

Channel Framework for Reduced Twisted Pair Gigabit Ethernet

May, 2012

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Agenda

- **Overview**
- **Goals & Assumptions**
- **Channel Modeling**
- **Conclusions**

Overview

Purpose of this presentation:

- **Establish a consensus on how to get to baseline channel models that will be used for evaluating PHY proposals for Reduced Twisted Pair Gigabit. Therefore,**
 - **Channel models must be acceptable to PHY participants**
 - **Channel models must be acceptable to cabling, connector & magnetics' participants**
 - **Channel models must be acceptable to OEM/Tier1 participants**
 - **Will require alignment on all fronts so that a good solution can be attained**
- **Need everyone to come to a consensus!**

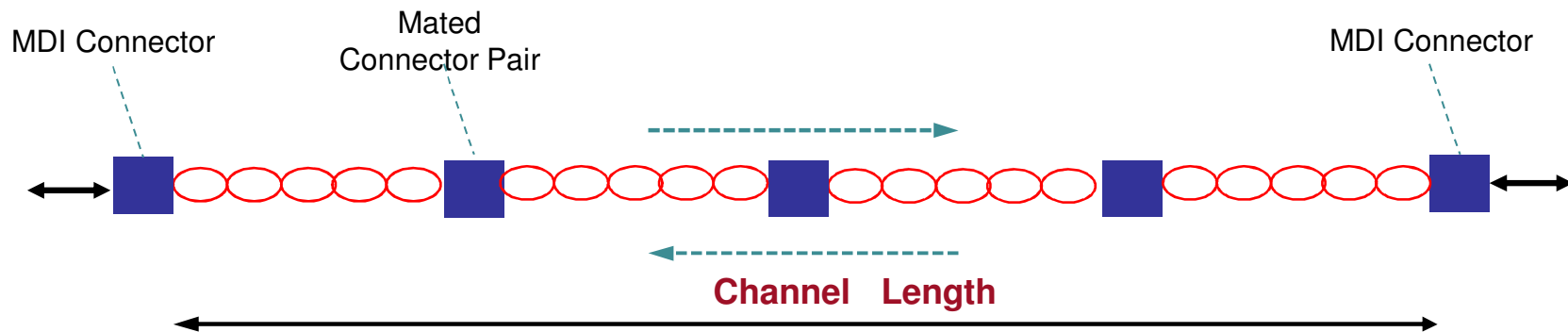
Goals & Assumptions

- **Framework of the discussion**
 - Will talk about
 - Single wire and pair
 - Link segment
 - Pair-to-pair effects
 - Framework does not imply or preclude any signaling solutions.
 - Whether its 1-Pair, 2-Pair or 3-Pair signaling, framework has to address the above (e.g. Insertion Loss, Return Loss, XTALK, AXTALK)
- **Overall Link Segment**
 - Needs to be economically feasible
 - Has good channel characteristics (over frequency)
 - Alien XTALK properties allow bundled segments
 - Meets Automotive EMC requirements
 - Performs well under harsh conditions of temperature and wear & tear (due to vibration, aging and bending).

Channel Definition: Single Wire and Pair Properties

- **Copper wiring**
- **Wire diameter**
- **Differential Characteristic Impedance (100Ω nominal)**
- **Frequency Range**
- **Attenuation**
- **Crosstalk**
- **Dielectric Material of Choice and its Properties**
- **Effect of Vibration, Aging, Bending, Temperature & Humidity**

Channel Definition: Link segment properties



- **Between two linked-up units running up to 1Gbps over Twisted Pair(s) (UTP/STP) channel length up to**
 - **15m for passenger vehicles**
 - **40m for commercial vehicles**
- **Consisting of:**
 - **5-connector structured Twisted Pair(s) (UTP/STP) copper cabling at least 15m on balanced copper cabling**
 - **Mated Connector Pairs (maximum three)**

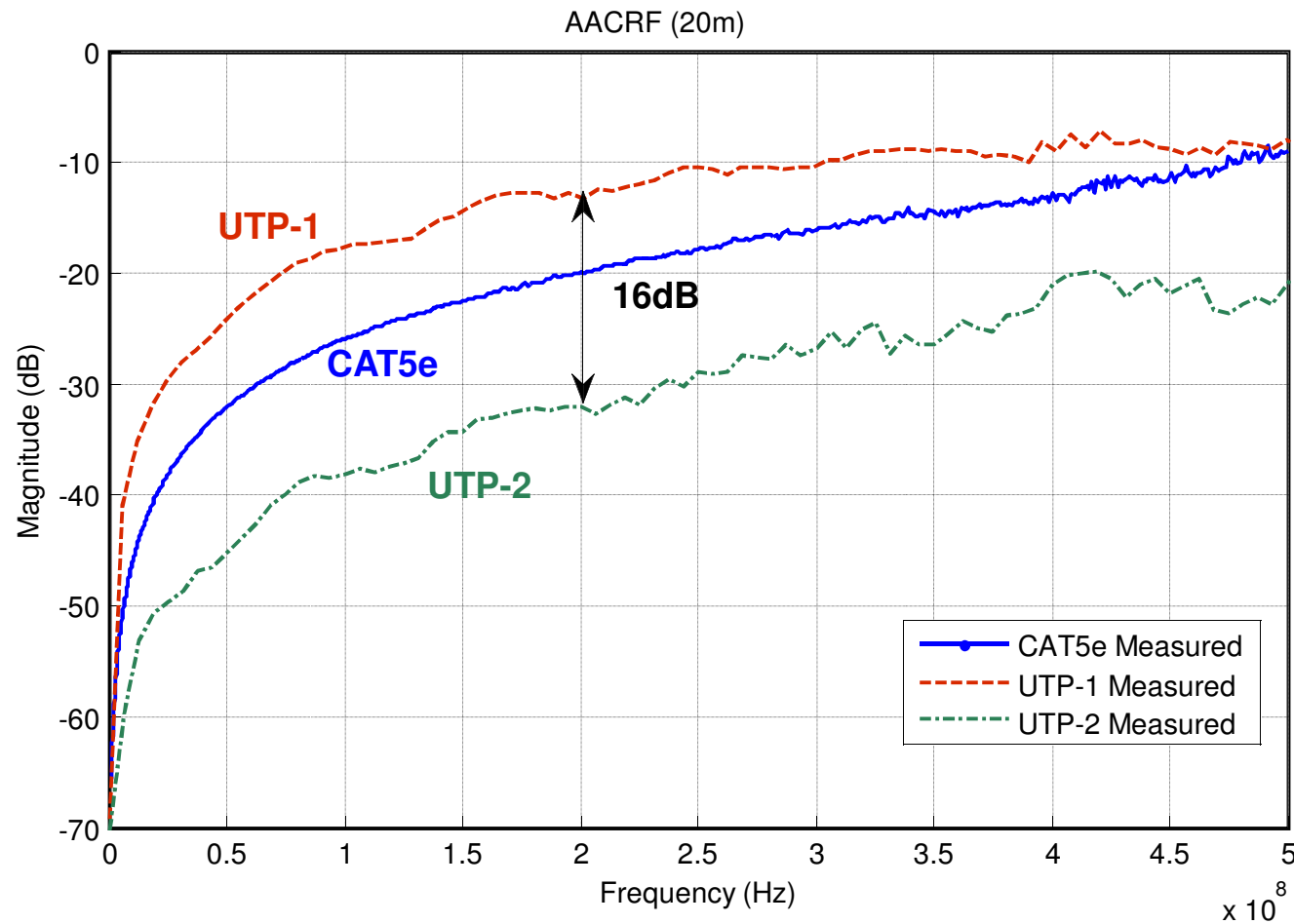
Parameters to Consider

- **For a given 100Ω terminated segment**
 - * **Differential Characteristic Impedance (100Ω nominal)**
 - * **Differential Insertion loss**
 - * **Differential Return Loss**
 - * **Differential XTALK**
 - * **Impedance Balance**
 - * **Common Mode to Differential Mode Conversion**
 - * **Common Mode to Differential Crosstalk**
- **These parameters**
 - **Will apply to whole channel (any segment of the cable, mated connectors, magnetics)**
 - **Need to be considered for environmental factors**
 - **Tolerances are to be determined**
- **Can look into similar requirements for automotive as to those listed under ANSI/TIA-568C.2 / ISO/IEC 11801 for premises, ANSI/TIA-1005 / ISO/IEC 24702 for industrial.**

What is available today?

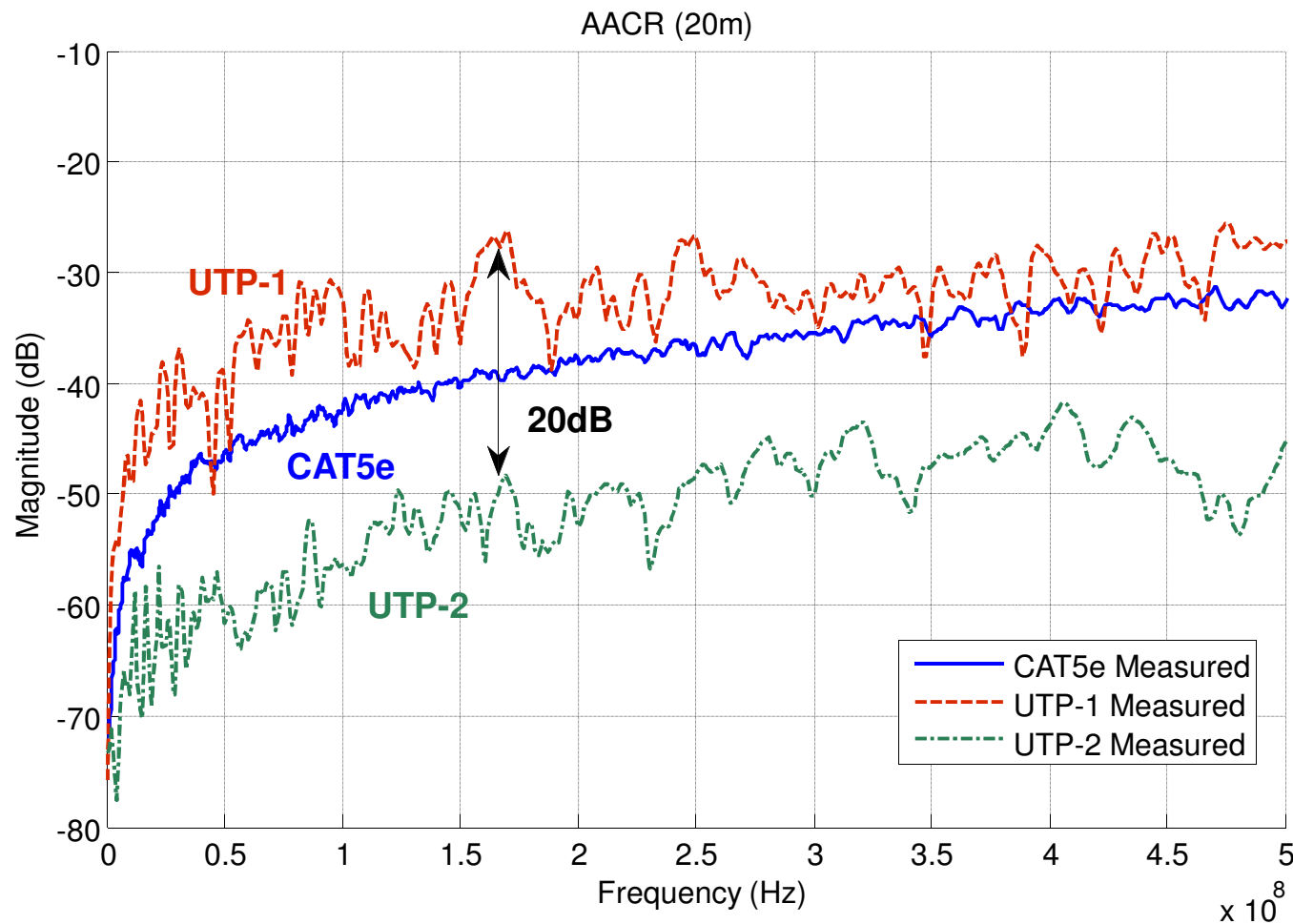
- There are a few commonly used “Automotive Qualified” UTP cables in the market place. These cables share some consistent characteristics (described earlier in the presentation).
 - E.g. $\sim 100\Omega$ Differential Characteristic Impedance
- Other characteristics (described earlier in the presentation) also matter to PHY architecture vary between different manufacturers. Examples include
 - Insertion loss
 - Return loss
 - Varying XTALK (AXTALK) properties
 - CM-DM/DM-CM Conversion (EMC properties)
- Similar issue with link segment. E.g. no consistent constraints on mated connectors
- By way of example, let's consider two of these cable systems and look at AACRF and AACR
 - UTP-1 (unjacketed UTP copper wiring)
 - UTP-2 (jacketed UTP copper wiring)

AACRF for 6-around-1 (typical 20m UTP)



Alien XTALK can be a dominant system impairment.

AACR for 6-around-1 (typical 20m UTP)



Alien XTALK can be a dominant system impairment.

Conclusions

- The existing “Automotive Qualified” cables have variable performances
- The Alien XTALK can vary drastically with different harness wiring options. Here, only a few cases are being considered.
- UTP with external plastic sleeve have much reduced AXTALK effect on the victim at high frequencies .
 - Need to choose the right channel model (UTP/STP cabling, connectors, magnetics) for a proper PHY feasibility analysis.
 - Automotive EMC requirements have to be additionally imposed on the link segment requirements.

Let's fill in the blanks for the properties described in this presentation to create an automotive channel model for RTPGE

Thank You!