Reduced Twisted Pair Gigabit Ethernet SG Link segments

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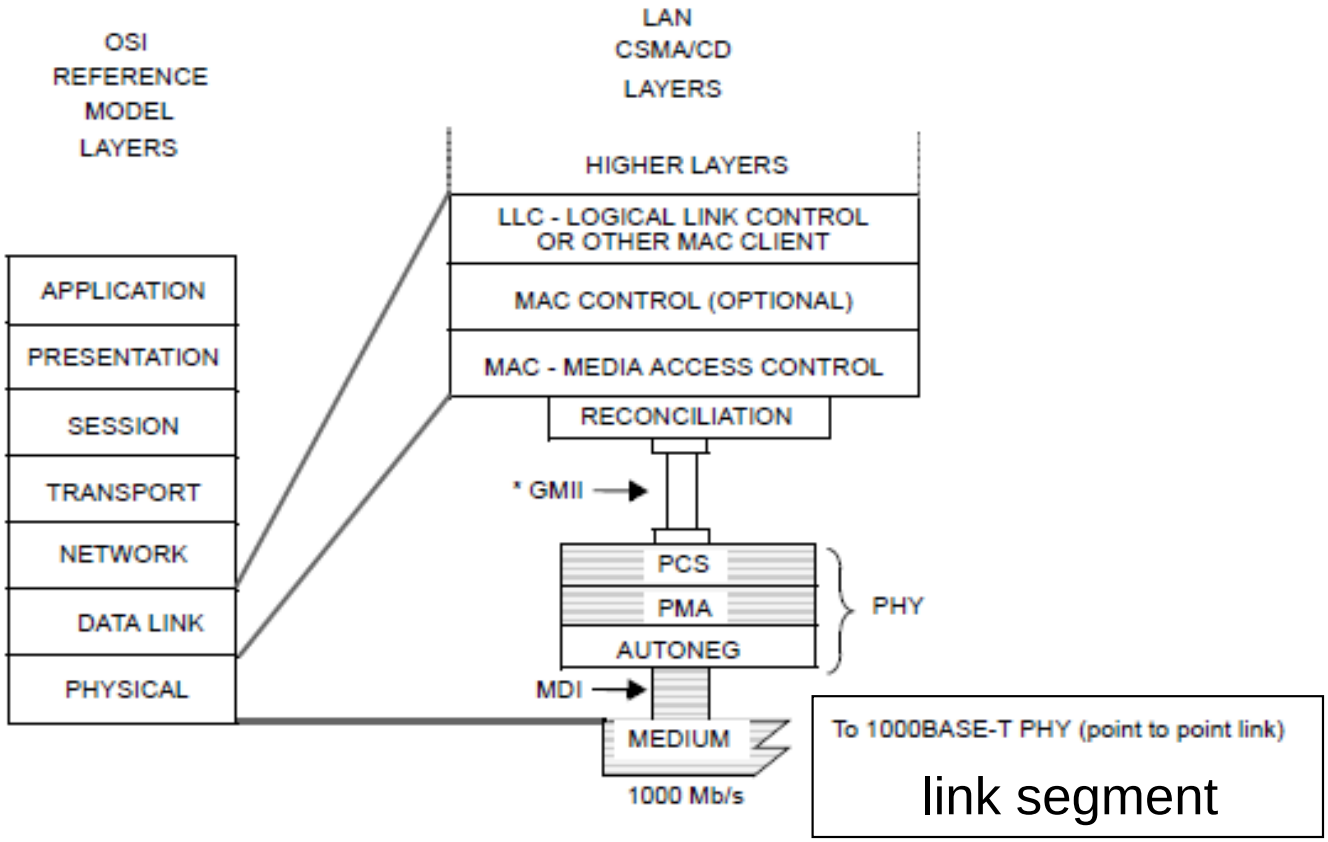
Chris DiMinico
MC Communications/
LEONI Cables & Systems LLC
cdiminico@ieee.org

Purpose

- **Link segment characteristics enables considerations for PHY (e.g., signaling, number of differential pairs, etc).**

- **Technical feasibility**

Gigabit Ethernet link segment



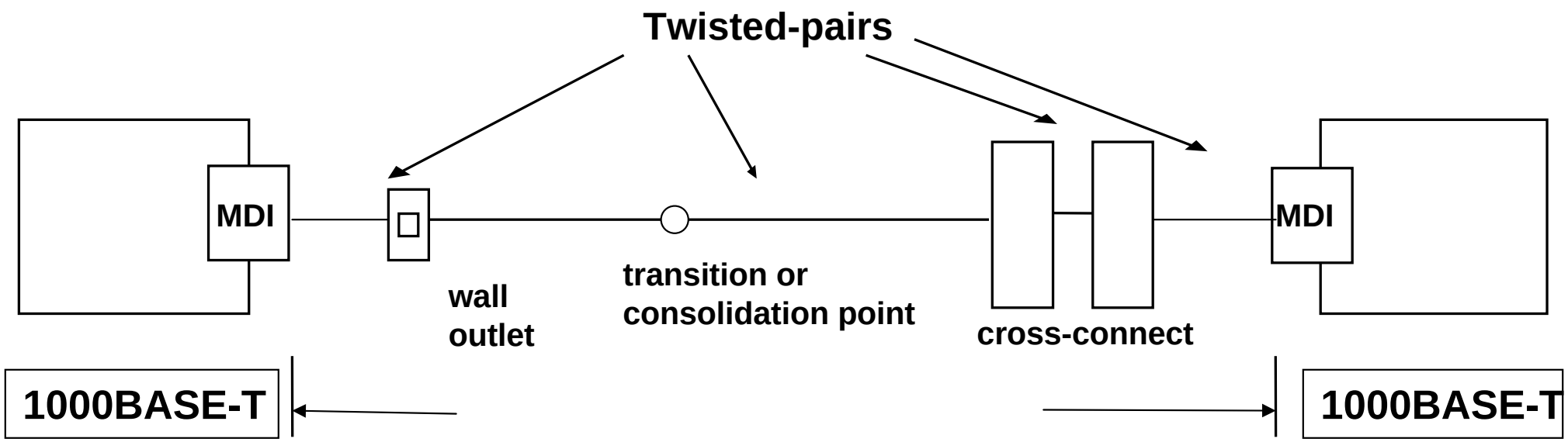
MDI = MEDIUM DEPENDENT INTERFACE
GMII = GIGABIT MEDIA INDEPENDENT INTERFACE

PCS = PHYSICAL CODING SUBLAYER
PMA = PHYSICAL MEDIUM ATTACHMENT
PHY = PHYSICAL LAYER DEVICE

*GMII is optional.

Figure 40–1—Type 1000BASE-T PHY relationship to the ISO Open Systems Interconnection (OSI) Reference Model and the IEEE 802.3 CSMA/CD LAN Model

Twisted Pair Link Segment



Structured cabling ISO/IEC, TR42

1000BASE-T Link transmission and coupling parameters

- **Insertion loss, Return loss**
- **NEXT, FEXT, Multiple Disturber Crosstalk**

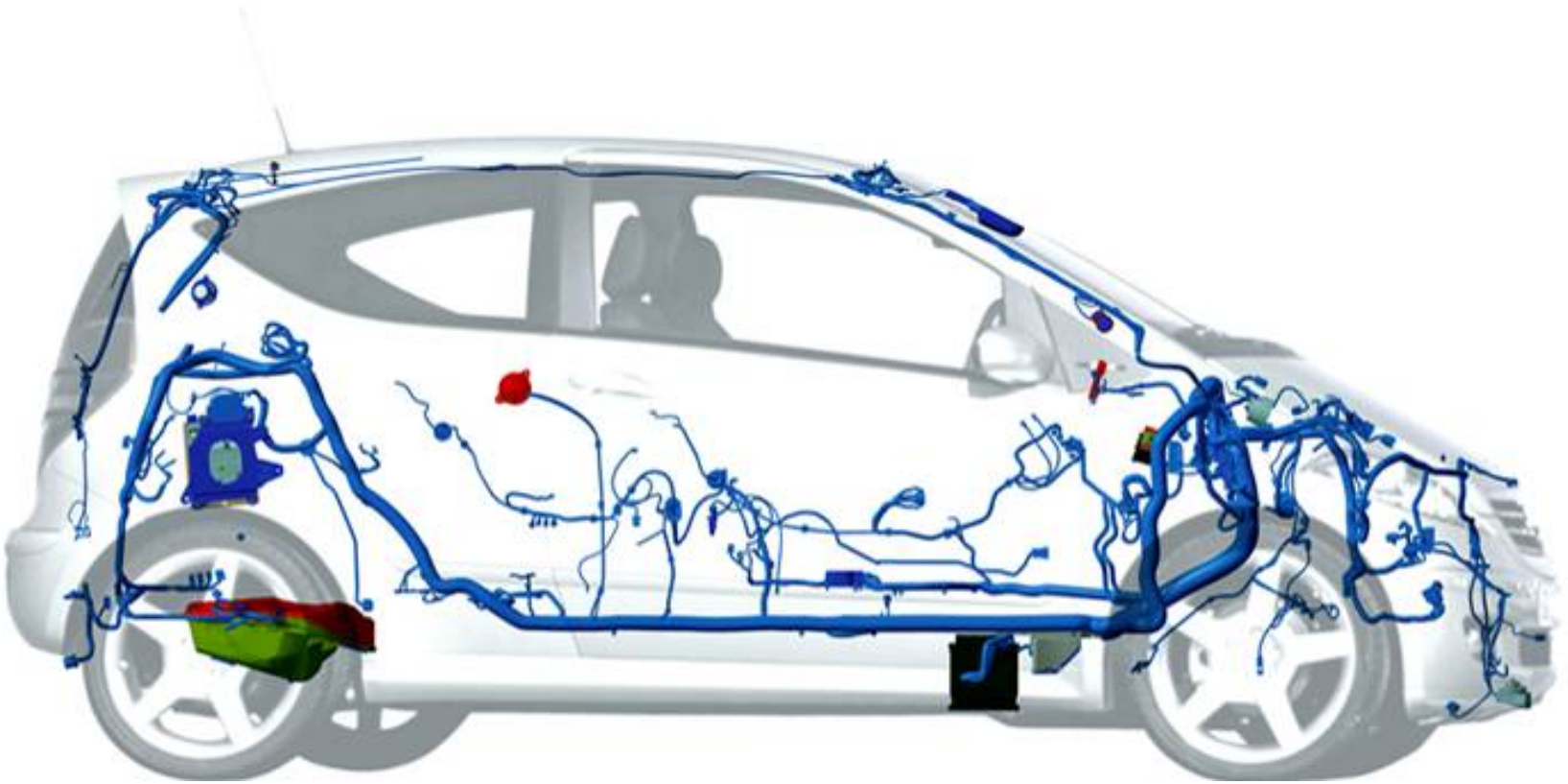
Automotive wiring system

Automotive wiring system example

- **Length of cable: more than 3 km**
- **Number of single cables : up to 1,500**
- **Number of contacts: up to 3,000**
- **Weight: up to 50 kg**

Automotive versus LAN cabling

- **Topology (identification of link segment)**
- **Temperature ratings (engine compartments)**
- **Jacketing and insulation materials (resistant to oil, gasoline, hydraulic fluids etc.)**
- **Mechanical properties**



RTP Objectives under discussion

a) Preserve the IEEE 802.3/Ethernet frame format at the MAC client service interface.

b) Preserve minimum and maximum frame size of the current IEEE 802.3 standard.

c) Support full duplex operation only.

d) Support a speed of 1000 Mb/s at the MAC/PLS service interface.

e) Support point-to-point operation over a N-connector link segment using copper cabling with less than four twisted-pairs.

f) Support a BER of less than or equal to 10e-10.

- The objectives (a) and (b) were accepted by the Study Group during May-2012 IEEE 802.3 interim meeting
- The objectives (c) to (f) were reviewed by RTPGE participants on 6/25/2012 Telco and will be presented to the RTPGE Study Group in July-2012 IEEE 802.3 plenary meeting.

RTP PHY link segments

- Topology
- Transmission and coupling parameters
- Environmental

- Topology
  - Length (up to at least 15 meters)
  - Number of connectors (three)

- Transmission and coupling parameters
  - Insertion loss
  - Link segment noise
    - o Noise within link segment –
      - ✓ return loss
      - ✓ mode conversion (balance)
      - ✓ For link segments > 1 pair - NEXT, FEXT and multiple disturber
    - o Noise coupling between link segments
      - ✓ Alien crosstalk - ANEXT, AFEXT and multiple disturber ANEXT and AFEXT
    - o Mode conversion (balance)

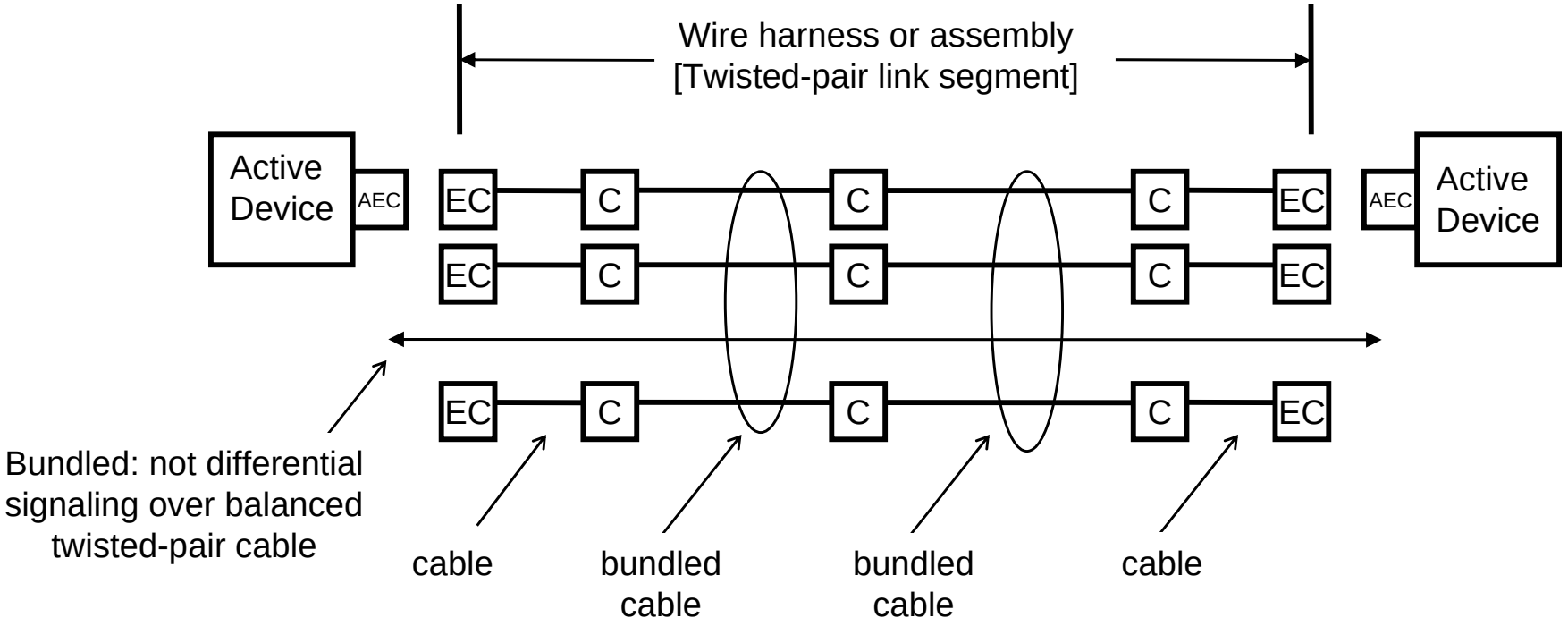
RTP PHY link segments

- RTP PHY electromagnetic environment
  - Susceptibility levels
    - o Sources of interference from the environment (TBD)…
      - ✓ External noise - noise from signaling or power in adjacent wire pairs from non-RTP-PHYs
  - Emission levels
    - oThe twisted-pair link segment shall comply with applicable local and national codes for the limitation of electromagnetic.

- RTP PHY operating environmental
  - Specific requirements for temperature, humidity and values for these parameters are considered to be beyond the scope of the RTP PHY specification. (informative annex?)
  - Specific requirements for physical stress (such as shock and vibration) and values for these parameters are considered to be beyond the scope of the RTP PHY specification. (informative annex?)

- RTP PHY MDI specifications
  - MDI electrical specifications (TBD)
  - Mechanical interface (non-objective)

Automotive cabling topology



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

Length objective [EC] to [EC].
Number of inline connectors [C]

C = inline connector

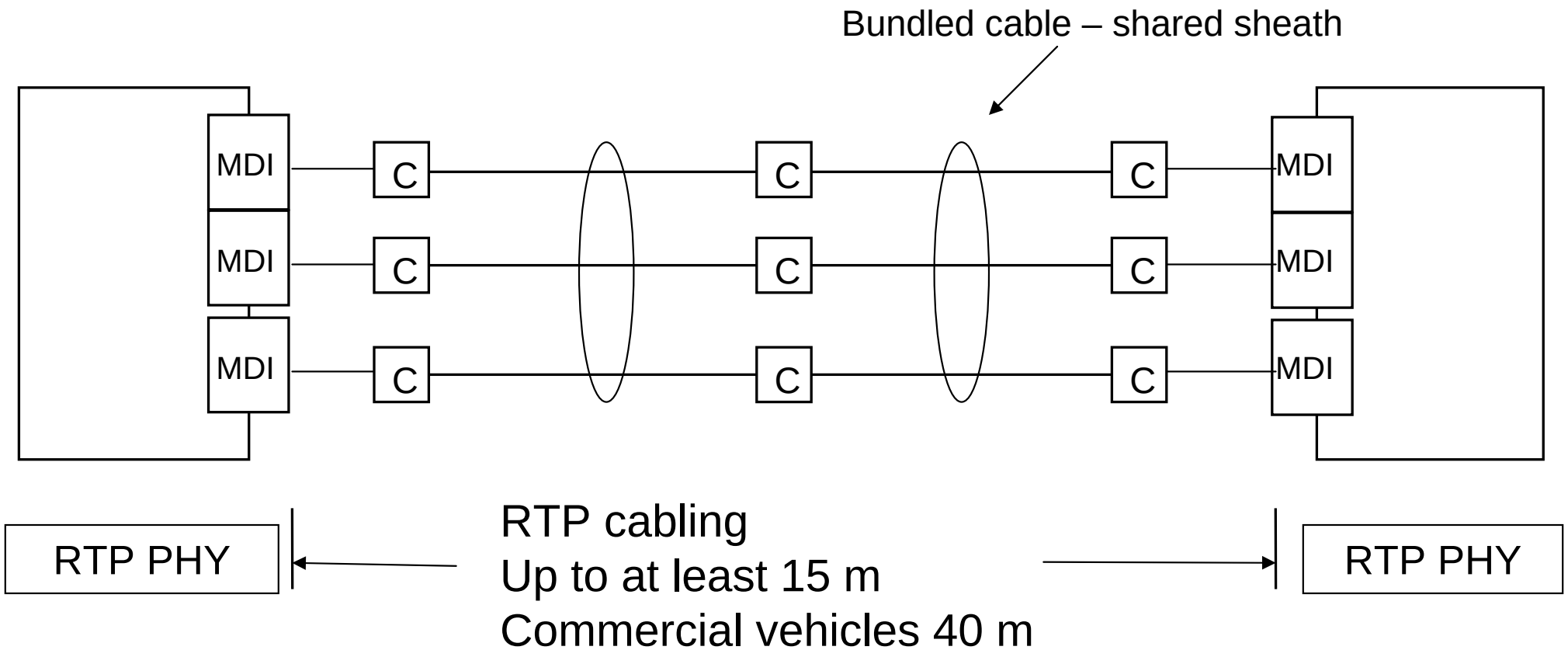
EC = connection to equipment

AEC = Active electronics connector [Medium dependent interface (MDI)]

Cabling parameters

Transmission parameters	Coupling parameters (within Link segments)	Coupling parameters (between Link segments)	Balance parameters
Insertion Loss	Near-End crosstalk (NEXT) loss	Alien Near-End crosstalk loss (ANEXT)	Transverse conversion loss (TCL) – SCD11
Differential characteristic impedance	Multiple disturber near-end crosstalk (MDNEXT) loss	Multiple Disturber Alien Far-End crosstalk loss (MDANEXT)	Longitudinal conversion loss (LCL) –SDC11
Return Loss	Far-End crosstalk (FEXT) loss Specified as equal level FEXT (ELFEXT)	Alien Near-End crosstalk loss (AFEXT)	Transverse conversion transmission loss (TCTL) – SCD12
Propagation Delay	Multiple disturber Far-end crosstalk (MDFEXT) loss Specified as MDELFEXT (ELFEXT)	Multiple Disturber Alien Far-End crosstalk loss (MDAFEXT) Specified as power sum (PSAELFEXT)	Longitudinal conversion transmission loss (LCTL) – SDC12
Delay Skew		Specified as power sum (PSAELFEXT)	

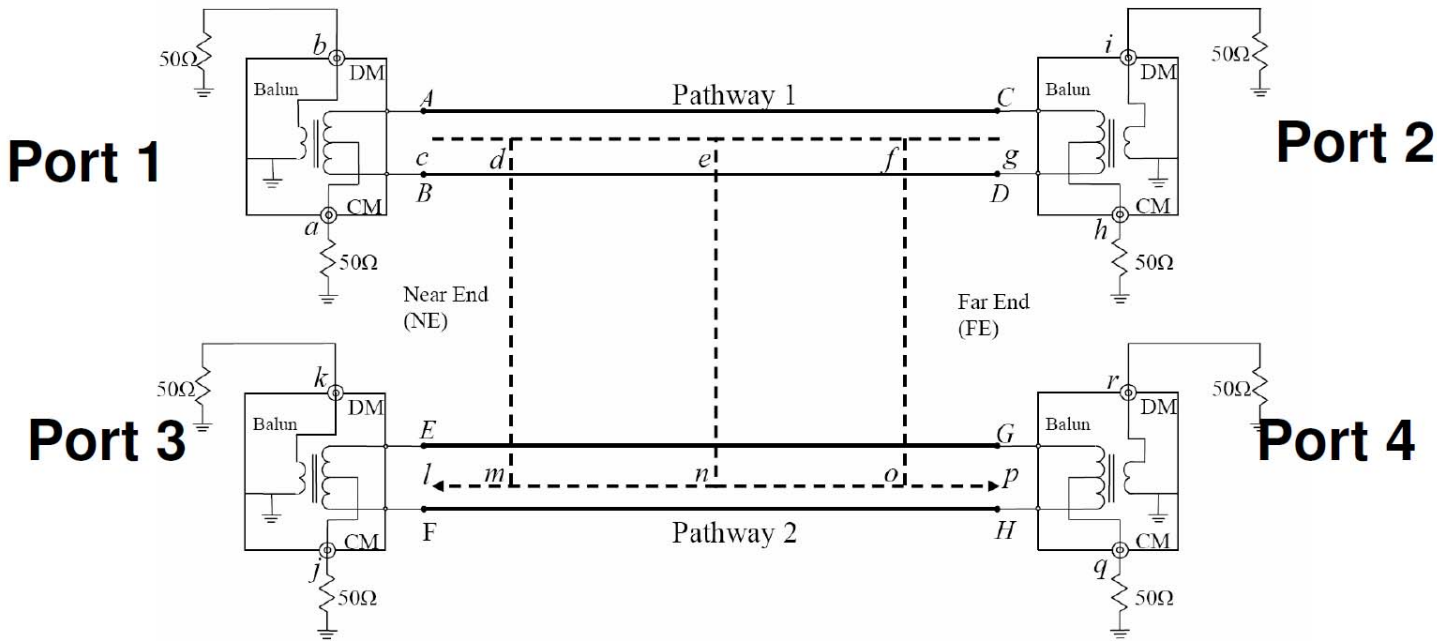
RTP Link Segment



RTP Link transmission and coupling parameters

- Insertion loss, return loss
- NEXT, FEXT, multiple disturber crosstalk
- Alien Crosstalk
- Balance parameters

Cabling parameters to s-parameters naming

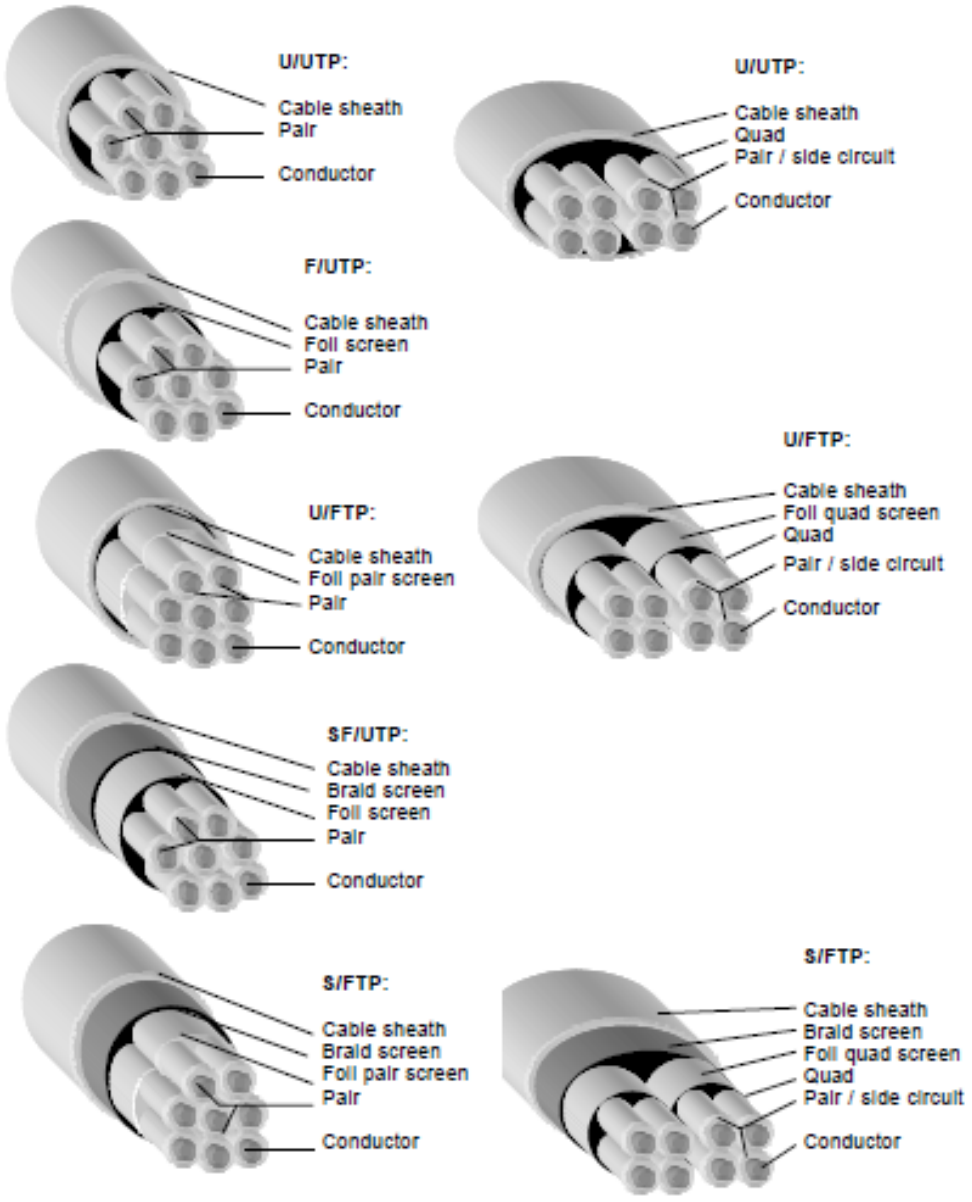


		Port 1		Port 2		Port 3		Port 4	
Port 1	cc	Scc11	RLcc11	Scc12	ILcc12	Scc13	NEXTcc13	Scc14	FEXTcc14
	cd	Scd11	TCLcd11	Scd12	TCTLcd12	Scd13	NEXTcd13	Scd14	FEXTcd14
	dc	Sdc11	LCLdc11	Sdc12	LCTLdc12	Sdc13	NEXTdc13	Sdc14	FEXTdc14
	dd	Sdd11	RLdd11	Sdd12	ILdd12	Sdd13	NEXTdd13	Sdd14	FEXTdd14
Port 2	cc	Scc21	ILcc21	Scc22	RLcc22	Scc23	FEXTcc23	Scc24	NEXTcc24
	cd	Scd21	TCTLcd21	Scd22	TCLcd22	Scd23	FEXTcd23	Scd24	NEXTcd24
	dc	Sdc21	LCTLdc21	Sdc22	LCLdc22	Sdc23	FEXTdc23	Sdc24	NEXTdc24
	dd	Sdd21	ILdd21	Sdd22	RLdd22	Sdd23	FEXTdd23	Sdd24	NEXTdd24
Port 3	cc	Scc31	NEXTcc31	Scc32	NEXTcc32	Scc33	RLcc33	Scc34	ILcc34
	cd	Scd31	NEXTcd31	Scd32	NEXTcd32	Scd33	TCLcd33	Scd34	TCTLcd34
	dc	Sdc31	NEXTdc31	Sdc32	NEXTdc32	Sdc33	LCLdc33	Sdc34	LCTLdc34
	dd	Sdd31	NEXTdd31	Sdd32	NEXTdd32	Sdd33	RLdd33	Sdd34	ILdd34
Port 4	cc	Scc41	FEXTcc41	Scc42	FEXTcc42	Scc43	ILcc43	Scc44	RLcc44
	cd	Scd41	FEXTcd41	Scd42	FEXTcd42	Scd43	TCTLcd43	Scd44	TCLcd44
	dc	Sdc41	FEXTdc41	Sdc42	FEXTdc42	Sdc43	LCTLdc43	Sdc44	LCLdc44
	dd	Sdd41	FEXTdd41	Sdd42	FEXTdd42	Sdd43	ILdd43	Sdd44	RLdd44

Technical feasibility

• 1 Gb/s full duplex operation over 3-connector link segments up to at least 15 meters using twisted copper cabling with less than 4-pairs and meet the bit error rate objective of less than or equal to 10e-10.

Cabling Types



Summary

- **Discussion of link segment characteristics for "Reduced Twisted Pair Gigabit Ethernet"**