Cabling and PHY options

IEEE 802.3 Multigig Automotive Ethernet PHY Study Group

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Outline

- Getting the Pump Primed!
  - What else matters
- Choices
- Interactions
- Implications
- Recommendations

Getting the Pump Primed!

- PHY designers design to a media spec
- Cabling designers design to an application's requirements

- BUT: Our objectives require us to make choices on both PHY and media type
  - The purpose of this presentation is to get things rolling...

What Else Matters

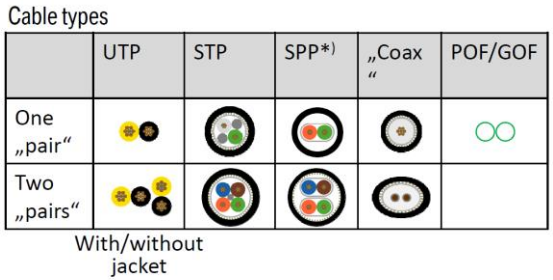
- Our media must be “automotive” quality
  - Installation and maintainability are key
  - Must be suitable for mass production and maintenance in automotive environments
- Some (not all) proposed applications could be safety-impacting (automated driving)
  - Robust performance must be achievable with minimal latency (e.g., without Layer 2/3 retransmission)
    - Unscheduled interruptions of data are not allowed
    - *Is this true at all speeds, or more true at 10Gbps, e.g., applications where uncompressed video and/or high frame rates are needed?*

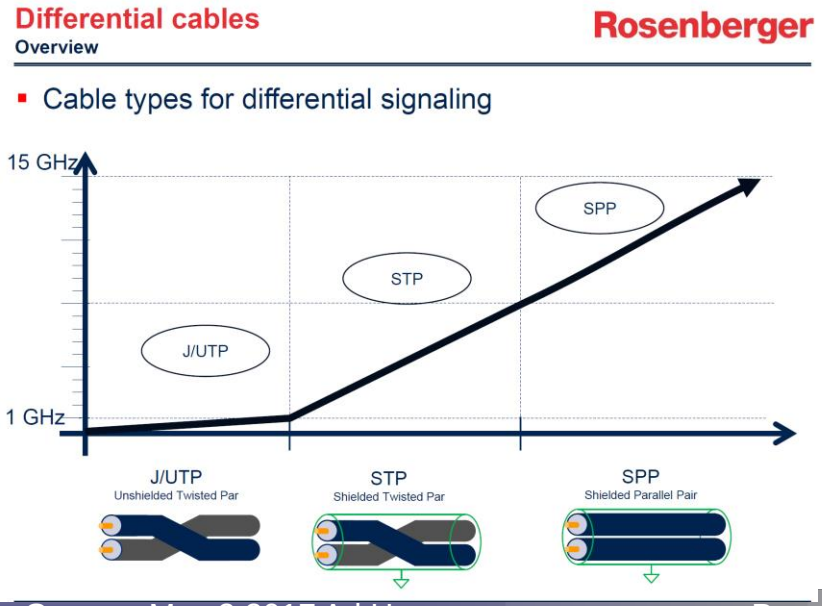
Choices

- Number of paths in the medium: 1 or more than 1?
  - If more than 1: bidirectional lanes or unidirectional?
  - Cost of echo-cancelling – PHY complexity
- Possible Cabling types:
  - Questions in:
    - matheus_kaindl_3NGauto_01a_0217.pdf
    - buntz_NGAUTO_01c_0217.pdf
- Possibilities given in: mueller_NGAuto_1a_0217.pdf
  - Various automotive types reviewed

Bandwidth	UTP	STQ	STP/SPP	Coax
<1 GHz	Likely	Likely	Likely	Likely
<3 GHz	Unlikely	Likely	Likely	Likely
<5 GHz	Unlikely	Unlikely	Likely	Likely
>6 GHz	Unlikely	Unlikely	Possible	Likely

Table above represents this presenter's impression from mueller





Interactions

- PHY levels/coding increases with decreasing cable complexity
  - Low bandwidths increase challenge to DSP & noise/EMC immunity
  - High bandwidths transfer complexity to cabling & analog

Cabling Bandwidth	UTP 10G PAM	STQ 10G PAM	STP/SPP 10G PAM	Coax 10G PAM
<1 GHz	76-128[1]	76-128	76-128	76-128
<3 GHz		5-16[2]	5-16	5-16
<5 GHz			3-4[3]	3-4
>6 GHz			2-4	2-4

- All levels based on requirement for 25% excess cabling bandwidth specified
- Red-yellow-green to indicate degree of difficulty with cabling & EMC considerations
- Notes on upper-end of PAM levels:
  1. 128 levels based on extension of 10G/40GBASE-T coding
  2. 16 levels is extension of 2.5/5/10/25/40GBASE-T
  3. 4 levels is extension of existing PAM-4 specifications

Implications

- Media choice and PHY complexity are tightly coupled
- PHY can be designed for any of these choices (except perhaps UTP/10G)
- Comparison of complexity is a systems issue, unless media choices are driven by other considerations

Recommendation

- Plan of attack:
  - Bring automotive media recommendations first (input from OEM's, Tier 1's)
  - Converge on a strawman link segment spec for each speed
    - Bandwidth, Shielding, IL
  - Recommend 10G first, as this can present a strawman for scaling to other rates
    - (either by baud or levels, TBD)

THANK YOU!

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