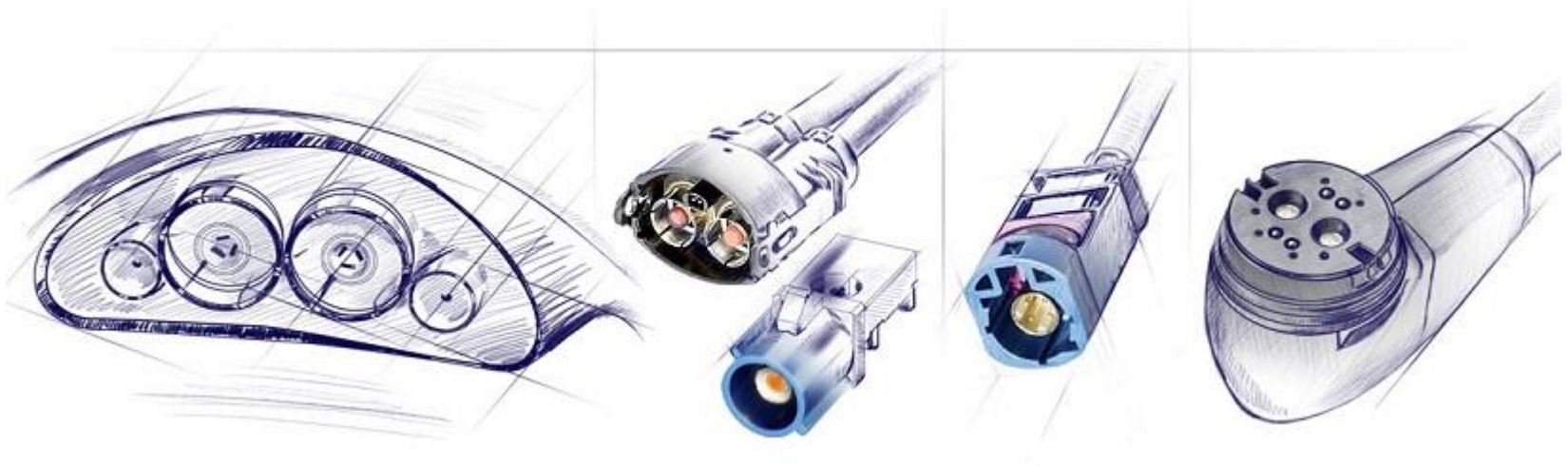
Link segment (alien) crosstalk and inter-pair skew measurement results

Thomas Müller (Rosenberger)



802.3cy link segment (alien) crosstalk and inter-pair skew

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Scope

- In the previous standards 802.3bw, 802.3bp and 802.3ch requirements on alien crosstalk of the link segment have been defined in order to limit the noise at the receiver.
- For 802.3cy alien crosstalk is expected to be similar to 802.3ch as similar shielded differential cables and connectors may be used.
- When 25G lanes are combined for 50G or 100G (zimmerman_3cy_01_02_23_21.pdf), crosstalk between lanes may occur. When lanes are implemented as individual cables, inter-pair crosstalk may be equal to alien crosstalk.
- Inter-pair skew may need to be constrained to allow proper timing of lanes.

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Crosstalk

- 802.3ch limits for PSANEXT and PSAACRF are shown below as reference.

$$PSANEXT\ loss(f) \geq (min\left(75,80 - 15log_{10}\frac{f}{100}\right)\text{dB}$$

where

f is the frequency in MHz; 1 ≤ f ≤ 4000

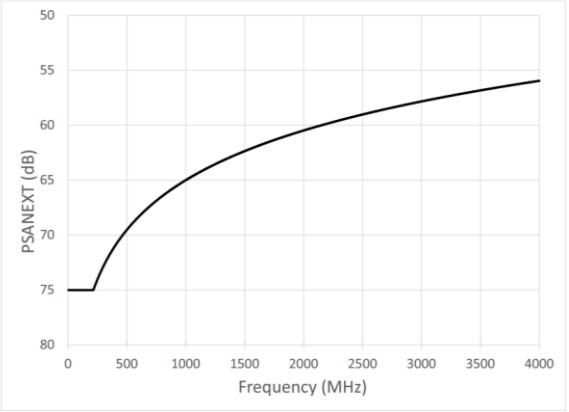

Figure 149–46—PSANEXT calculated using Equation (149–25)

$$PSAACRF\ loss(f) \geq (min\left(75,86 - 20log_{10}\frac{f}{100}\right)\text{dB}$$

where

f is the frequency in MHz; 1 ≤ f ≤ 4000

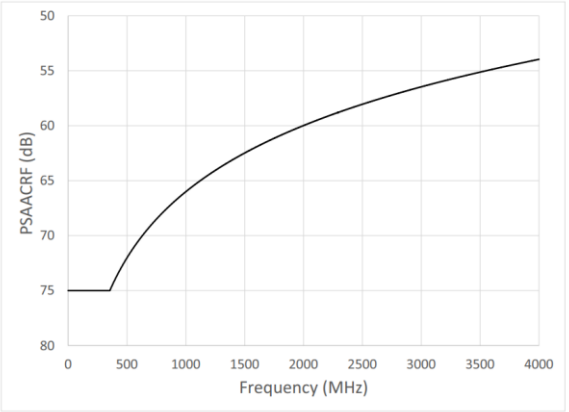

Figure 149–47—PSAACRF calculated using Equation (149–26)

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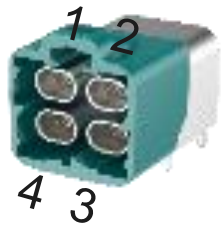
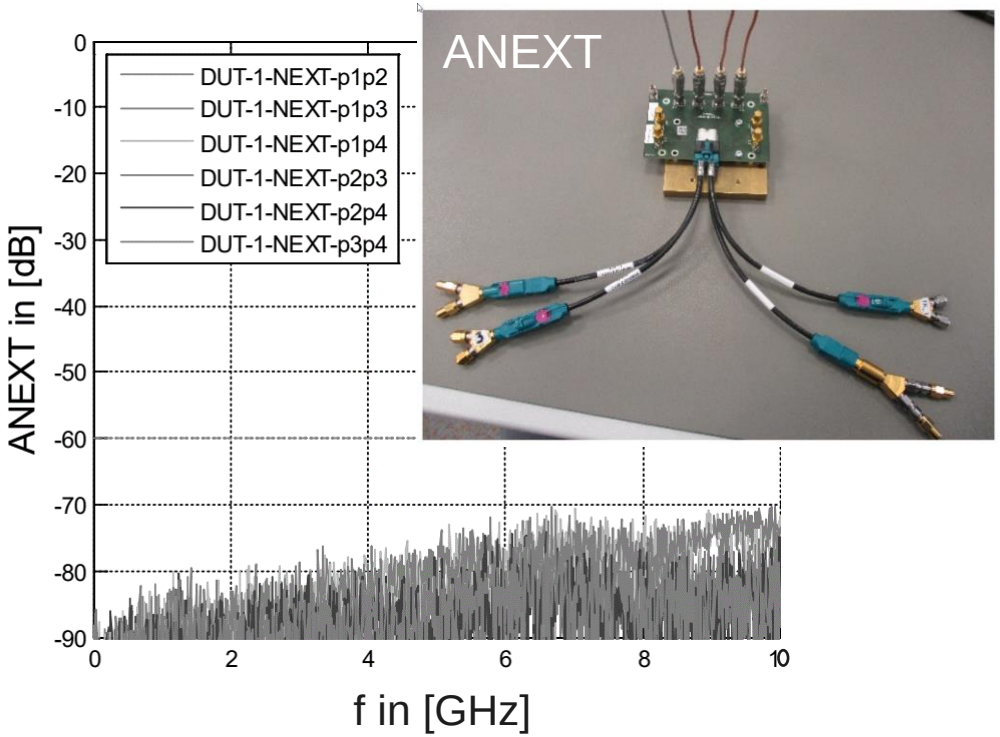
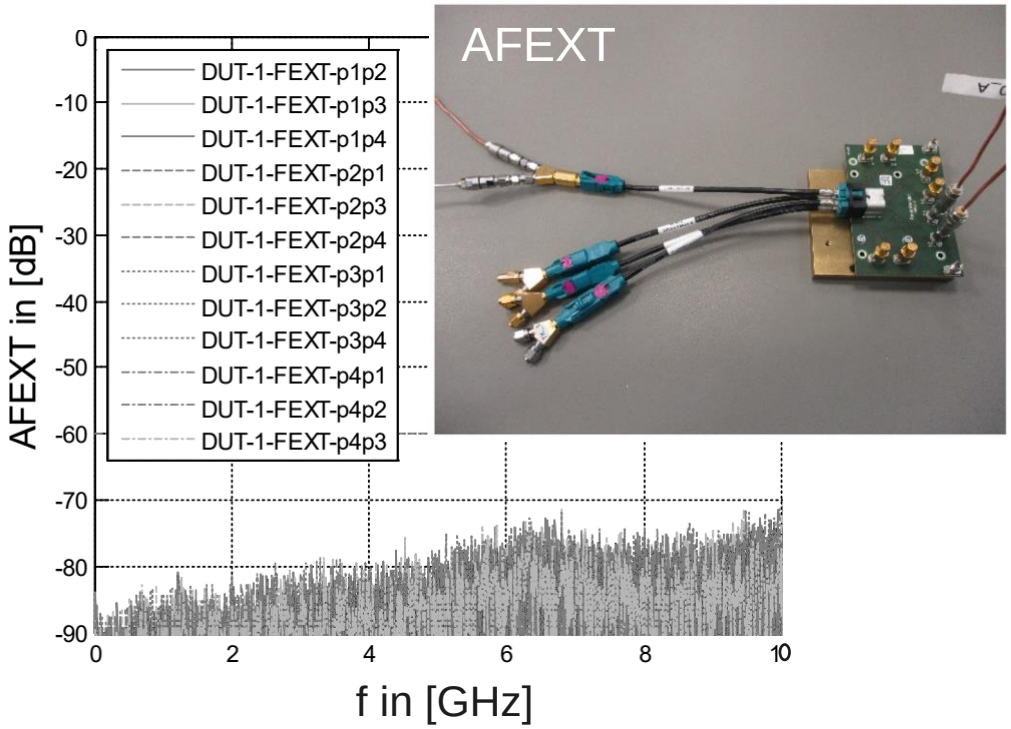
MDI connector crosstalk measurements



- Measurement setup similar to OPEN Alliance TC9 STP.
- 4-port connector with measurement fixture and 20 cm cables.
- Fixture crosstalk checked to be small.
- Differential alien crosstalk near- and far end low within the noise floor (dynamic range VNA)





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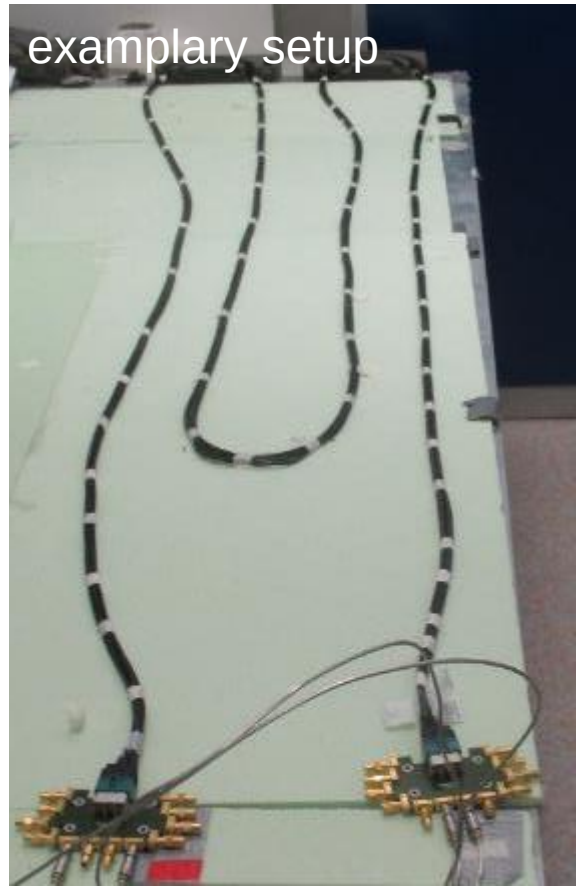
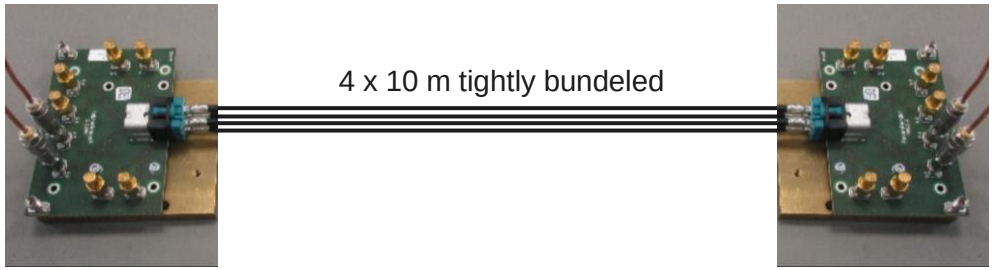
Link segment crosstalk measurement setup

- Measurement setup similar to 802.3bp Annex 97B Alien Crosstalk Test Procedure.
- 4 x 10 m STP cable (f_{max} = 4 GHz) length bundled together tightly.
- 4-port PCB connectors on both sides, no inline connectors.
- Cables are individually shielded with foil and braid, identical lay length.





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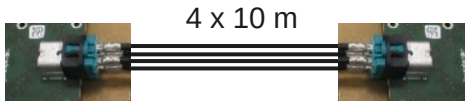
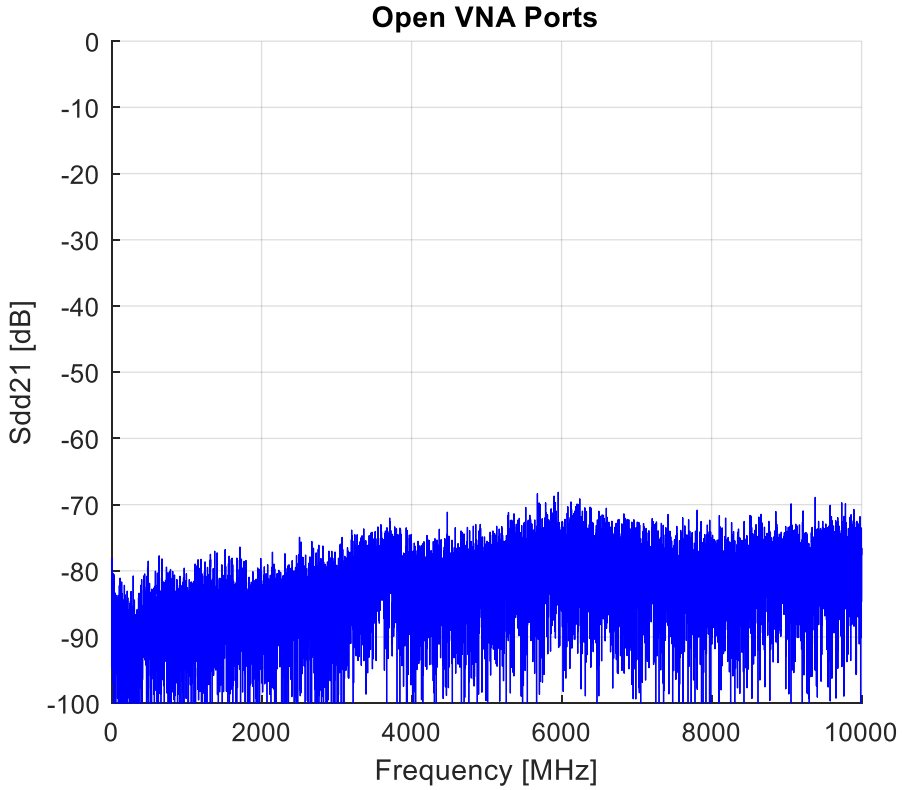
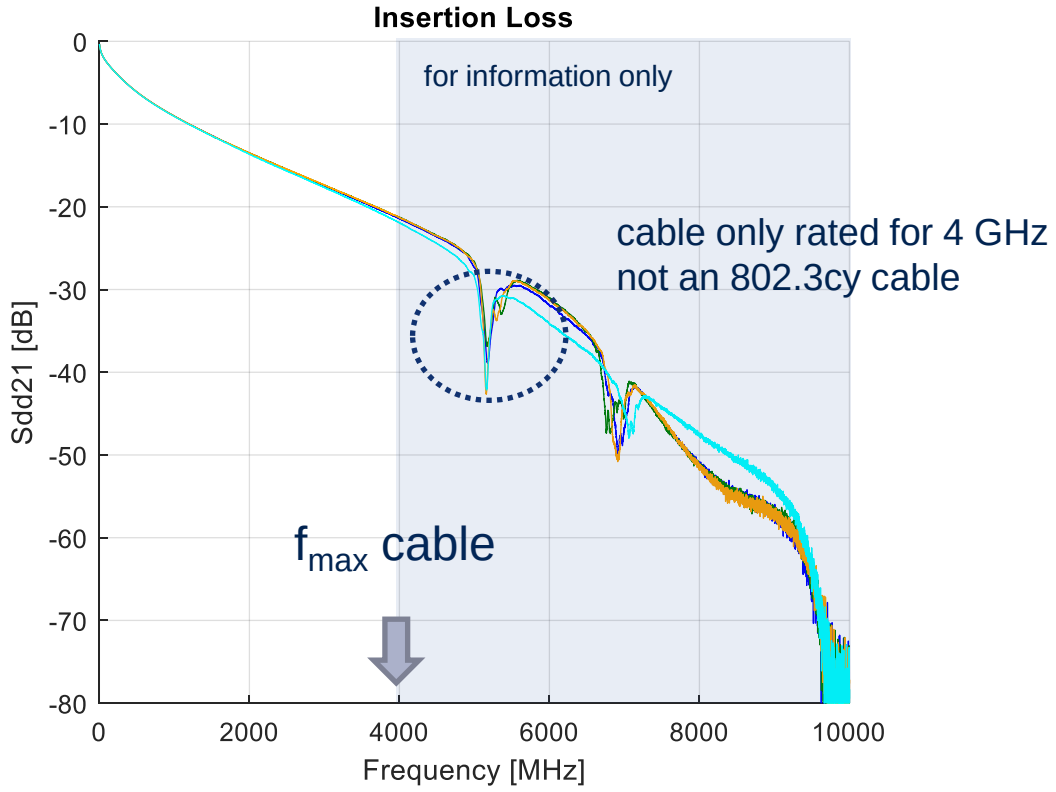
Link segment crosstalk measurement setup

- Dynamic range of the VNA as below (VNA coax open ports noise floor)
- Cable rated for 4 GHz
- Measurement results shown are valid up to 4 GHz only







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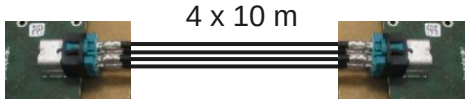
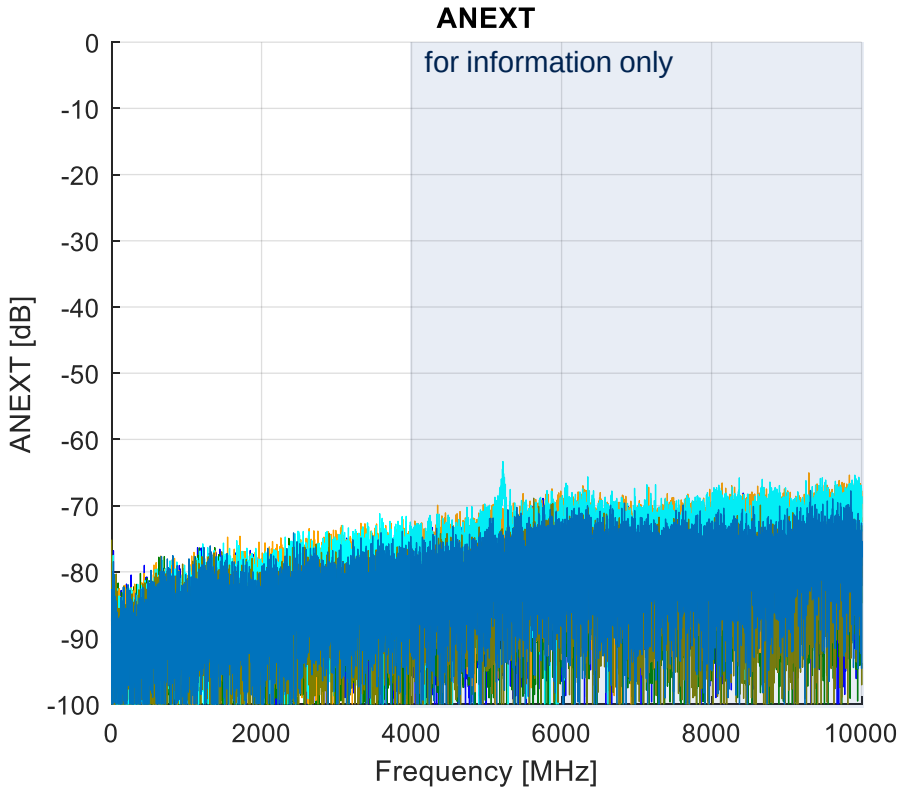
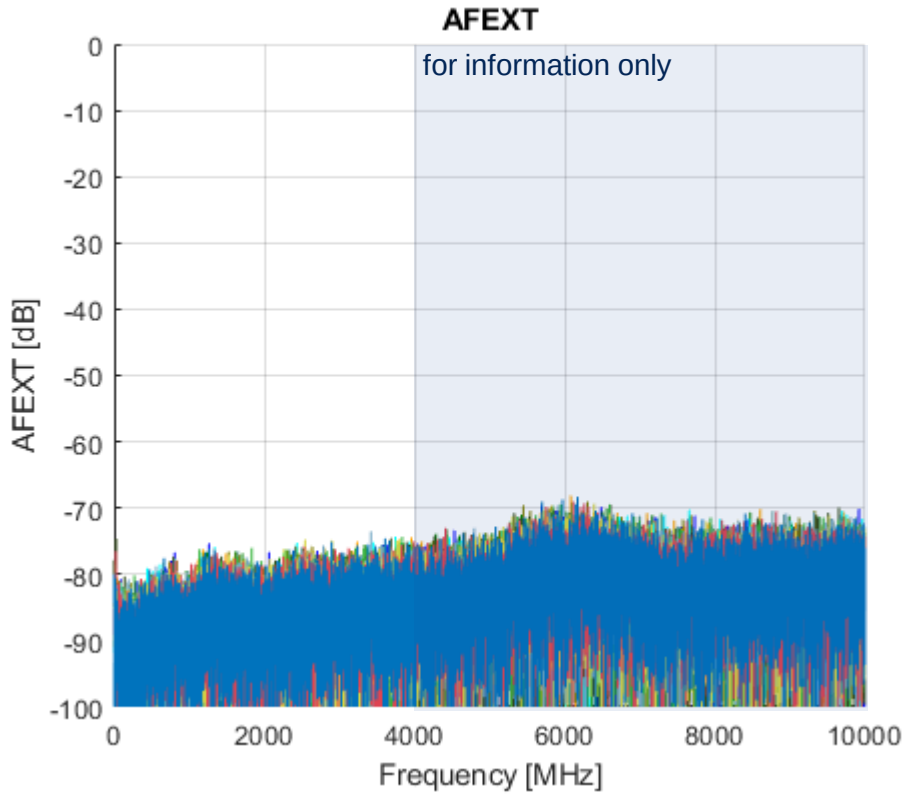
(A)NEXT and (A)FEXT



- As cable connectors cables are fully shielded, crosstalk may mainly occur if connectors, cables or PCB traces are not properly shielded.
- Differential alien crosstalk near- and far end low within the noise floor (dynamic range VNA)





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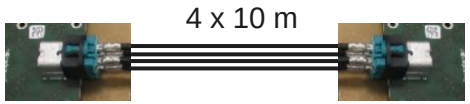
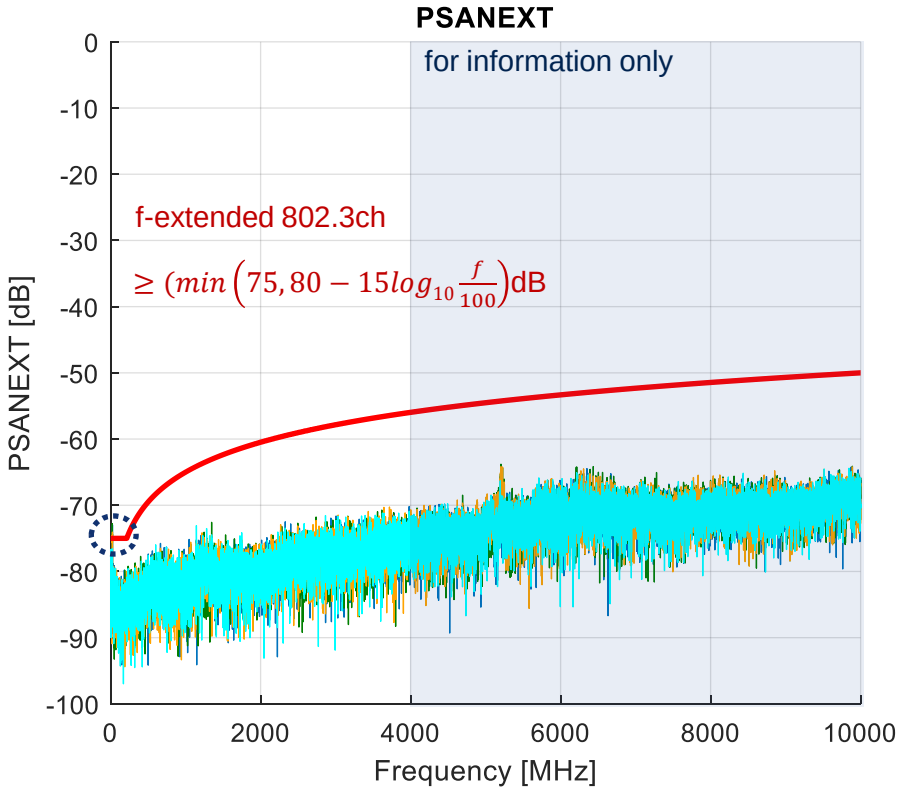
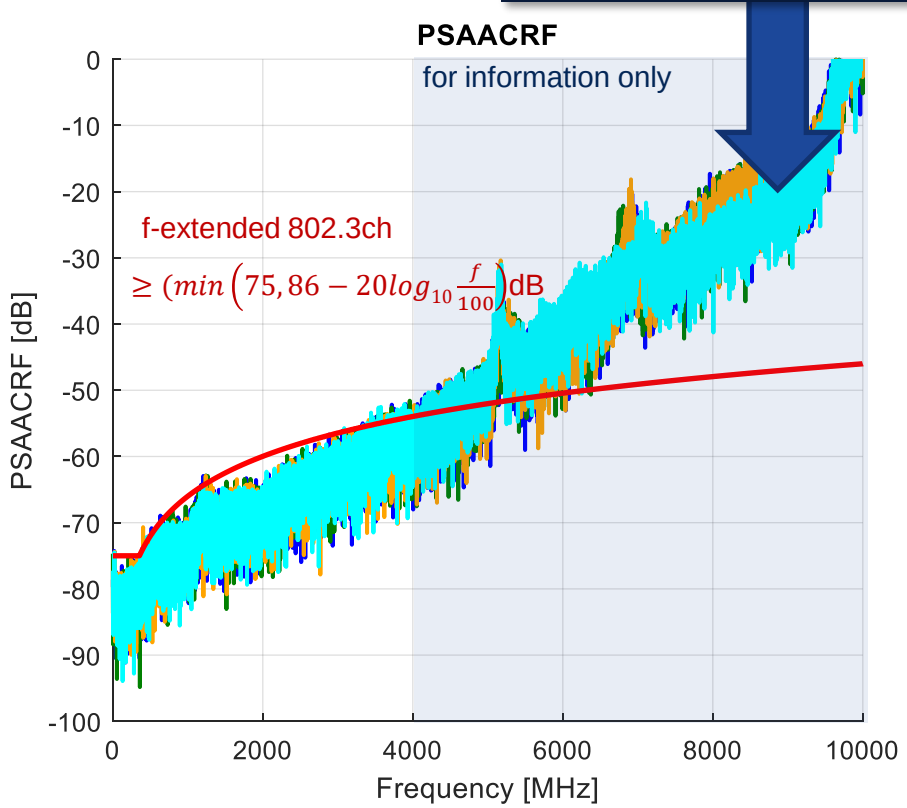
PS(A)NEXT and PS(A)ACRF

- Sum of crosstalk of 4 ports to one victim for each port
- Extending the 802.ch requirement for PSANEXT may be a good idea
- PS(A)ACRF needs more detailed analysis





Calculation / measurement method issue as high cable IL is subtracted!



802.3cy link segment (alien) crosstalk and inter-pair skew

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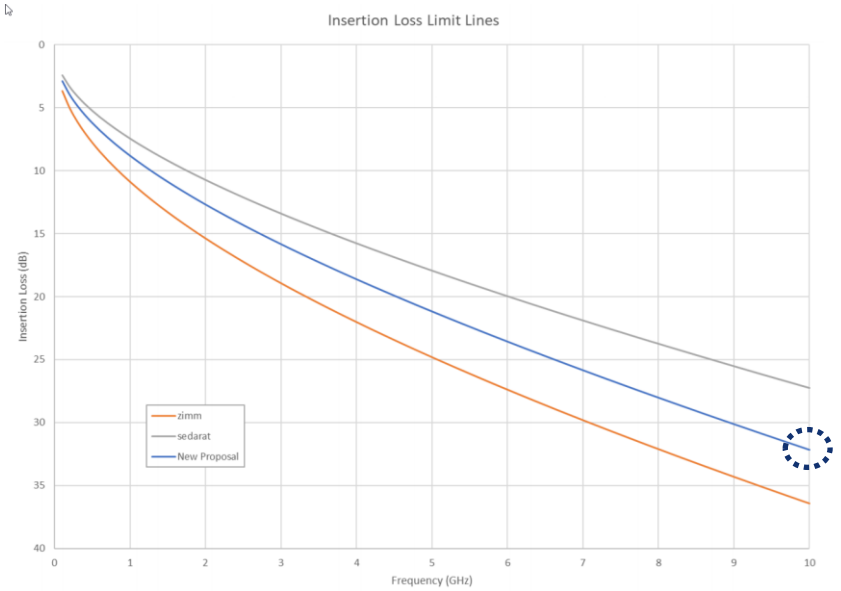
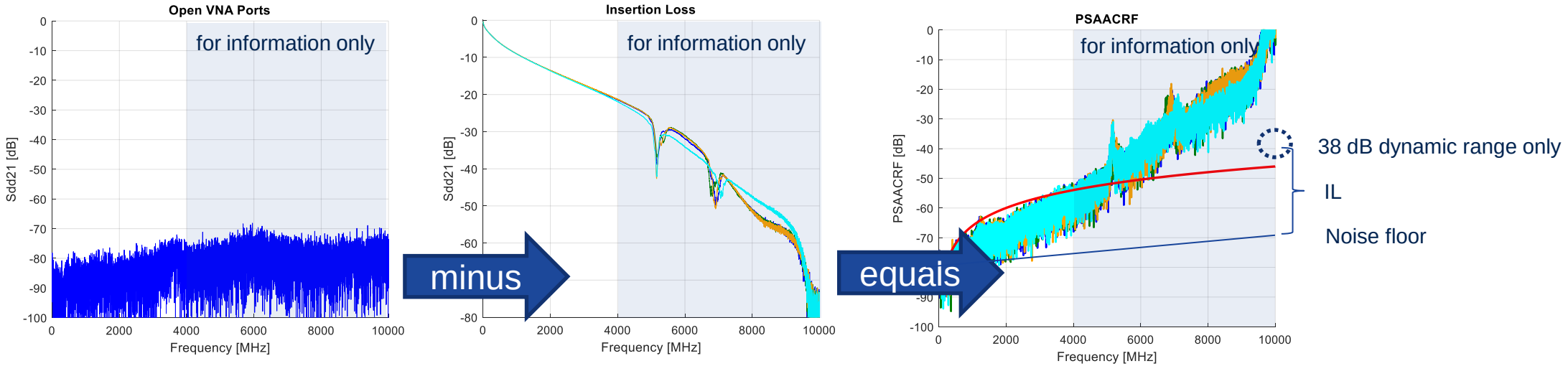
PS(A)ACRF

- (A)FEXT (noise floor) – IL = high PS(A)ARCF
- Cable IL high above specified f_{max}
- Measurements needs to be redone with a cable that fulfils IL strawman
- Noise floor may need to be improved
- If IL is 32 dB @ 10 GHz and -70 dB noise floor, crosstalk at the input needs to be at least -38 dB to be able to measure it.





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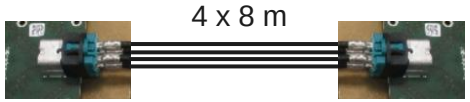
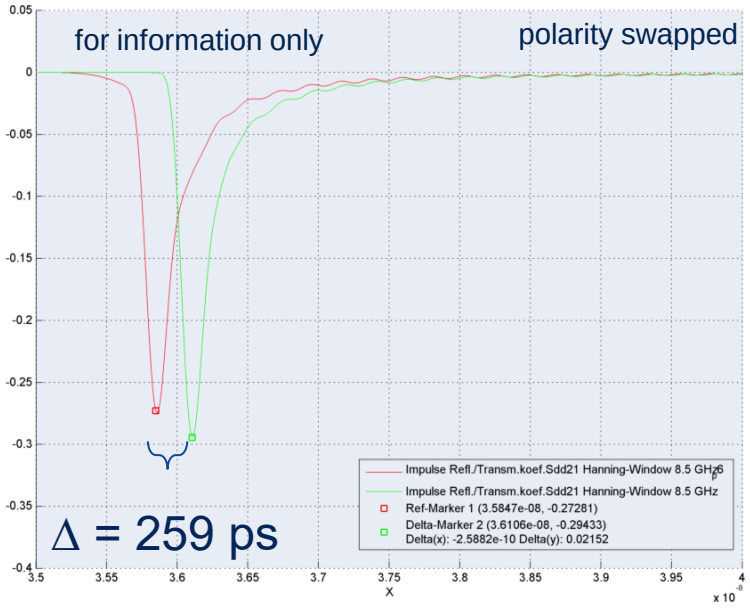
Inter-Pair Skew

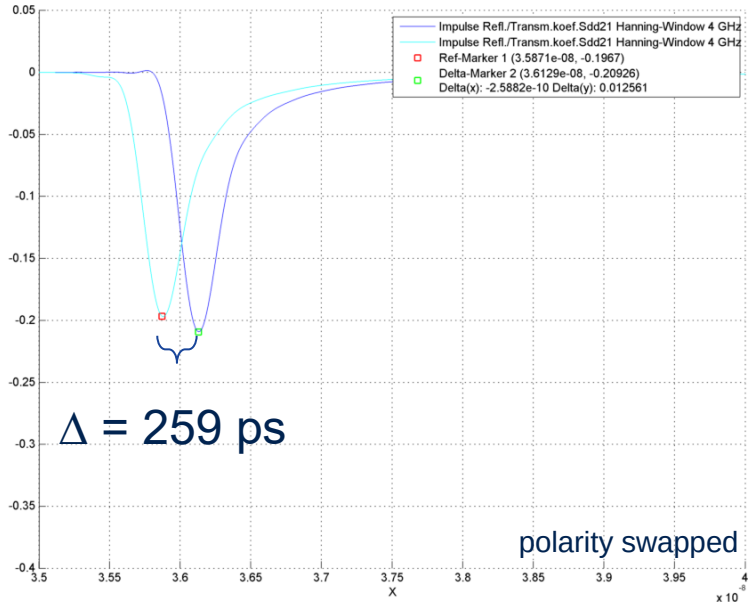
- Maximum propagation delay measured as impulse response difference 259 ps @ 8.5 GHz and 4 GHz bandwidth over 8 m in this example



Impulse response BW = 8.5 GHz



Impulse Response BW = 4 GHz



802.3cy link segment (alien) crosstalk and inter-pair skew

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Summary

- Measurement data of bundle of 4 automotive 4 GHz STP cables over 10 m with multiport PCB connectors on both sides was presented.
- Working group may consider to frequency-extend the 802.3ch limit alien crosstalk for PSANEXT, while PSAACRF needs a more detailed analysis.
- Feedback on the inter-pair skew presented will help defining requirements on components and processes.