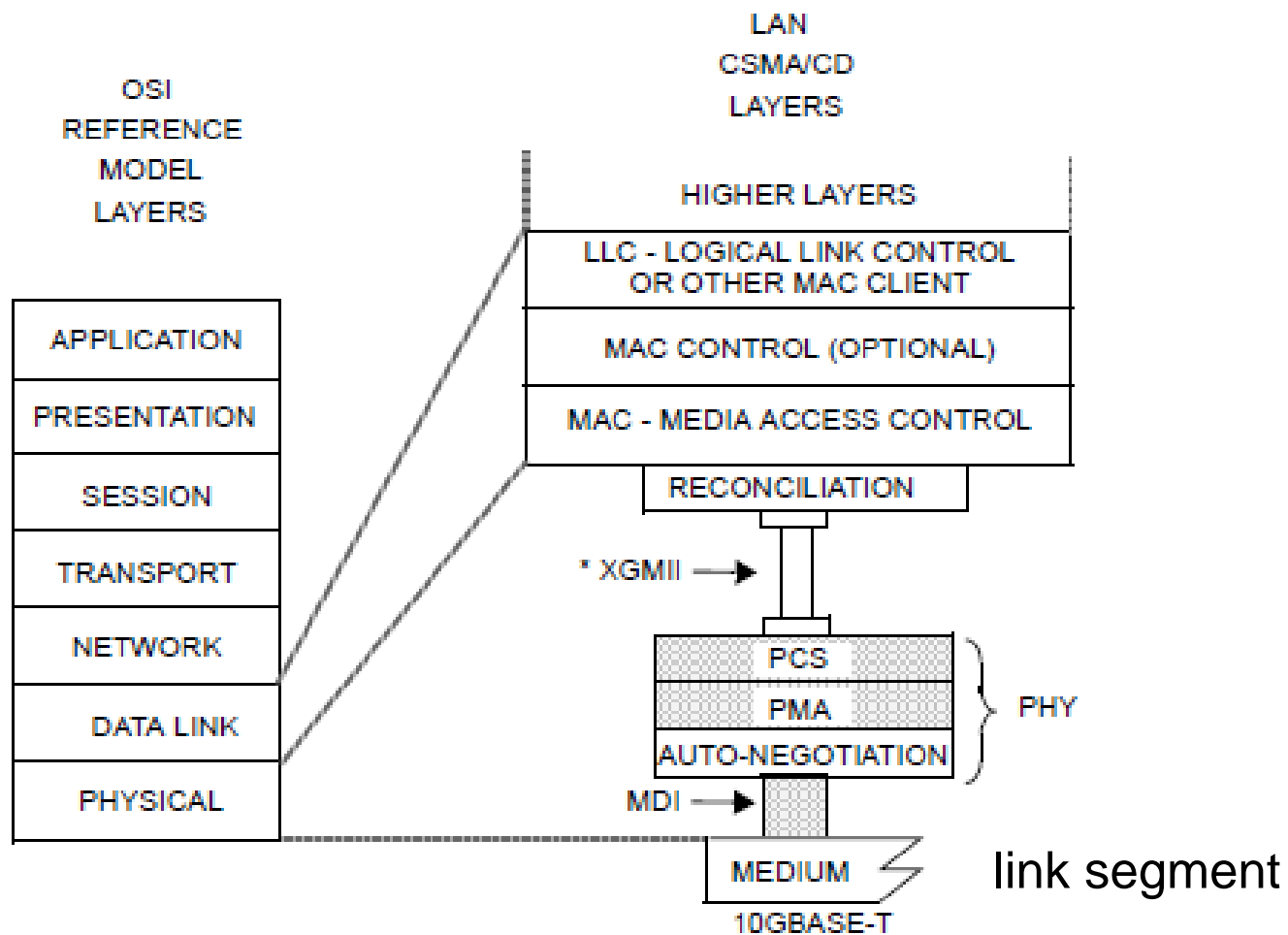# NGBASE-T Link Segments

Geneva, Switzerland
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Chris DiMinico
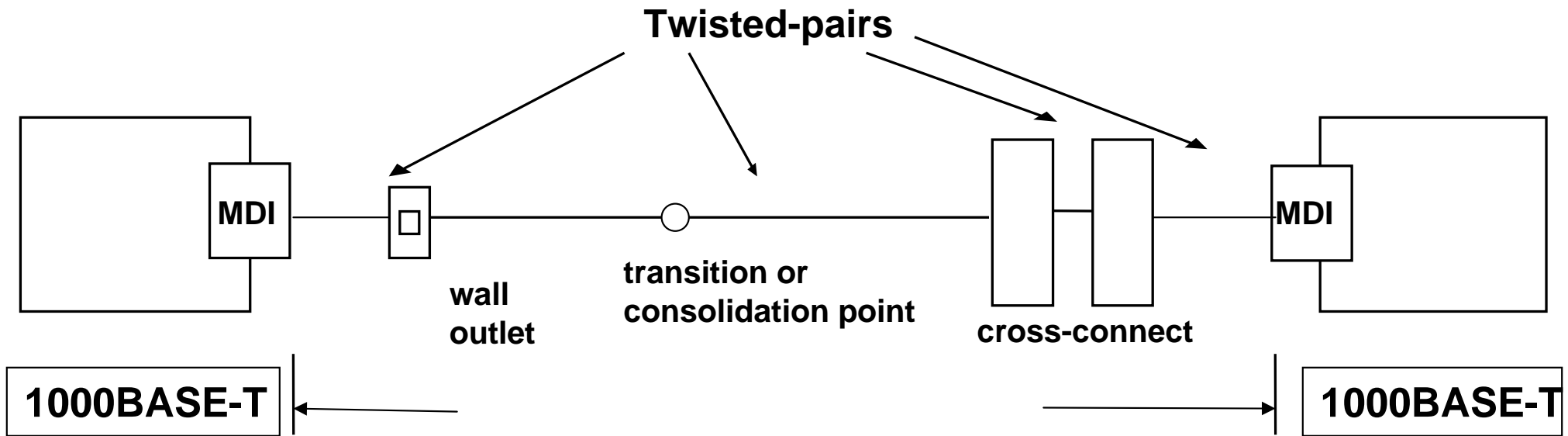**MC Communications**
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Purpose

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

- **MDI**

- **Environmental**

- **Technical feasibility**

10GBASE-T link segment

OSI
REFERENCE
MODEL
LAYERS

LAN
CSMA/CD
LAYERS

HIGHER LAYERS

LLC - LOGICAL LINK CONTROL
OR OTHER MAC CLIENT

MAC CONTROL (OPTIONAL)

MAC - MEDIA ACCESS CONTROL

RECONCILIATION

APPLICATION

PRESENTATION

SESSION

TRANSPORT

NETWORK

DATA LINK

PHYSICAL

* XGMII →

PCS

PMA

AUTO-NEGOTIATION

PHY

MDI →

MEDIUM

10GBASE-T

link segment

Twisted Pair Link Segment

Twisted-pairs

MDI		MDI

wall outlet

transition or consolidation point

cross-connect

1000BASE-T

1000BASE-T

Structured cabling ISO/IEC, TR42

1000BASE-T Link transmission and coupling parameters
- Insertion loss, Return loss
- NEXT, FEXT, Multiple Disturber Crosstalk

Link segments

- Topology
- Transmission and coupling parameters
- Environmental

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

- Transmission and coupling parameters
    - Insertion loss
    - Link segment noise
        - o Noise within link segment –
            - ✓ return loss
            - ✓ mode conversion (balance)
            - ✓ For link segments > 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)

Environmental and MDI

- 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-NGBASE-T PHYs
    - Emission levels
        - oThe twisted-pair link segment shall comply with applicable local and national codes for the limitation of electromagnetic.

- MDI specifications
    - MDI electrical specifications
    - Mechanical interface

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)	

Cabling parameters to s-parameters naming
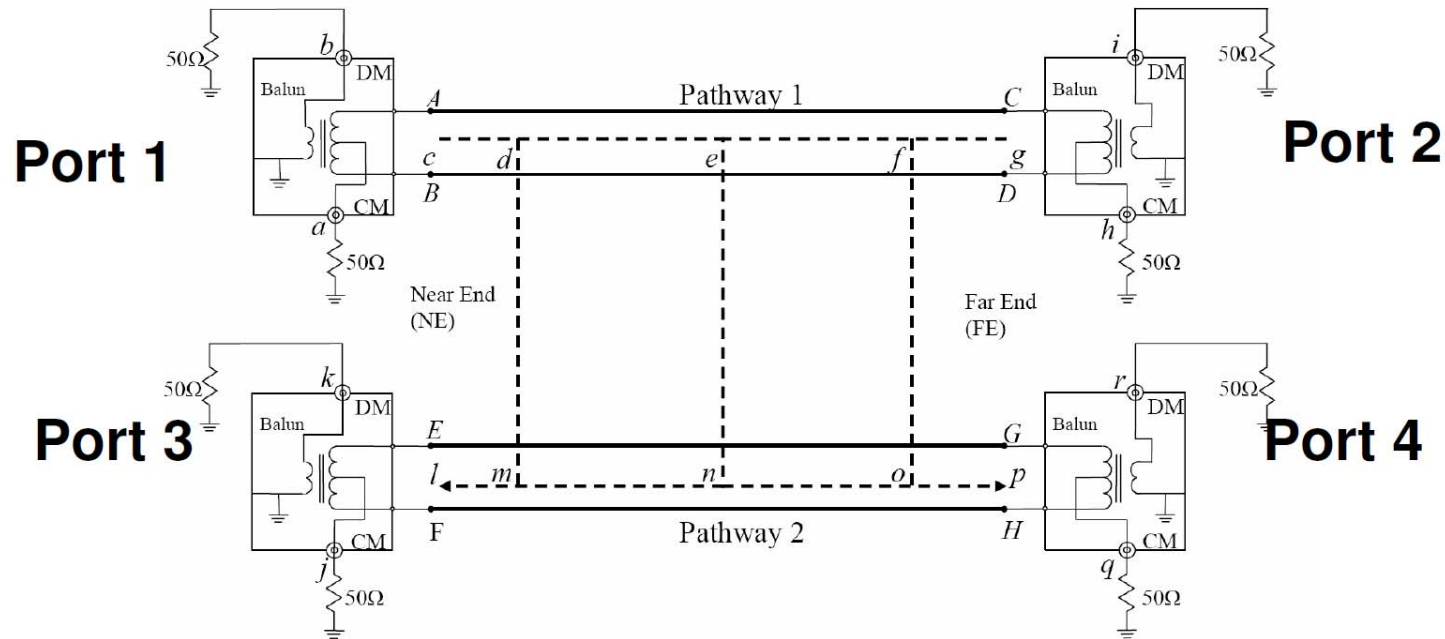
		Port 1		Port 2		Port 3		Port 4	
Port 1	cc	Scc11	RLcc11	Scc12	ILcc12	Scc13	NEXTcc13	Scc14	FEXTcc14
	cd	Scd11	TCLcd11	Scd12	TCTLcd12	Scd13	NEXTcd13	Scd14	FEXTcd14
	dc	Sdc11	LCLdc11	Sdc12	LCTLdc12	Sdc13	NEXTdc13	Sdc14	FEXTdc14
	dd	Sdd11	RLdd11	Sdd12	ILdd12	Sdd13	NEXTdd13	Sdd14	FEXTdd14
Port 2	cc	Scc21	ILcc21	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

- x Gb/s full duplex operation over x-connector link segments up to at least x meters using copper cabling and meet the bit error rate objective of less than or equal to x.

Summary

- **Discussion of link segment characteristics for NGBASE-T**