernet Applications

Table 2 lists maximum supportable distances and maximum channel attenuation for Ethernet applications using multimode optical fiber cabling. The table is based on the minimum performance requirements of 62.5/125 μm (OM1), 50/125 μm (OM2) and 850 nm laser-optimized 50/125 μm (OM3, OM4 and OM5) fiber established by ANSI/TIA-568.3. Applications are identified using industry standard nomenclature.

NOTE – OM1 and OM2 are no longer recognized media. Information is included for maintenance of legacy installations.

Table 2 - Maximum supportable distances and channel attenuation for multimode Ethernet applications

	Fiber Type	**62.5/125 μm**		**50/125 μm**		**850 nm laser-optimized 50/125 μm**			
	Fiber Standard	**ANSI/TIA-492AAAF (OM1)**		**ANSI/TIA-492AAAF (OM2)**		**ANSI/TIA-492AAAF (OM3)**		**ANSI/TIA-492AAAF (OM4/OM5)**	
	Nominal wavelength (nm)	**850**	**1300**	**850**	**1300**	**850**	**1300**	**850**	**1300**
Application	**Parameter**								
Ethernet 10/100BASE-SX	Channel attenuation (dB)	4.0	-	4.0	-	4.0	-	4.0	-
	Supportable distance m (ft)	300 (984)	-	300 (984)	-	300 (984)	-	300 (984)	-
Ethernet 10BASE-FL/FOIRL	Channel attenuation (dB)	12.5	-	12.5	-	12.5	-	12.5	-
	Supportable distance m (ft)	1000	-	1000	-	1000	-	1000	-
Ethernet 100BASE-FX	Channel attenuation (dB)	-	11.0	-	6.0	-	6.0	-	6.0
	Supportable distance m (ft)	-	2000 (6560)	-	2000 (6560)	-	2000 (6560)	-	2000 (6560)
Ethernet 1000BASE-SX	Channel attenuation (dB)	2.6	-	3.6	-	-	-	-	-
	Supportable distance m (ft)	275 (900)	-	550 (1804)	-	Note 1	-	Note 1	-
Ethernet 1000BASE-LX	Channel attenuation (dB)	-	2.3	-	2.3	-	2.3	-	2.3
	Supportable distance m (ft)	-	550 (1804)	-	550 (1804)	-	550 (1804)	-	550 (1804)
Ethernet 10GBASE-S	Channel attenuation (dB)	2.4	-	2.3	-	2.6	-	2.9	-
	Supportable distance m (ft)	33 (108)	-	82 (269)	-	300 (984)	-	400 (1312)	-
Ethernet 10GBASE-LX4	Channel attenuation (dB)	-	2.5	-	2.0	-	2.0	-	2.0
	Supportable distance m (ft)	-	300 (984)	-	300 (984)	-	300 (984)	-	300 (984)
Ethernet 10GBASE-LRM	Channel attenuation (dB)	-	1.9	-	1.9	-	1.9	-	1.9
	Supportable distance m (ft)	-	220 (720)	-	220 (720)	-	220 (720)	-	220 (720)

	Fiber Type	62.5/125 µm		50/125 µm		850 nm laser-optimized 50/125 µm			
	Fiber Standard	ANSI/TIA-492AAAF (OM1)		ANSI/TIA-492AAAF (OM2)		ANSI/TIA-492AAAF (OM3)		ANSI/TIA-492AAAF (OM4/OM5)	
	Nominal wavelength (nm)	850	1300	850	1300	850	1300	850	1300
Application	**Parameter**								
Ethernet 25GBASE-SR	Channel attenuation (dB)	-	-	-	-	1.8	-	1.9	-
	Supportable distance m (ft)	-	-	-	-	70 (230)	-	100 (328)	-
Ethernet 40GBASE-SR4	Channel attenuation (dB)	-	-	-	-	1.9	-	1.5 [2]	-
	Supportable distance m (ft)	-	-	-	-	100 (328)	-	150 (492)	-
Ethernet 50GBASE-SR	Channel attenuation (dB)	-	-	-	-	1.8	-	1.9	-
	Supportable distance m (ft)	-	-	-	-	70 (230)	-	100 (328)	-
Ethernet 100GBASE-SR4	Channel attenuation (dB)	-	-	-	-	1.8	-	1.9	-
	Supportable distance m (ft)	-	-	-	-	70 (230)	-	100 (328)	-
Ethernet 100GBASE-SR10	Channel attenuation (dB)	-	-	-	-	1.9	-	1.5 [2]	-
	Supportable distance m (ft)	-	-	-	-	100 (328)	-	150 (492)	-
Ethernet 100GBASE-SR2	Channel attenuation (dB)	-	-	-	-	1.8	-	1.9	-
	Supportable distance m (ft)	-	-	-	-	70 (230)	-	100 (328)	-
Ethernet 100GBASE-VR1	Channel attenuation (dB)	-	-	-	-	1.6	-	1.7	-
	Supportable distance m (ft)	-	-	-	-	30 (98)	-	50 (164)	-
Ethernet 100GBASE-SR1	Channel attenuation (dB)	-	-	-	-	1.7	-	1.8	-
	Supportable distance m (ft)	-	-	-	-	60 (196)	-	100 (328)	-
Ethernet 200GBASE-SR4	Channel attenuation (dB)	-	-	-	-	1.8	-	1.9	-
	Supportable distance m (ft)	-	-	-	-	70 (230)	-	100 (328)	-
Ethernet 200GBASE-VR2	Channel attenuation (dB)	-	-	-	-	1.6	-	1.7	-
	Supportable distance m (ft)	-	-	-	-	30 (98)	-	50 (164)	-
Ethernet 200GBASE-SR2	Channel attenuation (dB)	-	-	-	-	1.7	-	1.8	-
	Supportable distance m (ft)	-	-	-	-	60 (196)	-	100 (328)	-
Ethernet 400GBASE-VR4	Channel attenuation (dB)	-	-	-	-	1.6	-	1.7	-
	Supportable distance m (ft)	-	-	-	-	30 (98)	-	50 (164)	-
Ethernet 400GBASE-SR4	Channel attenuation (dB)	-	-	-	-	1.7	-	1.8	-
	Supportable distance m (ft)	-	-	-	-	60 (196)	-	100 (328)	-

	Fiber Type	**62.5/125 µm**		**50/125 µm**		**850 nm laser-optimized 50/125 µm**			
	Fiber Standard	**ANSI/TIA-492AAAF (OM1)**		**ANSI/TIA-492AAAF (OM2)**		**ANSI/TIA-492AAAF (OM3)**		**ANSI/TIA-492AAAF (OM4/OM5)**	
	Nominal wavelength (nm)	**850**	**1300**	**850**	**1300**	**850**	**1300**	**850**	**1300**
Application	**Parameter**								
Ethernet 400GBASE-SR8	Channel attenuation (dB)	-	-	-	-	1.8	-	1.9	-
	Supportable distance m (ft)	-	-	-	-	70 (230)	-	100 (328)	-
Ethernet 400GBASE-SR16	Channel attenuation (dB)	-	-	-	-	1.8	-	1.9	-
	Supportable distance m (ft)	-	-	-	-	70 (230)	-	100 (328)	-
Ethernet 400GBASE-SR4.2	Channel attenuation (dB)	-	-	-	-	1.7	-	1.8/2	-
	Supportable distance m (ft)	-	-	-	-	70 (230)	-	100/150 (328/492)	-

NOTES

1 – At the time 1000BASE-SX was developed, OM3 and OM4 had not been standardized. See entries for 1G Fibre Channel 100-MX-SN-I for guidance.

2 –1.0 dB total connection and splice loss allowance per IEEE 802.3.

4.2 Multimode Fibre Channel Applications

Table 3 lists maximum supportable distances and maximum channel attenuation for Fibre Channel applications using multimode optical fiber cabling. The table is based on the minimum performance requirements of 62.5/125 μm (OM1), 50/125 μm (OM2) and 850 nm laser-optimized 50/125 μm (OM3, OM4 and OM5) fiber established by ANSI/TIA-568.3. Applications are identified using industry standard nomenclature.

NOTE – OM1 and OM2 are no longer recognized media. Information is included for maintenance of legacy installations.

Table 3 - Maximum supportable distances and channel attenuation for multimode Fibre Channel applications

	Fiber Type	**62.5/125 μm**		**50/125 μm**		**850 nm laser-optimized 50/125 μm**			
	Fiber Standard	**ANSI/TIA-492AAAF (OM1)**		**ANSI/TIA-492AAAF (OM2)**		**ANSI/TIA-492AAAF (OM3)**		**ANSI/TIA-492AAAF (OM4/OM5)**	
	Nominal wavelength (nm)	**850**	**1300**	**850**	**1300**	**850**	**1300**	**850**	**1300**
Application	**Parameter**								
FC-PI-2 (1G Fibre Channel) 100-MX-SN-I	Channel attenuation (dB)	3.0	-	3.9	-	4.6	-	4.6	-
	Supportable distance m (ft)	300 (984)	-	500 (1640)	-	860 (2822)	-	860 (2822)	-
FC-PI-2 (2G Fibre Channel) 200-MX-SN-I	Channel attenuation (dB)	2.1	-	2.6	-	3.3	-	3.3	-
	Supportable distance m (ft)	150 (492)	-	300 (984)	-	500 (1640)	-	500 (1640)	-
FC-PI-4 (4G Fibre Channel) 400-MX-SN	Channel attenuation (dB)	1.8	-	2.1	-	2.9	-	3.0	-
	Supportable distance m (ft)	70 (230)	-	150 (492)	-	380 (1247)	-	400 (1312)	-
FC-PI-4 (8G Fibre Channel) 800-MX-SN	Channel attenuation (dB)	1.6	-	1.7	-	2.0	-	2.2	-
	Supportable distance m (ft)	21 (69)	-	50 (164)	-	150 (492)	-	190 (624)	-
FC-PI-4 (8G Fibre Channel) 800-MX-SA	Channel attenuation (dB)	1.6	-	1.9	-	2.6	-	2.2	-
	Supportable distance m (ft)	40 (131)	-	100 (328)	-	300 (984)	-	300 (984)	-
FC-PI-3 (10G Fibre Channel) 1200-MX-SN-I	Channel attenuation (dB)	2.4	-	2.2	-	2.6	-	2.9	-
	Supportable distance m (ft)	33 (108)	-	82 (269)	-	300 (984)	-	400 (1312)	-
FC-PI-5 (16G Fibre Channel) 1600-MX-SN	Channel attenuation (dB)	-	-	1.6	-	1.9	-	2.0	-
	Supportable distance m (ft)	-	-	35 (115)	-	100 (328)	-	125 (410)	-
FC-PI-6 (32G Fibre Channel) 3200-MX-SN-S 3200-MX-SN-I	Channel attenuation (dB)	-	-	2.0	-	1.9	-	1.9	-
	Supportable distance m (ft)	-	-	20 (66)	-	70 (230)	-	100 (328)	-

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	Fiber Type	62.5/125 µm		50/125 µm		850 nm laser-optimized 50/125 µm			
	Fiber Standard	ANSI/TIA-492AAAF (OM1)		ANSI/TIA-492AAAF (OM2)		ANSI/TIA-492AAAF (OM3)		ANSI/TIA-492AAAF (OM4)/(OM5)	
	Nominal wavelength (nm)	850	1300	850	1300	850	1300	850	1300
Application	**Parameter**								
FC-PI-7 (64G Fibre Channel) 64GFC-SW	Channel attenuation (dB)	-	-	-	-	1.8	-	1.9	-
	Supportable distance m (ft)	-	-	-	-	70 (230)	-	100 (328)	-
FC-PI-6P (128G Fibre Channel) 128GFC-SW4	Channel attenuation (dB)	-	-	-	-	1.46	-	1.36	-
	Supportable distance m (ft)	-	-	-	-	70 (230)	-	100 (328)	-
FC-PI-7P (256G Fibre Channel) 256GFC-SW	Channel attenuation (dB)	-	-	-	-	1.8	-	1.9	-
	Supportable distance m (ft)	-	-	-	-	70 (230)	-	100 (328)	-
FC-PI-8 (128G Fibre Channel) 128GFC-SW	Channel attenuation (dB)	-	-	-	-	1.7	-	1.8	-
	Supportable distance m (ft)	-	-	-	-	60 (197)	-	100 (328)	-
FDDI PMD ANSI X3.166	Channel attenuation (dB)	-	11.0	-	6.0	-	6.0	-	6.0
	Supportable distance m (ft)	-	2000 (6560)	-	2000 (6560)	-	2000 (6560)	-	2000 (6560)

4.3 Multimode InfiniBand Applications

Table 4, Table 5 and Table 6 list maximum supportable distances and maximum channel attenuation for InfiniBand applications using multimode optical fiber cabling. The table is based on the minimum performance requirements of 62.5/125 μm (OM1), 50/125 μm (OM2) and 850 nm laser-optimized 50/125 μm (OM3, OM4 and OM5) fiber established by ANSI/TIA-568.3. Applications are identified using industry standard nomenclature.

NOTE – OM1 and OM2 are no longer recognized media. Information is included for maintenance of legacy installations.

Table 4 – Maximum supportable distances and channel attenuation for multimode InfiniBand SDR applications

	Fiber Type	**62.5/125 µm**		**50/125 µm**		**850 nm laser-optimized 50/125 µm**			
	Fiber Standard	**ANSI/TIA-492AAAF (OM1)**		**ANSI/TIA-492AAAF (OM2)**		**ANSI/TIA-492AAAF (OM3)**		**ANSI/TIA-492AAAF (OM4/OM5)**	
	Nominal wavelength (nm)	**850**	**1300**	**850**	**1300**	**850**	**1300**	**850**	**1300**
Application	**Parameter**								
IB-1x-SX	Channel attenuation (dB)	2.0	-	2.44	-	2.44	-	2.44	-
	Supportable distance m (ft)	125 (410)	-	250 (820)	-	500 (1640)	-	500 (1640)	-
IB-4x-SX	Channel attenuation (dB)	1.8	-	1.9	-	1.9	-	1.9	-
	Supportable distance m (ft)	75 (246)	-	125 (410)	-	200 (656)	-	200 (656)	-
IB-8x-SX	Channel attenuation (dB)	1.8	-	1.9	-	1.9	-	1.9	-
	Supportable distance m (ft)	75 (246)	-	125 (410)	-	200 (656)	-	200 (656)	-
IB-12x-SX	Channel attenuation (dB)	1.8	-	1.9	-	1.9	-	1.9	-
	Supportable distance m (ft)	75 (246)	-	125 (410)	-	200 (656)	-	200 (656)	-

Table 5 – Maximum supportable distances and channel attenuation for multimode InfiniBand DDR applications

	Fiber Type	62.5/125 µm		50/125 µm		850 nm laser-optimized 50/125 µm			
	Fiber Standard	ANSI/TIA-492AAAF (OM1)		ANSI/TIA-492AAAF (OM2)		ANSI/TIA-492AAAF (OM3)		ANSI/TIA-492AAAF (OM4/OM5)	
	Nominal wavelength (nm)	850	1300	850	1300	850	1300	850	1300
Application	Parameter								
IB-1x-DDR-SX	Channel attenuation (dB)	1.76	-	1.97	-	1.97	-	1.97	-
	Supportable distance m (ft)	65 (213)	-	125 (410)	-	200 (656)	-	200 (656)	-
IB-4x-DDR-SX	Channel attenuation (dB)	1.7	-	1.78	-	2.06	-	2.06	-
	Supportable distance m (ft)	50 (164)	-	75 (246)	-	150 (492)	-	150 (492)	-
IB-8x-DDR-SX	Channel attenuation (dB)	1.8	-	1.9	-	1.9	-	1.9	-
	Supportable distance m (ft)	50 (164)	-	75 (246)	-	150 (492)	-	150 (492)	-
IB-12x-DDR-SX	Channel attenuation (dB)	1.8	-	1.9	-	1.9	-	1.9	-
	Supportable distance m (ft)	50 (164)	-	75 (246)	-	150 (492)	-	150 (492)	-

Table 6 – Maximum supportable distances and channel attenuation for multimode InfiniBand QDR applications

	Fiber Type	62.5/125 µm		50/125 µm		850 nm laser-optimized 50/125 µm			
	Fiber Standard	ANSI/TIA-492AAAF (OM1)		ANSI/TIA-492AAAF (OM2)		ANSI/TIA-492AAAF (OM3)		ANSI/TIA-492AAAF (OM4/OM5)	
	Nominal wavelength (nm)	850	1300	850	1300	850	1300	850	1300
Application	Parameter								
IB-1x-QDR-SX	Channel attenuation (dB)	2	-	2.44	-	2.44	-	2.44	-
	Supportable distance m (ft)	33 (108)	-	82 (269)	-	300 (984)	-	300 (984)	-

4.4 Single-mode Ethernet Applications

Table 7 lists maximum supportable distances and maximum channel attenuation for Ethernet applications using single-mode optical fiber cabling. The table is based on the minimum performance requirements of single-mode fiber established by ANSI/TIA-568.3. Applications are identified using industry standard nomenclature.

Table 7 - Maximum supportable distances and channel attenuation for single-mode Ethernet applications

	Fiber Type	**Dispersion unshifted single mode and low-water-peak**	
	Fiber Standard	**ANSI/TIA-492CAAC (OS1a) and ANSI/TIA-492CAAC (OS2)[1]**	
	Nominal wavelength (nm)	**1310**	**1550**
Application	**Parameter**		
Ethernet 100BASE-LX10 100BASE-BX10-U	Channel attenuation (dB)	6.0	-
	Supportable distance m (ft)	10000 (32810)	-
Ethernet 100BASE-BX10-D	Channel attenuation (dB)	-	5.5
	Supportable distance m (ft)	-	10000 (32810)
Ethernet 1000BASE-BX10-D (1490nm)[2]	Channel attenuation (dB)	-	5.5
	Supportable distance m (ft)	-	10000 (32810)
Ethernet 1000BASE-BX10-U (1310nm)	Channel attenuation (dB)	6.0	-
	Supportable distance m (ft)	10000 (32810)	-
Ethernet 1000BASE-LX	Channel attenuation (dB)	4.5	-
	Supportable distance m (ft)	5000 (16405)	-
Ethernet 1000BASE-LX10	Channel attenuation (dB)	6.0	-
	Supportable distance m (ft)	10000 (32810)	-
Ethernet 10GBASE-BR10	Channel attenuation (dB)	6.2	-
	Supportable distance m (ft)	10000 (32810)	-
Ethernet 10GBASE-BR20	Channel attenuation (dB)	15	-
	Supportable distance m (ft)	20000 (65620)	-
Ethernet 10GBASE-BR40	Channel attenuation (dB)	18	-
	Supportable distance m (ft)	40000 (131240)	-
Ethernet 10GBASE-LX4	Channel attenuation (dB)	6.3	-
	Supportable distance m (ft)	10000 (32810)	-

	Fiber Type	Dispersion unshifted single mode and low-water-peak	
	Fiber Standard	ANSI/TIA-492CAAC (OS1a) and ANSI/TIA-492CAAC (OS2)[1]	
	Nominal wavelength (nm)	1310	1550
Application	Parameter		
Ethernet 10GBASE-E	Channel attenuation (dB)	-	10.9
	Supportable distance m (ft)	-	30000/40000[3] (98425/131230)
Ethernet 10GBASE-L	Channel attenuation (dB)	6.2	-
	Supportable distance m (ft)	10000 (32810)	-
Ethernet 25GBASE-BR10	Channel attenuation (dB)	6.3	-
	Supportable distance m (ft)	10000 (32810)	-
Ethernet 25GBASE-BR20	Channel attenuation (dB)	15	-
	Supportable distance m (ft)	20000 (65620)	-
Ethernet 25GBASE-BR40	Channel attenuation (dB)	18	-
	Supportable distance m (ft)	40000 (131240)	-
Ethernet 25GBASE-LR	Channel attenuation (dB)	6.3	-
	Supportable distance m (ft)	10000 (32810)	-
Ethernet 25GBASE-ER	Channel attenuation (dB)	15/18	-
	Supportable distance m (ft)	30000/40000[3] (98430/131240)	-
Ethernet 40GBASE-FR[5]	Channel attenuation (dB)	4.0	4.0
	Supportable distance m (ft)	2000 (6562)	2000 (6562)
Ethernet 40GBASE-LR4	Channel attenuation (dB)	6.7	-
	Supportable distance m (ft)	10000 (32810)	-
Ethernet 40GBASE-ER4	Channel attenuation (dB)	16.5/18[4]	-
	Supportable distance m (ft)	30000/40000[3] (98430/131240)	-
Ethernet 50GBASE-BR10	Channel attenuation (dB)	6.2	-
	Supportable distance m (ft)	10000 (32810)	-
Ethernet 50GBASE-BR20	Channel attenuation (dB)	15	-
	Supportable distance m (ft)	20000 (65620)	-
Ethernet 50GBASE-BR40	Channel attenuation (dB)	18	-
	Supportable distance m (ft)	40000 (131240)	-
Ethernet 50GBASE-FR	Channel attenuation (dB)	4	-
	Supportable distance m (ft)	2000 (6562)	-
Ethernet 50GBASE-LR	Channel attenuation (dB)	6.3	-
	Supportable distance m (ft)	10000 (32810)	-

	Fiber Type	Dispersion unshifted single mode and low-water-peak	
	Fiber Standard	ANSI/TIA-492CAAC (OS1a) and ANSI/TIA-492CAAC (OS2)[1]	
	Nominal wavelength (nm)	1310	1550
Application	Parameter		
Ethernet 50GBASE-ER	Channel attenuation (dB)	15/18[4]	-
	Supportable distance m (ft)	30000/40000[3] (98430/131240)	-
Ethernet 100GBASE-DR	Channel attenuation (dB)	6	-
	Supportable distance m (ft)	500 (1640)	-
Ethernet 100GBASE-FR1	Channel attenuation (dB)	4	-
	Supportable distance m (ft)	2000 (6562)	-
Ethernet 100GBASE-LR1	Channel attenuation (dB)	6.3	-
	Supportable distance m (ft)	10000 (32810)	-
Ethernet 100GBASE-LR4	Channel attenuation (dB)	6.3	-
	Supportable distance m (ft)	10000 (32810)	-
Ethernet 100GBASE-ER4	Channel attenuation (dB)	15/18[4]	-
	Supportable distance m (ft)	30000/40000[3] (98430/131240)	-
Ethernet 200GBASE-DR4	Channel attenuation (dB)	3	-
	Supportable distance m (ft)	500 (1640)	-
Ethernet 200GBASE-FR4	Channel attenuation (dB)	4	-
	Supportable distance m (ft)	2000 (6562)	-
Ethernet 200GBASE-LR4	Channel attenuation (dB)	6.3	-
	Supportable distance m (ft)	10000 (32810)	-
Ethernet 200GBASE-ER4	Channel attenuation (dB)	15/18	-
	Supportable distance m (ft)	30000/40000[3] (98430/131240)	-
Ethernet 400GBASE-DR4	Channel attenuation (dB)	3	-
	Supportable distance m (ft)	500 (1640)	-
Ethernet 400GBASE-FR4	Channel attenuation (dB)	4	-
	Supportable distance m (ft)	2000 (6562)	-
Ethernet 400GBASE-FR8	Channel attenuation (dB)	4	-
	Supportable distance m (ft)	2000 (6562)	-
Ethernet 400GBASE-LR4-6	Channel attenuation (dB)	5	-
	Supportable distance m (ft)	6000 (19860)	-
Ethernet 400GBASE-LR8	Channel attenuation (dB)	6.3	-
	Supportable distance m (ft)	10000 (32810)	-

	Fiber Type	Dispersion unshifted single mode and low-water-peak	
	Fiber Standard	**ANSI/TIA-492CAAC (OS1a) and ANSI/TIA-492CAAC (OS2)[1]**	
	Nominal wavelength (nm)	**1310**	**1550**
Application	**Parameter**		
Ethernet 400GBASE-ER8	Channel attenuation (dB)	15/18	-
	Supportable distance m (ft)	30000/40000[3] (98430/131240)	-

NOTES:
1 – For the purpose of the details in this table, the cabled optical fiber attenuation of single-mode inside plant and indoor/outdoor cables is considered equivalent to OS2, which has lower specified maximum cabled fiber attenuation than OS1a.
2 – 1000BASE-BX10-D downstream wavelength is specified at 1490nm in IEEE802.3 clause 58.
3 – Links longer than 30km are considered engineered links. Attenuation for such links needs to be less than that guaranteed by IEC 60793-2-50 Type B-652 or B-657 single-mode cabled optical fiber.
4 – Refer to IEEE 802.3 for maximum channel insertion loss dependent of number of discrete reflectance.
5 – 40GBASE-FR transmit wavelength is specified at 1550nm, and receive wavelength is specified at both 1310nm and 1550nm.

4.5 Single-mode Fibre Channel Applications

Table 8 lists maximum supportable distances and maximum channel attenuation for Fibre Channel applications using single-mode optical fiber cabling. The table is based on the minimum performance requirements of single-mode fiber established by ANSI/TIA-568.3. Applications are identified using industry standard nomenclature.

Table 8 - Maximum supportable distances and channel attenuation for single-mode Fibre Channel applications

	Fiber Type	**Dispersion unshifted single mode and low-water-peak**	
	Fiber Standard	**TIA-492CAAC (OS1a) and TIA-492CAAC (OS2)[1]**	
	Nominal wavelength (nm)	**1310**	**1550**
Application	**Parameter**		
FC-PI-2 (1G Fibre Channel) 100-SM-LC-L	Channel attenuation (dB)	7.8	-
	Supportable distance m (ft)	10000 (32810)	-
FC-PI-2 (2G Fibre Channel) 200-SM-LC-L	Channel attenuation (dB)	7.8	-
	Supportable distance m (ft)	10000 (32810)	-
FC-PI-5 (4G Fibre Channel) 400-SM-LC-M	Channel attenuation (dB)	4.8	-
	Supportable distance m (ft)	4000 (13124)	-
FC-PI-5 (4G Fibre Channel) 400-SM-LC-L	Channel attenuation (dB)	7.8	-
	Supportable distance m (ft)	10000 (32810)	-
FC-PI-5 (8G Fibre Channel) 800-SM-LC-I	Channel attenuation (dB)	2.6	-
	Supportable distance m (ft)	1400 (4593)	-
FC-PI-5 (8G Fibre Channel) 800-SM-LC-L	Channel attenuation (dB)	6.4	-
	Supportable distance m (ft)	10000 (32810)	-
FC-PI-3 (10G Fibre Channel) 1200-SM-LL-L	Channel attenuation (dB)	6.0	-
	Supportable distance m (ft)	10000 (32810)	-
FC-PI-5 (16G Fibre Channel) 1600-SM-LC-L	Channel attenuation (dB)	6.4	-
	Supportable distance m (ft)	10000 (32810)	-

	Fiber Type	**Dispersion unshifted single mode and low-water-peak**	
	Fiber Standard	**TIA-492CAAC (OS1a) and TIA-492CAAC (OS2)[1]**	
	Nominal wavelength (nm)	**1310**	**1550**
Application	**Parameter**		
FC-PI-6 (32G Fibre Channel) 3200-SM-LC-L	Channel attenuation (dB)	6.3	-
	Supportable distance m (ft)	10000 (32810)	-
FC-PI-7 (64G Fibre Channel) 64GFC-LW	Channel attenuation (dB)	6.3	-
	Supportable distance m (ft)	10000 (32810)	-
FC-PI-6P (128G Fibre Channel) 128GFC-PSM4	Channel attenuation (dB)	3	-
	Supportable distance m (ft)	500 (1640)	-
FC-PI-6P (128G Fibre Channel) 128GFC-CWDM4	Channel attenuation (dB)	4.1	-
	Supportable distance m (ft)	2000 (6562)	-
FC-PI-8 (128G Fibre Channel) 128GFC-LI	Channel attenuation (dB)	4	-
	Supportable distance m (ft)	2000 (6562)	-
FC-PI-8 (128G Fibre Channel) 128GFC-LW	Channel attenuation (dB)	6.3	-
	Supportable distance m (ft)	10000 (32810)	-
FDDI SMF-PMD ANSI X3.184	Channel attenuation (dB)	10.0	-
	Supportable distance m (ft)	10000 (32810)	-

NOTES:
1 – For the purpose of the details in this table, the cabled optical fiber attenuation of single-mode inside plant and indoor/outdoor cables is considered equivalent to OS2, which has lower specified maximum cabled fiber attenuation than OS1a

4.6 Single-mode InfiniBand Applications

Table 9 , Table 10 and Table 11 list maximum supportable distances and maximum channel attenuation for InfiniBand applications using single-mode optical fiber cabling. The table is based on the minimum performance requirements of single-mode fiber established by ANSI/TIA-568.3. Applications are identified using industry standard nomenclature.

Table 9 – Maximum supportable distances and channel attenuation for single-mode InfiniBand SDR applications

	Fiber Type	**Dispersion unshifted single mode and low-water-peak**	
	Fiber Standard	**ANSI/TIA-492CAAC (OS1a) and ANSI/TIA-492CAAC (OS2)[1]**	
	Nominal wavelength (nm)	**1310**	**1550**
Application	**Parameter**		
IB-1x-LX	Channel attenuation (dB)	6.64	-
	Supportable distance m (ft)	10000 (32808)	-
IB-4x-LX	Channel attenuation (dB)	6.2	-
	Supportable distance m (ft)	10000 (32808)	-
Notes: 1 - For the purpose of the details in this table, the cabled optical fiber attenuation of single-mode inside plant and indoor/outdoor cables is considered equivalent to OS2, which has lower specified maximum cabled fiber attenuation than OS1a.			

Table 10 – Maximum supportable distances and channel attenuation for single-mode InfiniBand DDR applications

	Fiber Type	**Dispersion unshifted single mode and low-water-peak**	
	Fiber Standard	**ANSI/TIA-492CAAC (OS1a) and ANSI/TIA-492CAAC (OS2)[1]**	
	Nominal wavelength (nm)	**1310**	**1550**
Application	**Parameter**		
IB-1x-DDR-LX	Channel attenuation (dB)	5.66	-
	Supportable distance m (ft)	10000 (32808)	-
Notes: 1 - For the purpose of the details in this table, the cabled optical fiber attenuation of single-mode inside plant and indoor/outdoor cables is considered equivalent to OS2, which has lower specified maximum cabled fiber attenuation than OS1a.			

Table 11 - Maximum supportable distances and channel attenuation for single-mode InfiniBand QDR applications

	Fiber Type	**Dispersion unshifted single mode and low-water-peak**	
	Fiber Standard	**ANSI/TIA-492CAAC (OS1a) and ANSI/TIA-492CAAC (OS2)[1]**	
	Nominal wavelength (nm)	**1310**	**1550**
Application	**Parameter**		
IB-1x-QDR-LX	Channel attenuation (dB)	6.64	-
	Supportable distance m (ft)	10000 (32808)	-

Notes:
1 - For the purpose of the details in this table, the cabled optical fiber attenuation of single-mode inside plant and indoor/outdoor cables is considered equivalent to OS2, which has lower specified maximum cabled fiber attenuation than OS1a.

4.7 Single-mode Passive Optical Network (PON) Applications

Table 12 lists maximum supportable distances, and minimum and maximum channel attenuation including the attenuation of couplers and splitters for Passive Optical Networks (PON) applications using single-mode optical fiber cabling. The table is based on the minimum performance requirements of single-mode fiber established by ANSI/TIA-568.3. Applications are identified using industry standard nomenclature.

Table 12 - Maximum supportable distances and minimum and maximum channel attenuation for single-mode fiber passive optical network (PON) applications

Application	**Fiber Type**	**Dispersion unshifted single-mode and low-water-peak**			
	Fiber Standard	**ANSI/TIA-492CAAC (OS1a) and ANSI/TIA-492CAAC (OS2)[3]**			
	Parameter	**Nominal wavelength (nm), wavelength range (nm) and direction**			
		1270	**1310**	**1490**	**1577**
		1260..1280	**1260..1360**	**1480..1500**	**1575..1580**
		Upstream		**Downstream**	
1000BASE-PX10 EPON (IEEE 802.3)	Min channel attenuation, dB		5	5	
	Max channel attenuation, dB		20	19.5	
	Max supportable distance, m (ft)	10000 (32810)			
1000BASE-PX20 EPON (IEEE 802.3)	Min channel attenuation, dB		10	10	
	Max channel attenuation, dB		24	23.5	
	Max supportable distance, m (ft)	20000 (65620)			
10GBASE-PRX10 10G-EPON (IEEE 802.3)	Min channel attenuation, dB		5		5
	Max channel attenuation, dB		20		20
	Max supportable distance, m (ft)	10000 (32810)			
10GBASE-PR10 10G-EPON (IEEE 802.3)	Min channel attenuation, dB	5			5
	Max channel attenuation, dB	20			20
	Max supportable distance, m (ft)	10000 (32810)			
10GBASE-PRX20 10G-EPON (IEEE 802.3)	Min channel attenuation, dB		10		10
	Max channel attenuation, dB		24		24
	Max supportable distance, m (ft)	20000 (65620)			

Application	Fiber Type	Dispersion unshifted single-mode and low-water-peak			
	Fiber Standard	ANSI/TIA-492CAAC (OS1a) and ANSI/TIA-492CAAC (OS2)[4]			
	Parameter	Nominal wavelength (nm), wavelength range (nm) and direction			
		1270	1310	1490	1577
		1260..1280	1260..1360	1480..1500	1575..1580
		Upstream		Downstream	
10GBASE-PR20 10G-EPON (IEEE 802.3)	Min channel attenuation, dB	10			10
	Max channel attenuation, dB	24			24
	Max supportable distance, m (ft)	20000 (65620)			
10GBASE-PRX30 10G-EPON (IEEE 802.3)	Min channel attenuation, dB		15		15
	Max channel attenuation, dB		29		29
	Max supportable distance, m (ft)	20000 (65620)			
10GBASE-PR30 10G-EPON (IEEE 802.3)	Min channel attenuation, dB	15			15
	Max channel attenuation, dB	29			29
	Max supportable distance, m (ft)	20000 (65620)			
25GBASE-PQ20 25G-EPON (IEEE 802.3)	Min channel attenuation, dB	10			10
	Max channel attenuation, dB	24			24
	Max supportable distance, m (ft)	20000 (65620)			
25GBASE-PQ30 25G-EPON (IEEE 802.3)	Min channel attenuation, dB	15			15
	Max channel attenuation, dB	29			29
	Max supportable distance, m (ft)	20000 (65620)			
50GBASE-PQ20 50G-EPON (IEEE 802.3)	Min channel attenuation, dB	10			10
	Max channel attenuation, dB	24			24
	Max supportable distance, m (ft)	20000 (65620)			
50BASE-PQ30 50G-EPON (IEEE 802.3)	Min channel attenuation, dB	15			15
	Max channel attenuation, dB	29			29
	Max supportable distance, m (ft)	20000 (65620)			

Application	Fiber Type	Dispersion unshifted single-mode and low-water-peak			
	Fiber Standard	ANSI/TIA-492CAAC (OS1a) and ANSI/TIA-492CAAC (OS2)[3]			
	Parameter	Nominal wavelength (nm), wavelength range (nm) and direction			
		1270	1310	1490	1577
		1260..1280	1260..1360	1480..1500	1575..1580
		Upstream		Downstream	
GPON Class B (ITU-T G.984)	Min channel attenuation, dB		10	10	
	Max channel attenuation, dB		25	25	
	Max supportable distance, m (ft)	20000 (65620)			
GPON Class C (ITU-T G.984)	Min channel attenuation, dB		15	15	
	Max channel attenuation, dB		30	30	
	Max supportable distance, m (ft)	20000 (65620)			
GPON Class B+ (ITU-T G.984)	Min channel attenuation, dB		13	13	
	Max channel attenuation, dB		28	28	
	Max supportable distance, m (ft)	20000 (65620)			
GPON Class C+ (ITU-T G.984)	Min channel attenuation, dB		17	17	
	Max channel attenuation, dB		32	32	
	Max supportable distance, m (ft)	60000 (196850) [1]			
Class N1 XG-PON (ITU-T G.987)	Min channel attenuation, dB	14			14
	Max channel attenuation, dB	29			29
	Max supportable distance, m (ft)	40000 (131230) [2]			
Class N2 XG-PON (ITU-T G.987)	Min channel attenuation, dB	16			16
	Max channel attenuation, dB	31			31
	Max supportable distance, m (ft)	40000 (131230) [2]			

NOTES

1 – Subject to 20km differential fiber distance limit for conventional ITU-T G.984 GPON systems, and subject to 40 km differential fiber distance limit for the ITU-T G.984.7-compliant systems.

2 – Supportable fiber distance can be increased up to 60 km, subject to 40km differential distance limit.

3 – For the purpose of the details of this table, the cabled optical fiber attenuation of single-mode inside plant and indoor/outdoor cables is considered equivalent to OS2, which has lower specified maximum cabled fiber attenuation than OS1a.

5 BROADBAND COAXIAL CABLING SUPPORTABLE DISTANCES

Table 13 lists maximum supportable distances for applications using broadband coaxial cabling. The table is based on the minimum performance requirements of specific balanced coaxial cabling established by ANSI/TIA-568.4.

Table 13 - Maximum supportable distances for broadband coaxial cabling applications

Application	Media	Distance m (ft)
CATV	series 6	56 (184)
	series 11	100 (328)
Satellite TV	series 6	56 (184)
	series 11	100 (328)

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