

Technical Feasibility of 10Gbps PHYs on 1 pair SFTP

IEEE 802.3 Multigig Automotive Ethernet PHY
Study Group

George Zimmerman

CME Consulting, Inc./Aquantia & Commscope

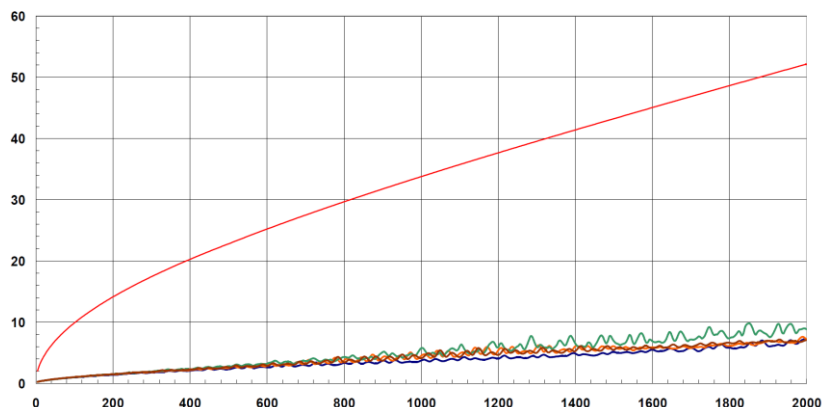
Supporters

802.3bq-2016

- 40Gbps Ethernet on 30m Cat 8 cabling
 - 2 GHz bandwidth S/FTP 4-pair Cabling
 - 2 RJ-45 connectors in channel
 - Split pairs increase connector impairments
 - 25 600 BT (640 nsec) latency
 - 128 DSQ LDPC + RS-FEC coding

Cat 8 cabling shows SFTP is feasible

Commscope short channel IL



IEEE NGBASE-T SG January 2013
Larsen_01_0113_NGBT

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Category 8 IL is dominated by 30m length
Reduction to 15m length lowers IL by:

9.3 dB at 1GHz

13.6 dB at 2GHz

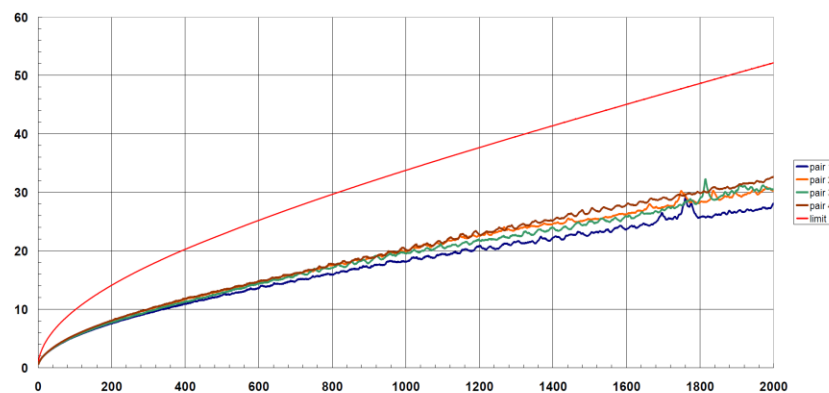
15m Cat 8-based channel spec would be
relaxed to:

12.7 dB at 1GHz

20.1 dB at 2GHz

Control of cabling IL suckouts on SFTP cabling up to 2GHz has been demonstrated in the IEEE 802.3bq 40GBASE-T project and resulted in the TIA Category 8 and ISO/IEC Standards

Commscope long channel insertion loss



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Source: Larsen_01_0113_NGBT.pdf

10Gbps/pair transmission is feasible

- 1 lane of 40GBASE-T, 802.3bq
- Multiple studies of power tradeoffs point to sweet spot 20-30m
 - Analog front end power should be a greater fraction with single pair solutions
- 15m channel reduces PHY front-end power well into the sweet spot

Source: TR42.7-2011-10-085-40GigPHYcomplexity.pdf
(G. Zimmerman, TIA TR42.7 contribution)

Source: zimmerman_01_0313_NGBT.pdf
(IEEE 802.3 40GBASE-T Study Group contribution)

PHY FRONT END POWER VS. LENGTH

- PHY front-end power (~1/3 to 1/2 total power) is related to front-end bandwidth and SNR requirements, through a technology “figure of merit”

$$\text{FOM} = P / (2^{\text{ENOB}} * f_s)$$

- f_s is 2 x bandwidth, ENOB is the receiver equivalent number of bits (a measure of SNR & SFDR), and P is the power consumed by the front end.

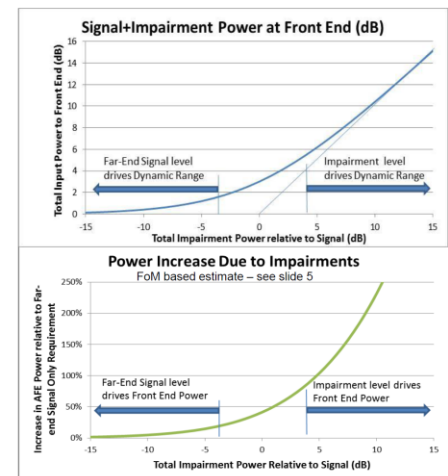
- For a given technology & skill, generally:

$$P \sim 2^{\text{ENOB}} * f_s$$

- PHY design studies can compute what the required ENOB is for a given cable insertion loss curve.

Impact of Far End Signal Power

- Two regions – one dominated by far-end requirements, one by impairments
- Diminishing returns for impairment power below signal
 - Impairments 6dB or more below far-end signal, add <1dB to dynamic range
 - Less than 12% more front end power



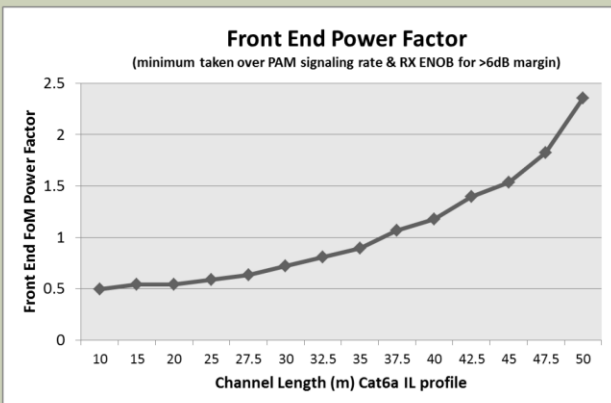
Multiple Vendors, Same Results

Source: TR42.7-2011-10-085-40GigPHYcomplexity.pdf
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(IEEE 802.3 40GBASE-T Study Group contribution)

POWER VS. LENGTH - 40GBPS

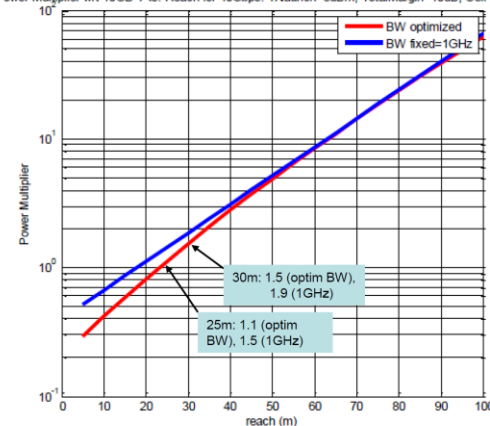
- Dynamic range of received signal across frequency tends to drive front end power up at reaches between 35 and 45m for Cat6a IL



Example at left shows effect is present even at high levels of DSP cancellation (60 dB echo, 50 dB NEXT, 35 dB FEXT)

Reconciliation to Bliss_1_0912

Power Multiplier wrt 10GB-T vs. Reach for 40Gbps. TX launch=3dBm, TotalMargin=10dB, Self Noise



Power ratios 25m/30m:

- Optimum BW=36%
- 1GHz BW=26%

Model Differences:

- Bliss model doesn't include Alien FEXT, which limits lower BW power
- Zimmerman model has a term to include non-signal processing overhead

YET, Results are in-line

Source: Bliss_01_0912.pdf, slide 25

IEEE 802.3 Next Generation BASE-T Study Group Jan. 2013 Interim, Phoenix, AZ USA

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Single Pair

Automotive EMC Concerns

- Use of FTP cabling and strong FEC provide primary protection from interference
- Fully-coded 16-level transmission in both 802.3bq or 802.3bz based transmission provides impulse protection

Conclusions

- 10 Gbps/twisted pair transmission feasible
 - Based on existing, standardized PHY and Cable technology
- Lower rates possible by rate scaling
 - 802.3bq and 802.3bz show examples how
 - NBASE-T products shipping show feasibility
- 15m FTP single pair cabling reduces complexity and risk

THANK YOU!