
10GBASE-T

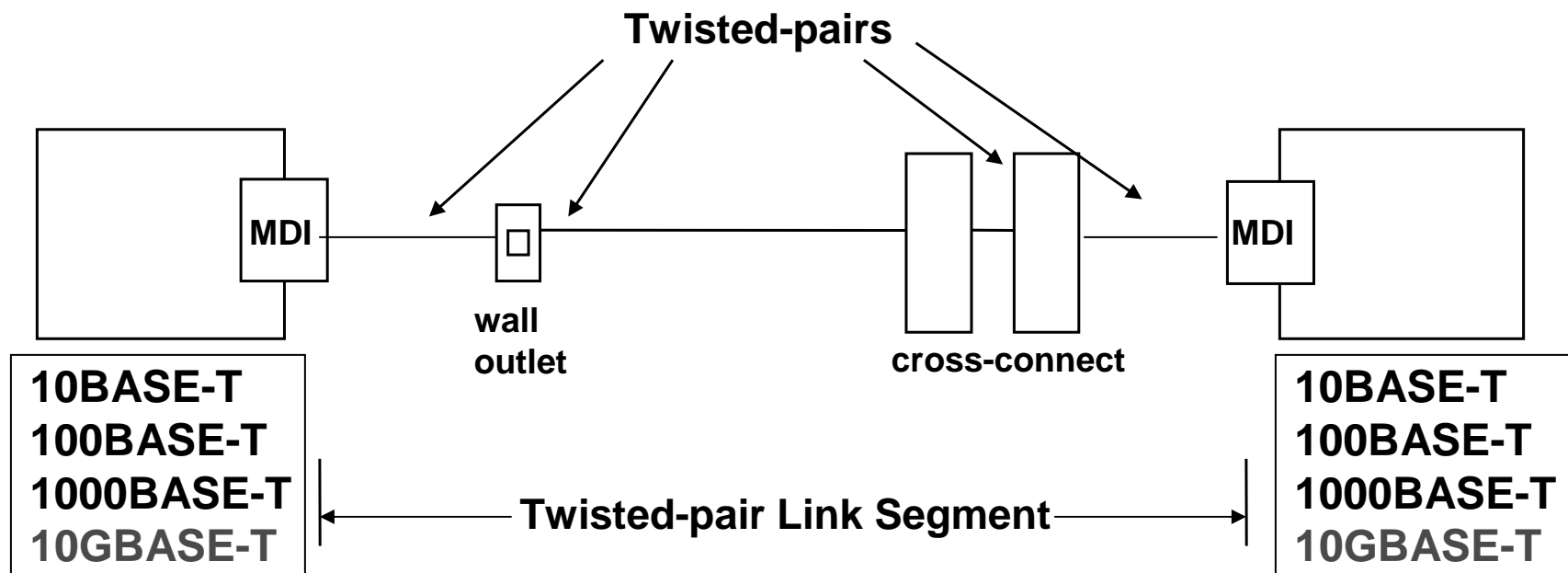
Physical Layer Specifications

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10GBASE-T

Twisted-pair Link Segment



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1000BASE-T Link Segment

•1000BASE-T- The cabling system components (cables, cords, and connectors) used to provide the link segment shall consist of Category 5 components as specified in ANSI/TIA/EIA-568-A:1995 and ISO/IEC 11801:1995. Additionally:

b) 1000BASE-T is an ISO/IEC 11801 Class D application, with additional installation requirements and transmission parameters specified in Annex 40A.

•The term 'link segment' refers to four duplex channels and the term 'duplex channel' refers to a single channel with full duplex capability.

•Specifications for a link segment apply equally to each of the four duplex channels.

Annex 40A - Cabling Configurations - 40A-1

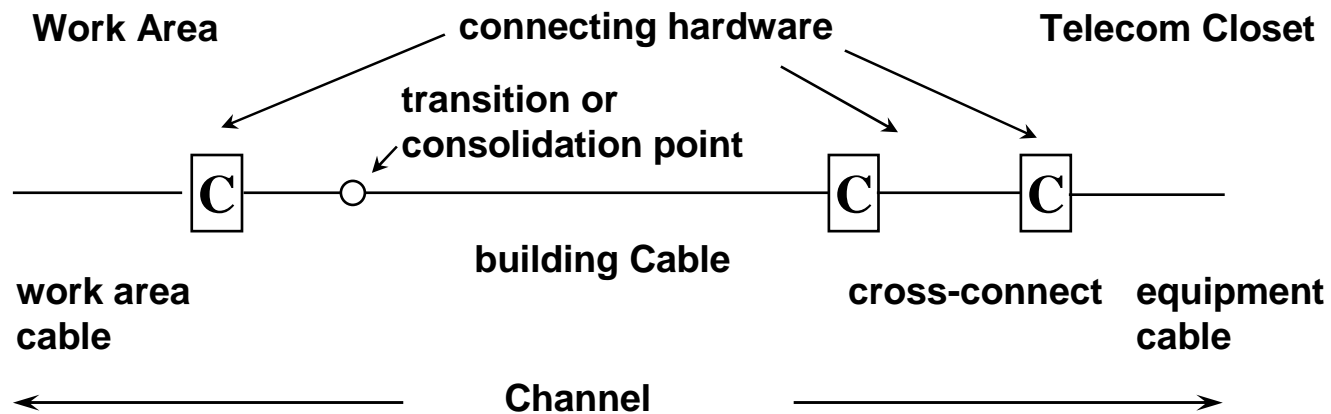


Figure 40A-1—Maximum horizontal subsystem configuration

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Annex 40A - Cabling Configurations - 40A-2

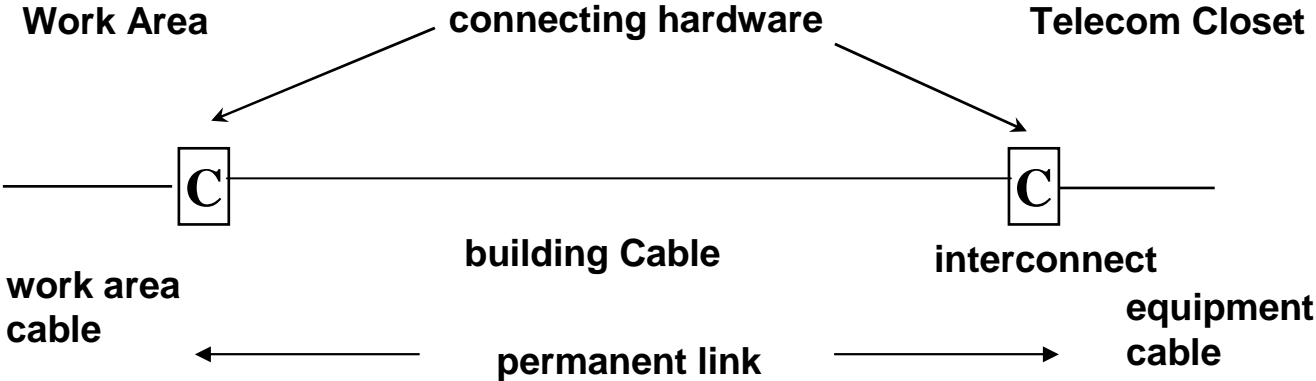


Figure 40A-2—Minimum horizontal subsystem configuration

1000BASE-T Channel Models

- **Worst Case NEXT - 3 disturbers - Cat 5**

 - $27.1 - 16.8 \log_{10}(f/100)$ dB

- **FEXT - 3 disturbers**

 - $17 - 20 \log_{10}(f/100)$ dB
 - $19.5 - 20 \log_{10}(f/100)$ dB
 - $23 - 20 \log_{10}(f/100)$ dB

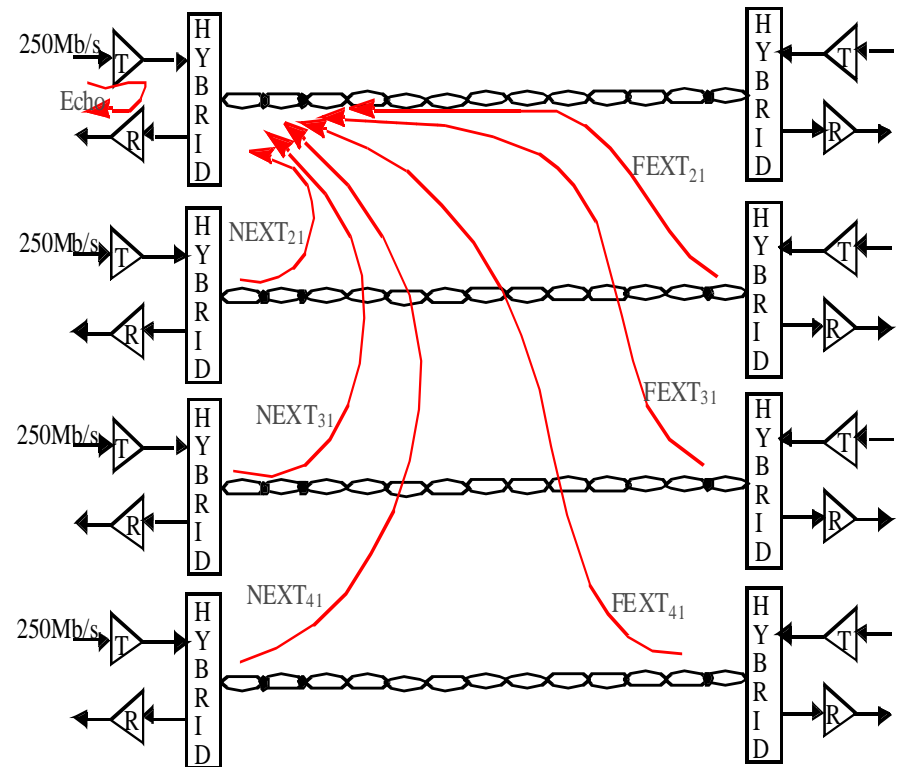
- **PSELFEXT loss > $14.4 - 20 \log_{10}(f/100)$ dB**

- **Return loss (2 models)**

 - 15 dB (1-20 MHz)
 - $15 - 10 \log_{10}(f/20)$ (20-100 MHz)

- **Insertion Loss (cat 5)**

 - $\text{Insertion_Loss}(f) < 2.1 f^{0.529} + 0.4/f$ (dB)



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1000BASE-T Matlab Code

- 3dB Design Point
- 10dB Design Point

3 dB Design Point -Summary Assumptions

D/ A: 17 levels at 125MHz

Launch Level: 2V ptp

Analog Transmit Filter: Single pole RC

Analog Receive Filter: BW2@ 100MHz

A/ D: 5.5bits ideal at 125MHz

Baseline Wander Correction: Digital

FFE - #taps: 12 taps at 125MHz

DFE - #taps: 10 taps at 125MHz

NEXT Cancellers - #taps: 12 taps at 125MHz

Echo Canceller - #taps: 50 taps at 125MHz

Viterbi Decoder: 12- stage

Total worst- case latency: 31BT < 40BT

Uniform Jitter Tolerance for 0dB margin: 1.3ns ptp [> 10ns ptp Gaussian]

Worst- Case Total Noise Budget: 140mV ptp

Est. Gate Count/ Power Consumption: 130K/ 2.2W

Margin without FEXT: 3.6dB (relative external noise margin)

Margin with Worst- Case FEXT: 2.6dB (relative external noise margin)

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10 dB Design Point -Summary Assumptions

D/A: 17 levels at 125MHz

Launch Level: 2V ptp

Analog Transmit Filter: Single pole RC

Analog Receive Filter: BW2@ 100MHz

A/ D: 6.5bits ideal at 125MHz

Baseline Wander Correction: Digital

FFE - #taps: 16 taps at 125MHz

DFE - #taps: 12 taps at 125MHz

NEXT Cancellers - #taps: 72 taps at 125MHz

Echo Canceller - #taps: 120 taps at 125MHz

Viterbi Decoder: 12- stage

Total worst- case latency: 31BT < 40BT

Uniform Jitter Tolerance for 0dB margin: 1.5ns ptp [> 10ns ptp Gaussian]

Worst- Case Total Noise Budget: 140mV ptp

Est. Gate Count/ Power Consumption: 330K/ 4W

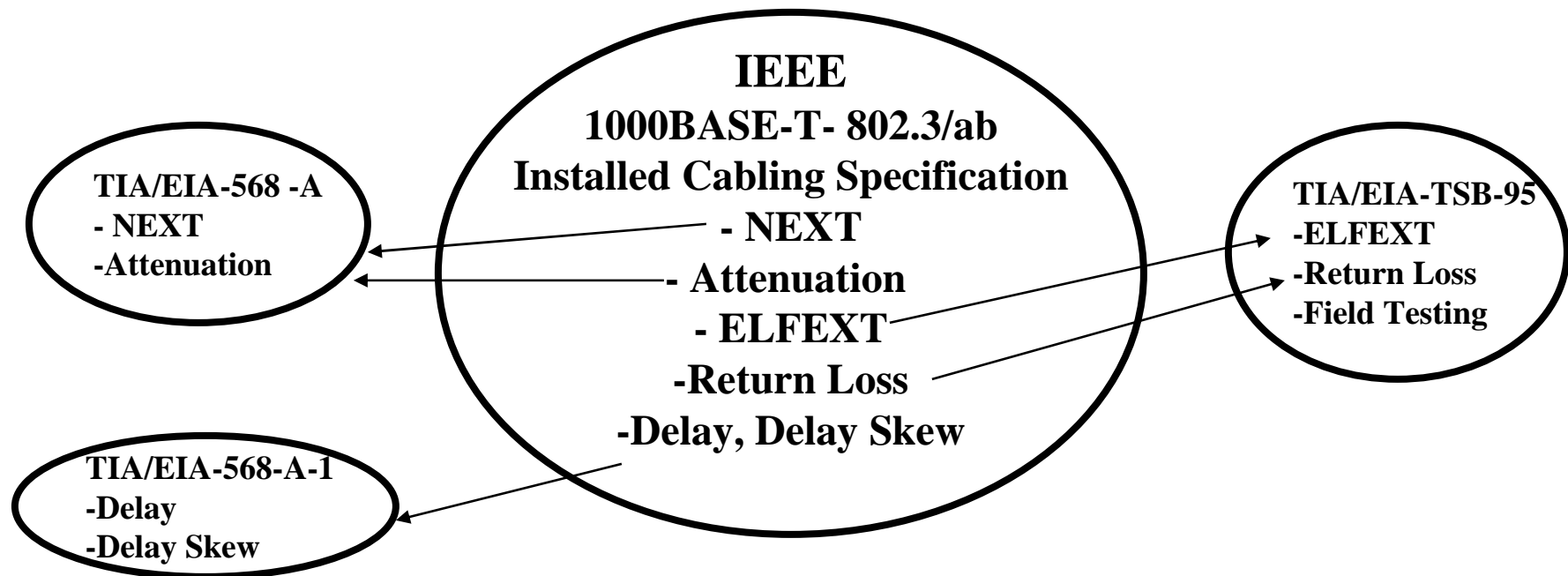
Margin without FEXT: 10.5dB (relative external noise margin residual noise)

Margin with Worst- Case FEXT: 7.0dB (relative external noise margin residual no

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1000BASE-T Link Specifications - Minimum Requirements

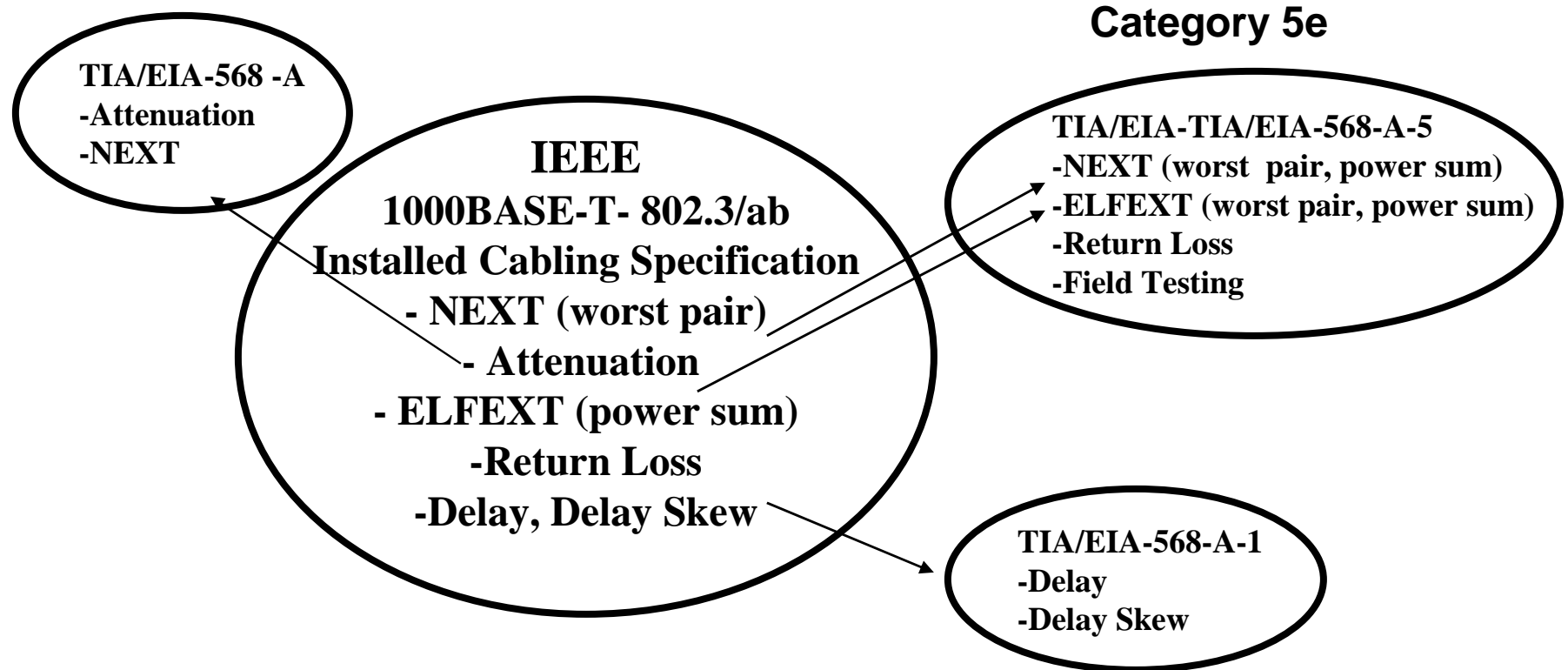
Cabling Installed to TIA/EIA-568-A with additional parameters as specified in Addendum and proposed TIA/EIA-Technical System Bulletin



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1000BASE-T Link Specifications

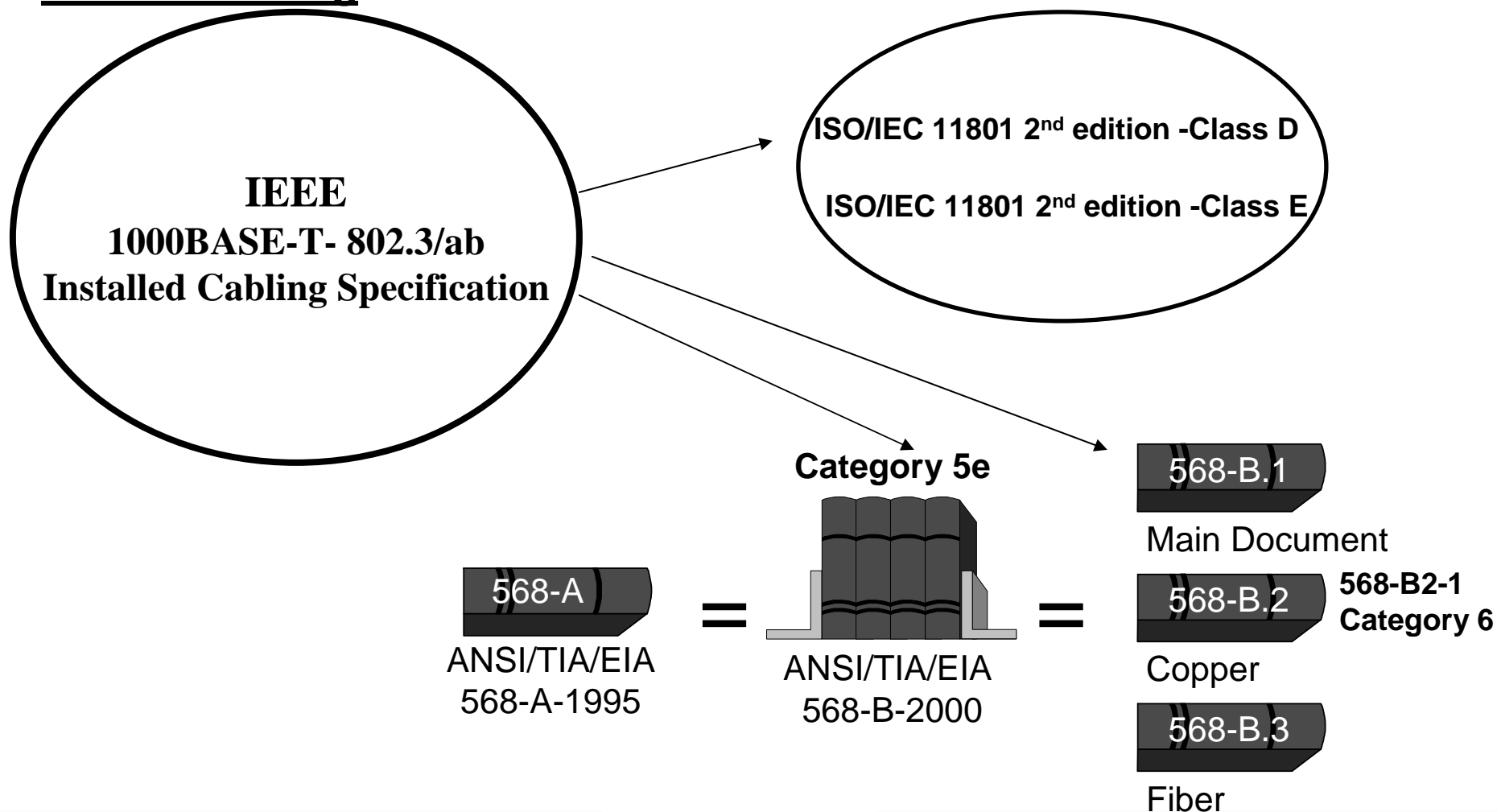
When Installing 1000BASE-T Links



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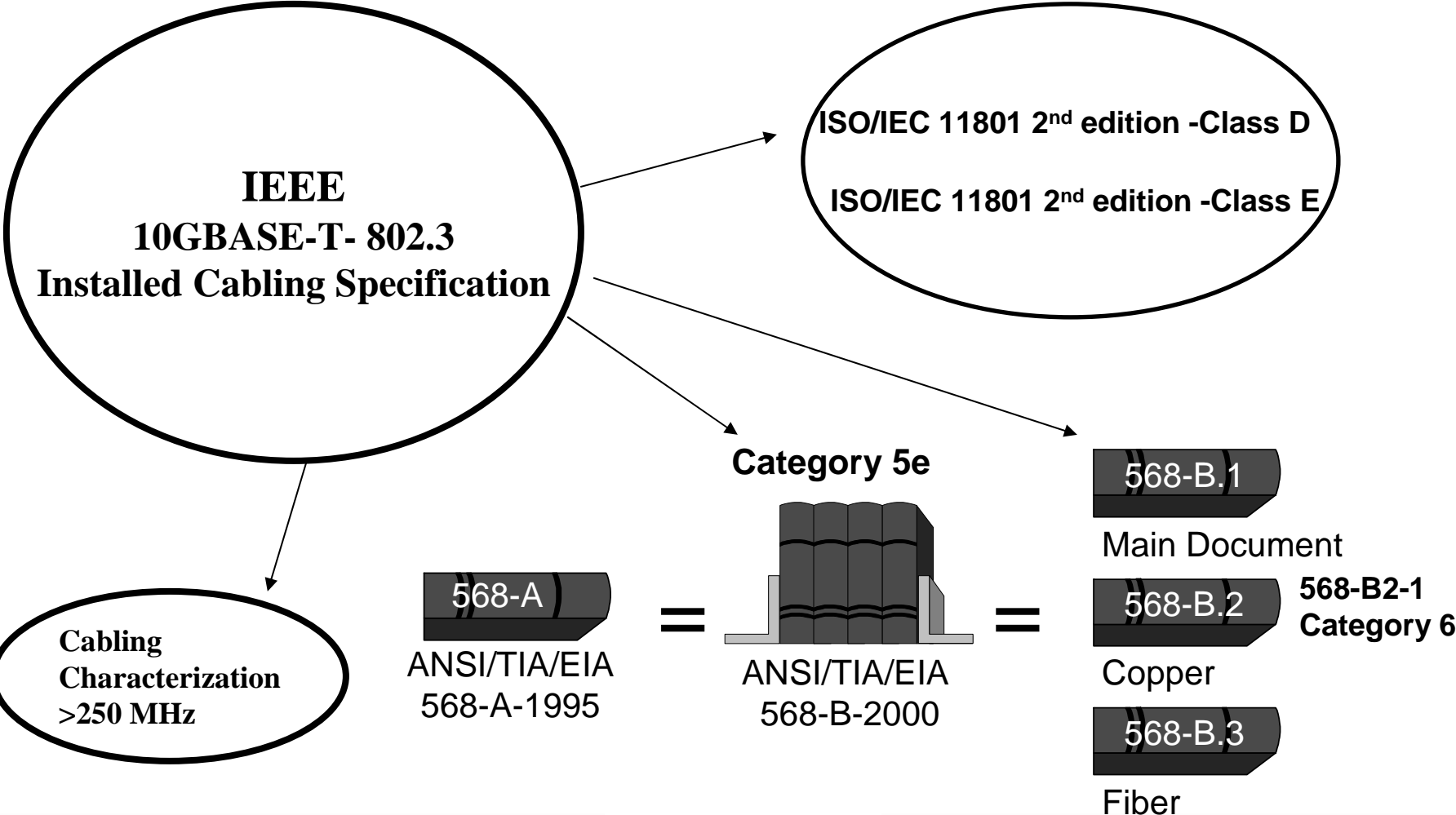
1000BASE-T Link Specifications

When Installing 1000BASE-T Links



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10GBASE-T Link Specifications



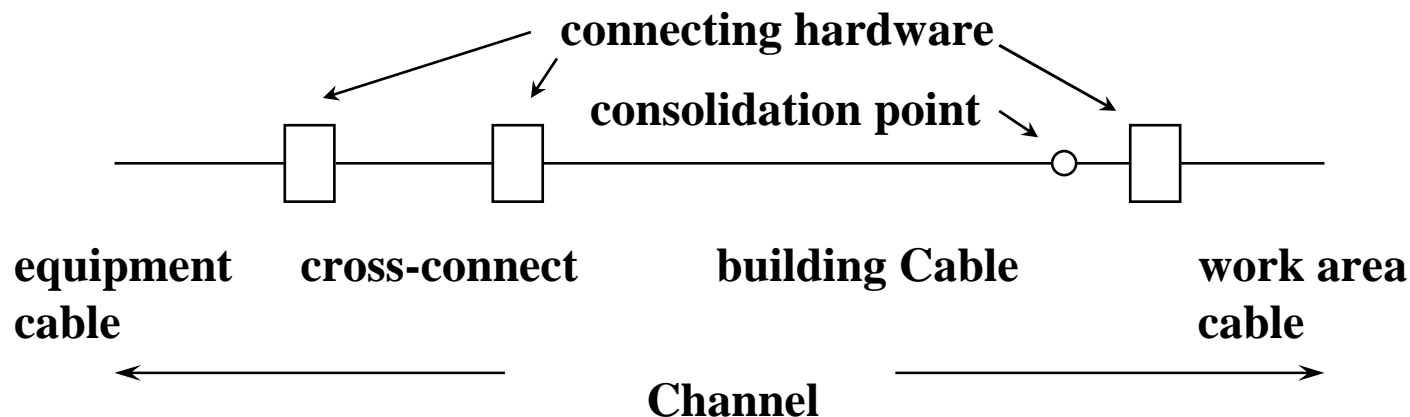
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Cabling - Specifications

*Category 5e Channel Transmission Performance

Frequency MHz	Ins. Loss Max (dB)	NEXT Min (dB)	ACR Min (dB)	PSNEXT Min (dB)	PSACR Min (dB)	ELFEXT Min (dB)	PSELFEXT Min (dB)	Return Loss Min (dB)	Prop. Delay Max (ns/100m)	Delay Skew Max (ns/100m)
1	2.2	>60	>57.8	>57	>54.8	57.4	54.4	17	580	50
4	4.5	53.5	49	50.5	46	45.4	42.4	17	562	50
8	6.3	48.6	42.3	45.6	39.3	39.3	36.3	17	557	50
10	7.1	47	39.9	44	36.9	37.4	34.4	17	555	50
16	9.1	43.6	34.5	40.6	31.5	33.3	30.3	17	553	50
20	10.2	42	31.8	39	28.8	31.4	28.4	17	552	50
25	11.4	40.3	28.9	37.3	25.9	29.4	26.4	16	551	50
31.25	12.9	38.7	25.8	35.7	22.8	27.5	24.5	15.1	550	50
62.5	18.6	33.6	15	30.6	12	21.5	18.5	12.1	549	50
100	24	30.1	6.1	27.1	3.1	17.4	14.4	10	548	50

(*ISO/IEC 11801 2nd edition -Class D)



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Cabling - Specifications

*Category 6 Channel Transmission Performance

Frequency MHz	Ins. Loss Max (dB)	NEXT Min (dB)	ACR Min (dB)	PSNEXT Min (dB)	PSACR Min (dB)	ELFEXT Min (dB)	PSELFEXT Min (dB)	Return Loss Min (dB)	Prop. Delay Max (ns/100m)	Delay Skew Max (ns/100m)
1	2.1	>65	>62.9	>62	>59.9	63.3	60.3	19	580	50
4	4	63	59	60.5	56.5	51.2	48.2	19	562	50
8	5.7	58.2	52.5	55.6	49.9	45.2	42.2	19	557	50
10	6.3	56.6	50.3	54	47.7	43.3	40.3	19	555	50
16	8	53.2	45.2	50.6	42.6	39.2	36.2	18	553	50
20	9	51.6	42.6	49	40	37.2	34.2	17.5	552	50
25	10.1	50	39.9	47.3	37.2	35.3	32.3	17	551	50
31.25	11.4	48.4	37	45.7	34.3	33.4	30.4	16.5	550	50
62.5	16.5	43.4	26.9	40.6	24.1	27.3	24.3	14	549	50
100	21.3	39.9	18.6	37.1	15.8	23.3	20.3	12	548	50
200	31.5	34.8	3.3	31.9	0.4	17.2	14.2	9	547	50
250	35.9	33.1	-2.8	30.2	-5.7	15.3	12.3	8	546	50

(*~ISO/IEC 11801 2nd edition -Class E)

Difference in Channel Transmission Performance (Cat 6 vs. Cat 5e)

Frequency MHz	Ins. Loss Max (dB)	NEXT Min (dB)	ACR Min (dB)	PSNEXT Min (dB)	PSACR Min (dB)	ELFEXT Min (dB)	PSELFEXT Min (dB)	Return Loss Min (dB)	Prop. Delay Max (ns/100m)	Delay Skew Max (ns/100m)
1	-0.1	>5	>5	>5	>5	5.9	5.9	2	0	0
4	-0.5	9.5	10	10	10.5	5.8	5.8	2	0	0
8	-0.6	9.6	10.2	10	10.6	5.9	5.9	2	0	0
10	-0.8	9.6	10.4	10	10.8	5.9	5.9	2	0	0
16	-1.1	9.6	10.7	10	11.1	5.9	5.9	1	0	0
20	-1.2	9.6	10.8	10	11.2	5.8	5.8	0.5	0	0
25	-1.3	9.7	11	10	11.3	5.9	5.9	1	0	0
31.25	-1.5	9.7	11.2	10	11.5	5.9	5.9	1.4	0	0
62.5	-2.1	9.8	11.9	10	12.1	5.8	5.8	1.9	0	0
100	-2.7	9.8	12.5	10	12.7	5.9	5.9	2	0	0

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