Media Considerations - Insertion Loss and EMC

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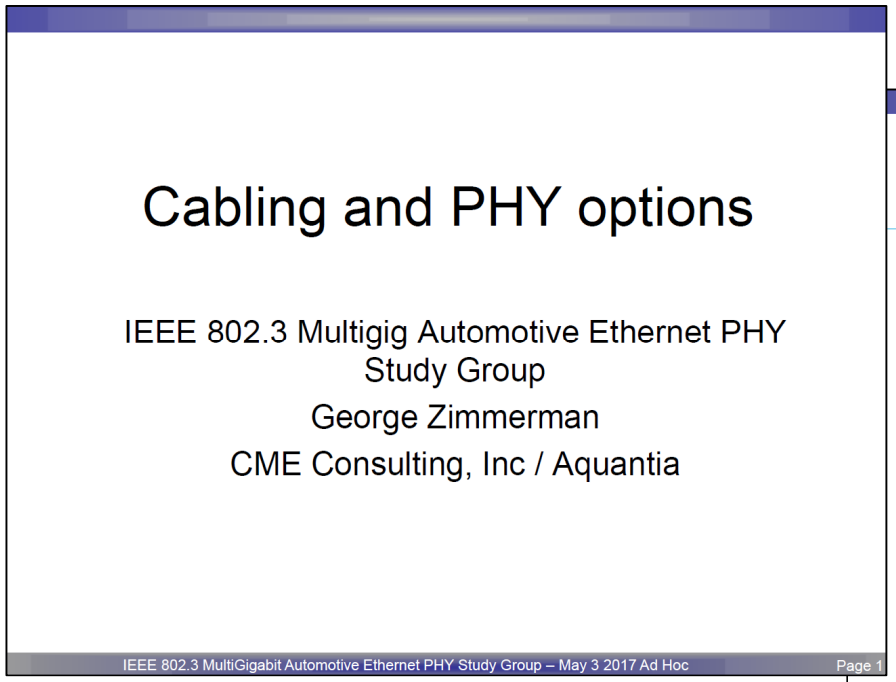
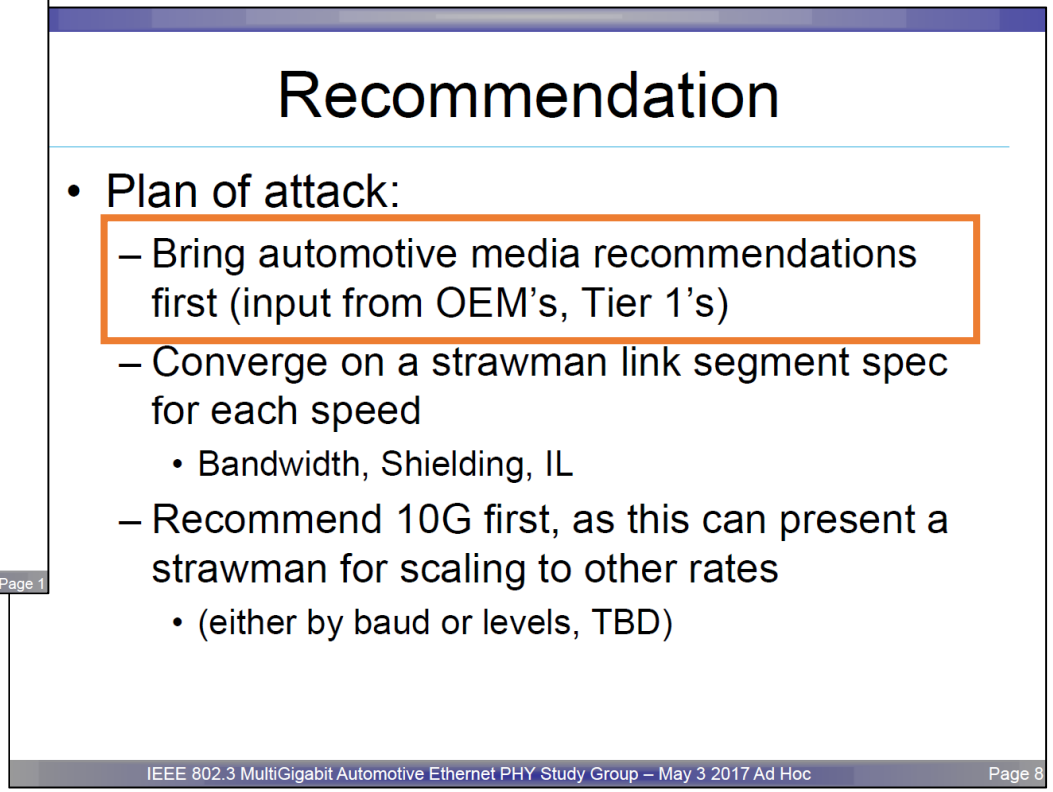
IEEE 802.3 Multi-Gig Automotive Ethernet PHY Study Group

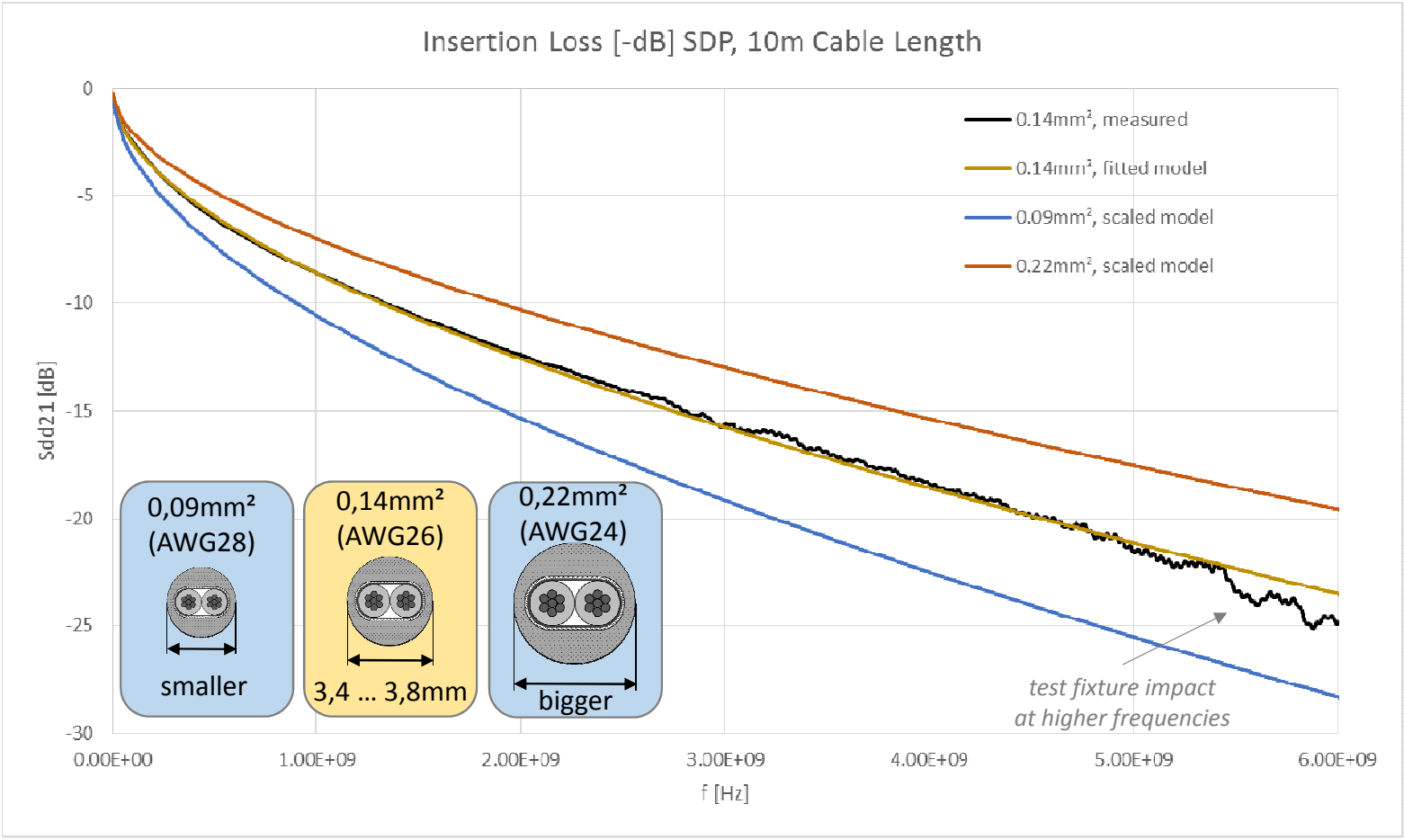
May-22, 2017 – Interim Meeting – New Orleans

Motivation – Discussion about NGAUTO Media





Cable Insertion Loss – Shielded Differential Pair (SDP)



Simple model for fitting (*):

$$|Sdd21|(dB) = K_1\sqrt{f} + K_2 f$$

Copper loss

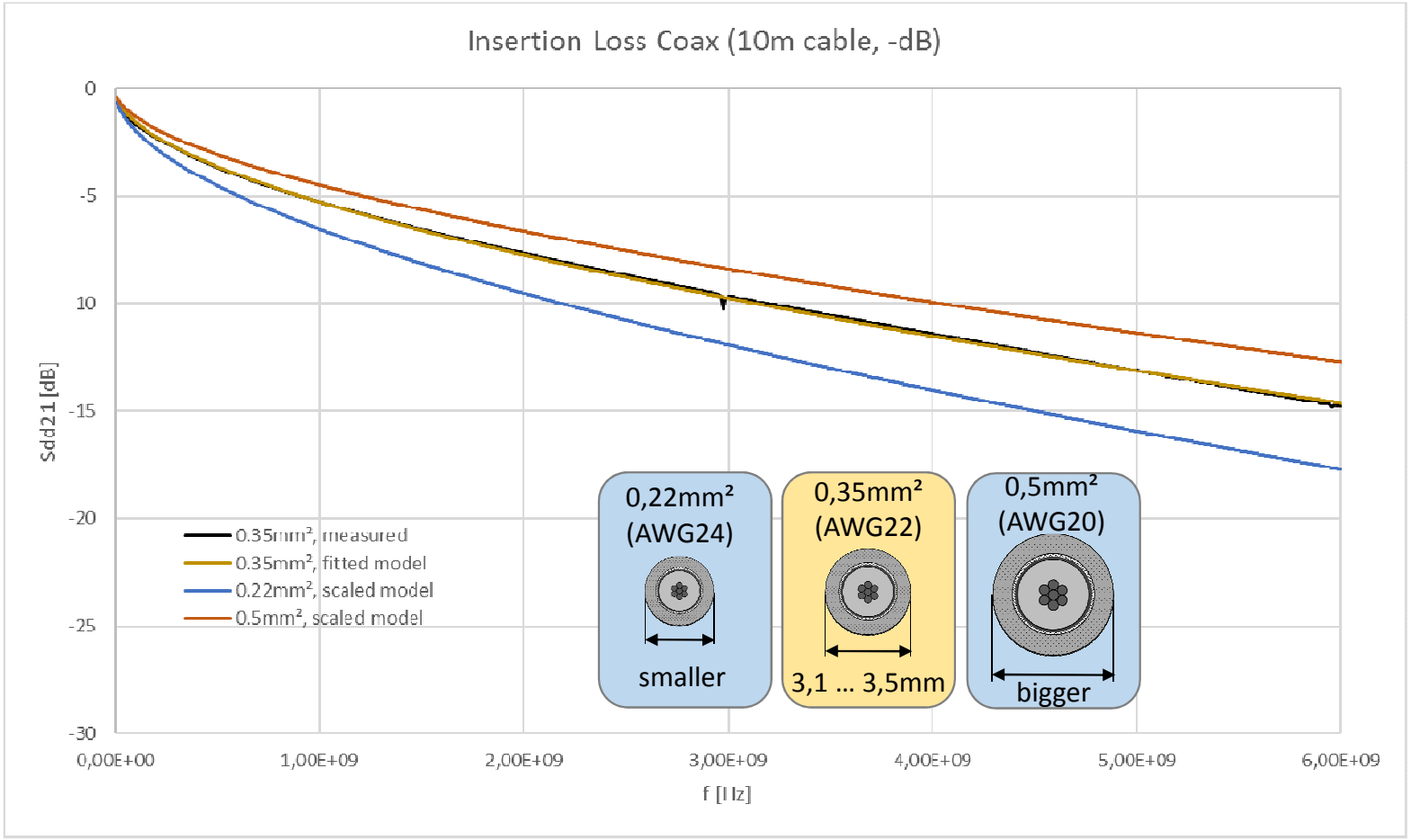
Dielectric loss

Scaling for other cross section (*):

$$|Sdd21|(dB) = \frac{\sqrt{0.14mm^2}}{\sqrt{A_X}} K_1\sqrt{f} + K_2 f$$

(*) T. Herman et al., "RTPGE Channel Requirements Proposal for 1-Pair Ethernet," CommScope Inc., IEEE802.3 Plenary Meeting Geneva 07/2013, url: http://www.ieee802.org/3/bp/public/jul13/herman_3bp_01_0713.pdf, 2014-07-17

Cable Insertion Loss – Coax



Simple model for fitting (*):

$$|Sdd21|(dB) = K_1\sqrt{f} + K_2 f$$

Dielectric loss

Copper loss

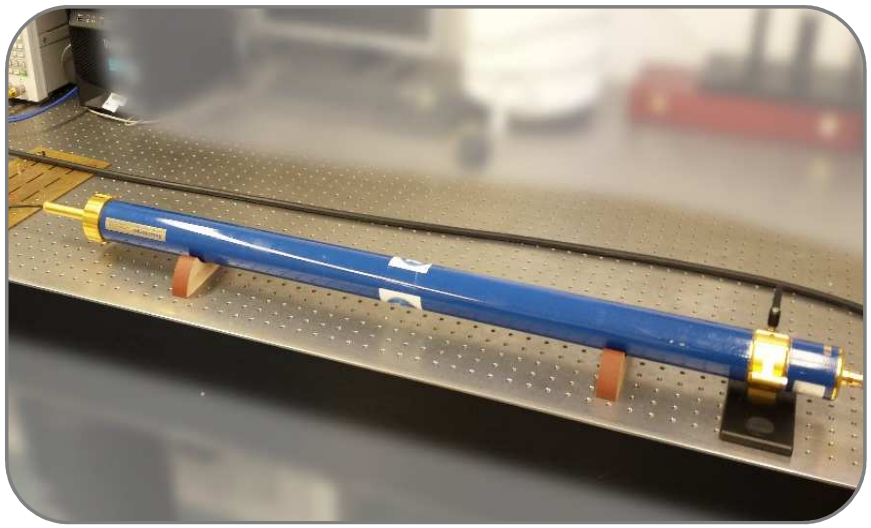
Scaling for other cross section (*):

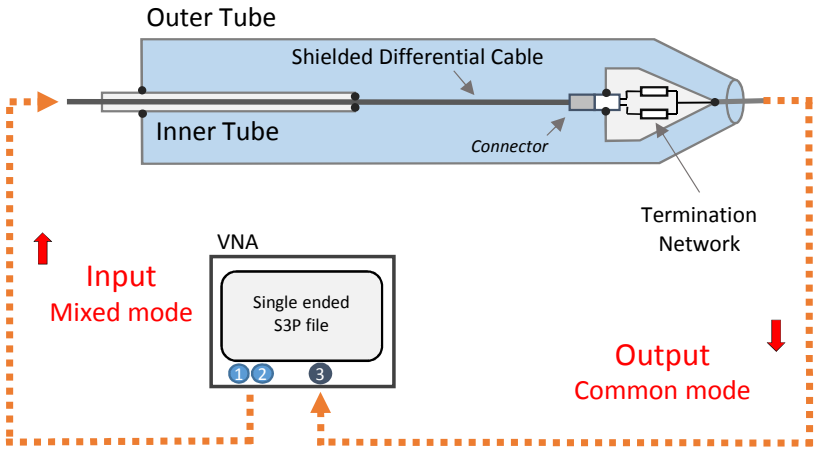
$$|Sdd21|(dB) = \frac{\sqrt{0.35mm^2}}{\sqrt{A_X}} K_1\sqrt{f} + K_2 f$$

(*) T. Herman et al., "RTPGE Channel Requirements Proposal for 1-Pair Ethernet," CommScope Inc., IEEE802.3 Plenary Meeting Geneva 07/2013, url: http://www.ieee802.org/3/bp/public/jul13/herman_3bp_01_0713.pdf, 2014-07-17

EMC – Differential vs. Common Mode (SDP)

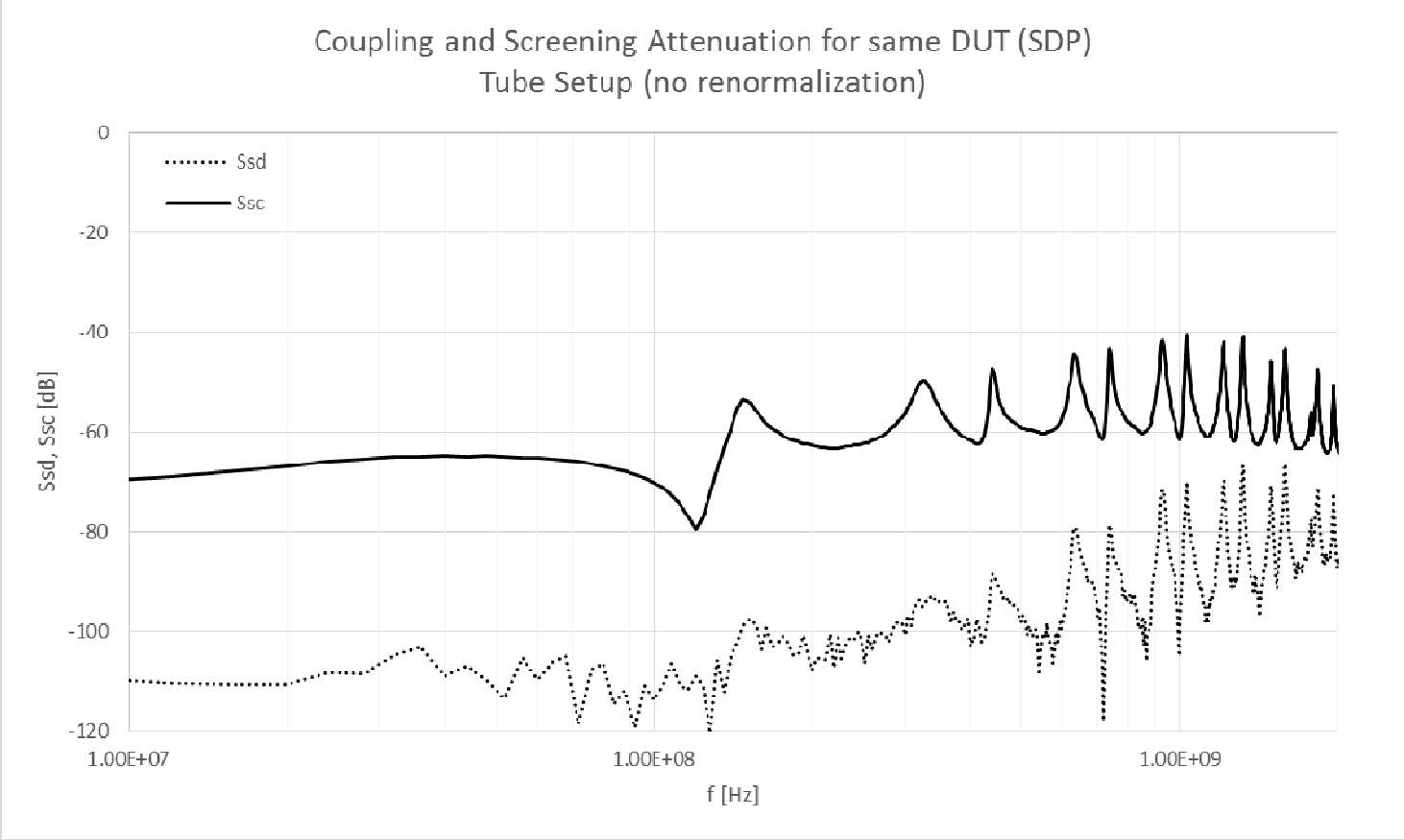
Setup (Tube-in-tube, IEC 62153-4-7):

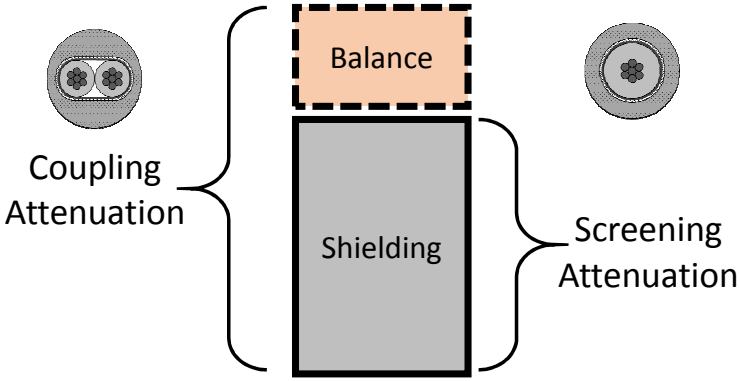




Ssd … differential mode, transfer function differential-to-single → coupling attenuation
Ssc … common mode, transfer function common-to-single → screening attenuation

EMC – Differential vs. Common Mode (SDP)





- Same DUT / same shielding (SDP)
- Lower emission for differential mode compared to coax mode
- Depends on frequency

Conclusion

- Recommend to focus on “small size” cables with outer diameter < 3,8 mm as baseline for insertion loss and bandwidth definition, e.g. 0.14mm² (AWG26) SDP or 0.35mm² (AWG22) Coax
  - Smaller cable diameters support weight reduction
  - Smaller cable diameters would support high port density at switch devices, e.g. 4mm port pitch

- Considerations for environmental degradation versus frequency (temperature, humidity)

- SDP has higher insertion loss than coax (for similar cable sizes) but lower emissions due to differential signaling
  - Consider electromagnetic emission for sensitive services at higher frequencies (GPS, BT/WiFi, etc.)

Thank You!!!