
1000BASE-Tx

Link Segments Baseline

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Purpose

- **Review 100BASE-Tx Link Segment baseline consensus (UTP)**
 - **Action plan to complete**
- **Propose a baseline for the 1000BASE-Tx optional link segment (ScTP/Shielded)**
 - **Action plan to complete**

802.3bp Link Segment Objectives

- Define the performance characteristics of an automotive link segment and a PHY to support point-to-point operation over this link segment with less than three twisted pairs supporting up to four inline connectors using balanced copper cabling for at least 15m for the automotive link segment.

- Define the performance characteristics of optional link segment(s) for the above PHY for industrial controls and/or automation, transportation (aircraft, railway, bus and heavy trucks) applications with a goal of at least 40m reach

• *APPROVED 802.3 WG (November 15, 2012)*

Affirmation of 1-pair

Motion

Move that:

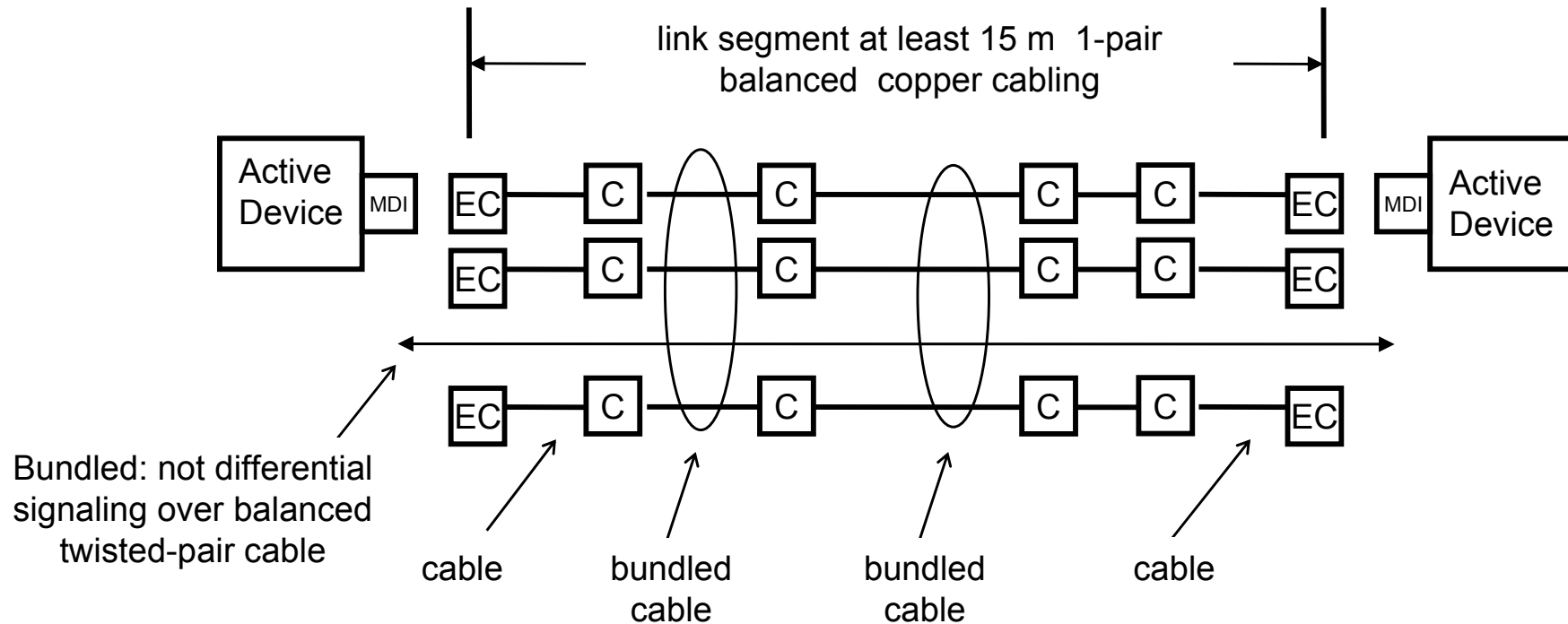
The IEEE P802.3bp Task Force affirms a 1-pair PHY Solution at 15m.

- M: Matheus, K.
- S: Diab, W.

• Y: 32 N: 0 A: 7

Source: http://www.ieee802.org/3/bp/public/may13/tezebay_3bp_02_0513.pdf

1000BASE-Tx Link Segment



The IEEE 802.3 nomenclature is bracketed to identify relationship to the IEEE 802.3 definitions.

Length objective [EC] to [EC] at least 15 m
 Number of inline connectors [C] = 4

- C = inline connector
- EC = connection to equipment
- MDI = Active electronics connector [Medium dependent interface (MDI)]

Link segment transmission parameters (UTP)

Link segment transmission and coupling parameters (UTP)

- Insertion loss

- Return loss

- Alien Crosstalk

- PSANEXT, PSAACRF

- Common to differential conversion loss (SDC12/SDC21)

- Insertion loss

- Amended Motion #2 - Move that The IEEE P802.3bp Task Force affirms the proposed

- Baseline IL Channel Performance for link segment insertion to establish the absolute

- value across the frequency range through 600MHz. (herman_3bp_01_0913.pdf)

- Technical 75%

- Vote

- Y: 25 N: 0 A: 4

- MOTION: Passes

$$IL = .4927\sqrt{f} + 0.0023f + (0.0639 / \sqrt{f}) + 0.08\sqrt{f} + 0.018\sqrt{f}$$

where

f := frequency_in_MHz

Link segment transmission parameters (UTP)

• Alien Crosstalk -PSANEXT, PSAACRF

Motion #8 - Move that The IEEE P802.3bp Task Force affirms the proposed Baseline PSANEXT (in slide 11 in herman_3bp_01_0913.pdf) and PSAACRF (in slide 13 in herman_3bp_01_0913.pdf) for link segment specification over frequency range 1MHz - 600MHz. (alien crosstalk configuration in

http://www.ieee802.org/3/bp/public/jul13/moffitt_3bp_01_0713.pdf)

M: Todd Herman S: Xiaofeng Wang

Technical 75%

Vote

Y: 18 N: 1 A: 10

MOTION: Passes

PSANEXT

from 1 to 100 MHz

$$\text{PSANEXT} := 60 - 10 \cdot \log\left(\frac{f}{100}\right)$$

from 100 to 500 MHz

$$\text{PSANEXT} := 60 - 15 \cdot \log\left(\frac{f}{100}\right) - 6 \cdot \left[\frac{(f - 100)}{400}\right]$$

PSAACRF

$$\text{PSAACRF} := -20 \cdot \log\left(10 \left(\frac{-10 \cdot \log\left(\frac{15}{100}\right) + 38.2 - 20 \cdot \log\left(\frac{f}{100}\right)}{-20} + 4 \cdot 10 \frac{67 - 20 \cdot \log\left(\frac{f}{100}\right)}{-20} \right)\right)$$

where

f:= frequency_in_MHz

Link segment transmission parameters (UTP)

- No consensus on return loss and mode conversion
 - Return Loss

equations for return loss of 1-pair ethernet channel

- 19 dB from 1 to 10 MHz
- $24 - 5 \cdot \log(f)$ from 10 to 40 MHz
- 16 dB from 40 to 130 MHz
- $37 - 10 \cdot \log(f)$ from 130 to 400 MHz
- 11 dB from 400 to 500 MHz

•Mode conversion¹

$$- 50_{\text{dB}} \quad 10 < f_{\text{MHz}} < 80$$

$$[5 \log_n (f_{\text{MHz}}) - 72]_{\text{dB}} \quad 80 < f_{\text{MHz}} < 600$$

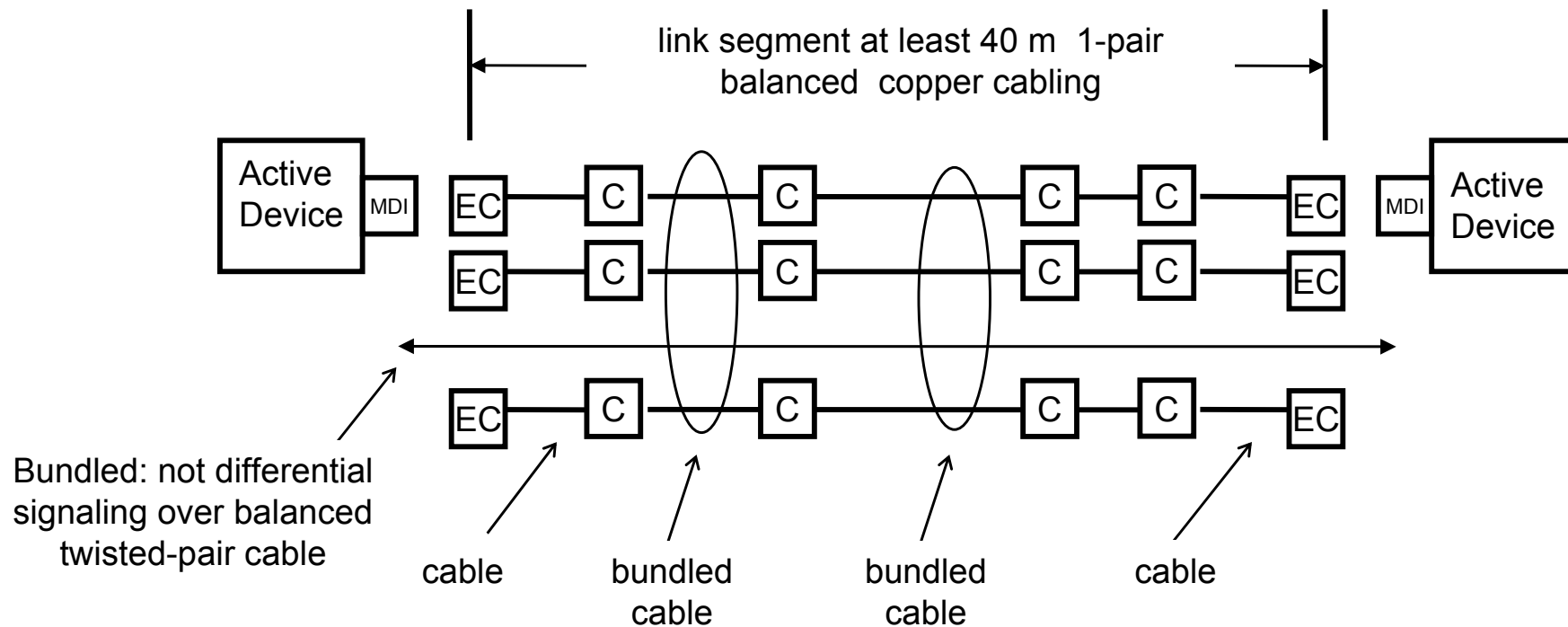
Link Segment (optional)

Straw Poll #1 – Support optional link segment consisting of shielded/screened components

Y: 18 N: 2




Source: Unconfirmed meeting minutes – 802.3bp September 3-5, 2013 York, UK
http://www.ieee802.org/3/bp/public/sep13/minutes_u_3bp_0913.pdf

1000BASE-Tx Link Segment (optional)



The IEEE 802.3 nomenclature is bracketed to identify relationship to the IEEE 802.3 definitions.

Length objective [EC] to [EC] at least 40 m
Number of inline connectors [C] = 4

-  = inline connector
-  = connection to equipment
-  = Active electronics connector [Medium dependent interface (MDI)]

Link segment transmission parameters (ScTP/Shielded)

Link segment transmission and coupling parameters (ScTP/Shielded)

- Insertion loss - 22 AWG stranded copper at 125 degrees C (0.2% deg C)
- Return loss (UTP proposal)
- Alien Crosstalk
 - PSANEXT (Category 8), PSAACRF (Category 8)
- Coupling attenuation - ANSI/TIA-1005-A-2012 Telecommunications Infrastructure Standard for Industrial Premises. Electromagnetic environmental classifications specified in ANSI/TIA-568-C.0.
- Insertion loss

$$InsertionLoss(f) \leq \underbrace{0.9409\sqrt{f} + 0.0053 \cdot f + \frac{0.1452}{\sqrt{f}}}_{25.89 \text{ dB @500 MHz}} + \underbrace{0.08\sqrt{f}}_{40 \text{ meters cable}} + \underbrace{0.018\sqrt{f}}_{\substack{\text{four} \\ \text{connectors}}} + \underbrace{0.018\sqrt{f}}_{ILD}$$

Link segment transmission parameters (ScTP/Shielded)

- Alien Crosstalk

- PSANEXT

Calculations that result in PSANEXT loss values greater than 75 dB (TBD) shall revert to a requirement of 75 dB minimum (TBD).

Frequency (MHz)	PSANEXT (dB)
$1 \leq f < 100$	$\geq 85 - 10\log(f/100)$
$10 \leq f \leq 600$	$\geq 85 - 15\log(f/100)$

- PSAACRF

Calculations that result in PSAACRF loss values greater than 75 dB (TBD) shall revert to a requirement of 75 dB minimum (TBD). PSAACRF values are for information only when PSAFEXT loss is greater than either $72 - 15\log(f/100)$ dB or 67 dB (TBD).

Frequency (MHz)	PSAACRF (dB)
$1 \leq f \leq 600$	$\geq 61 - 20\log(f/100)$

Link segment transmission parameters (ScTP/Shielded)

- Alien Crosstalk

- PSANEXT

Calculations that result in PSANEXT loss values greater than 75 dB (TBD) shall revert to a requirement of 75 dB minimum (TBD).

Frequency (MHz)	PSANEXT (dB)
$1 \leq f < 100$	$\geq 85 - 10\log(f/100)$
$10 \leq f \leq 600$	$\geq 85 - 15\log(f/100)$

- PSAACRF

Calculations that result in PSAACRF loss values greater than 75 dB (TBD) shall revert to a requirement of 75 dB minimum (TBD). PSAACRF values are for information only when PSAFEXT loss is greater than either $72 - 15\log(f/100)$ dB or 67 dB (TBD).

Frequency (MHz)	PSAACRF (dB)
$1 \leq f \leq 600$	$\geq 61 - 20\log(f/100)$

Link segment transmission parameters (ScTP/Shielded)

- **Coupling attenuation** - Consistent with Category 6A specified in ANSI/TIA-1005-A-2012 Telecommunications Infrastructure Standard for Industrial Premises. The coupling attenuation requirements (E1, E2, E3) depend on the electromagnetic environmental classifications specified in ANSI/TIA-568-C.0.

• Coupling attenuation

Frequency (MHz)	Minimum (dB)		
	E1	E2	E3
$30 \leq f \leq 600$	80-20Log(f) (Max 60 dB)	90-20Log(f) (Max 60 dB)	100-20Log(f) (Max 60 dB)

• Environmental classification

Electromagnetic	E ₁	E ₂	E ₃
Radiated RF - AM	3 V/m at (80 to 1 000 MHz) 3 V/m at (1 400 to 2 000 MHz) 1 V/m at (2 000 to 2 700 MHz)	3 V/m at (80 to 1 000 MHz) 3 V/m at (1 400 to 2 000 MHz) 1 V/m at (2 000 to 2 700 MHz)	10 V/m at (80 to 1 000 MHz) 3 V/m at (1 400 to 2 000 MHz) 1 V/m at (2 000 to 2 700 MHz)
Conducted RF	3 V at 150 kHz to 80 MHz	3 V at 150 kHz to 80 MHz	3 V at 150 kHz to 80 MHz