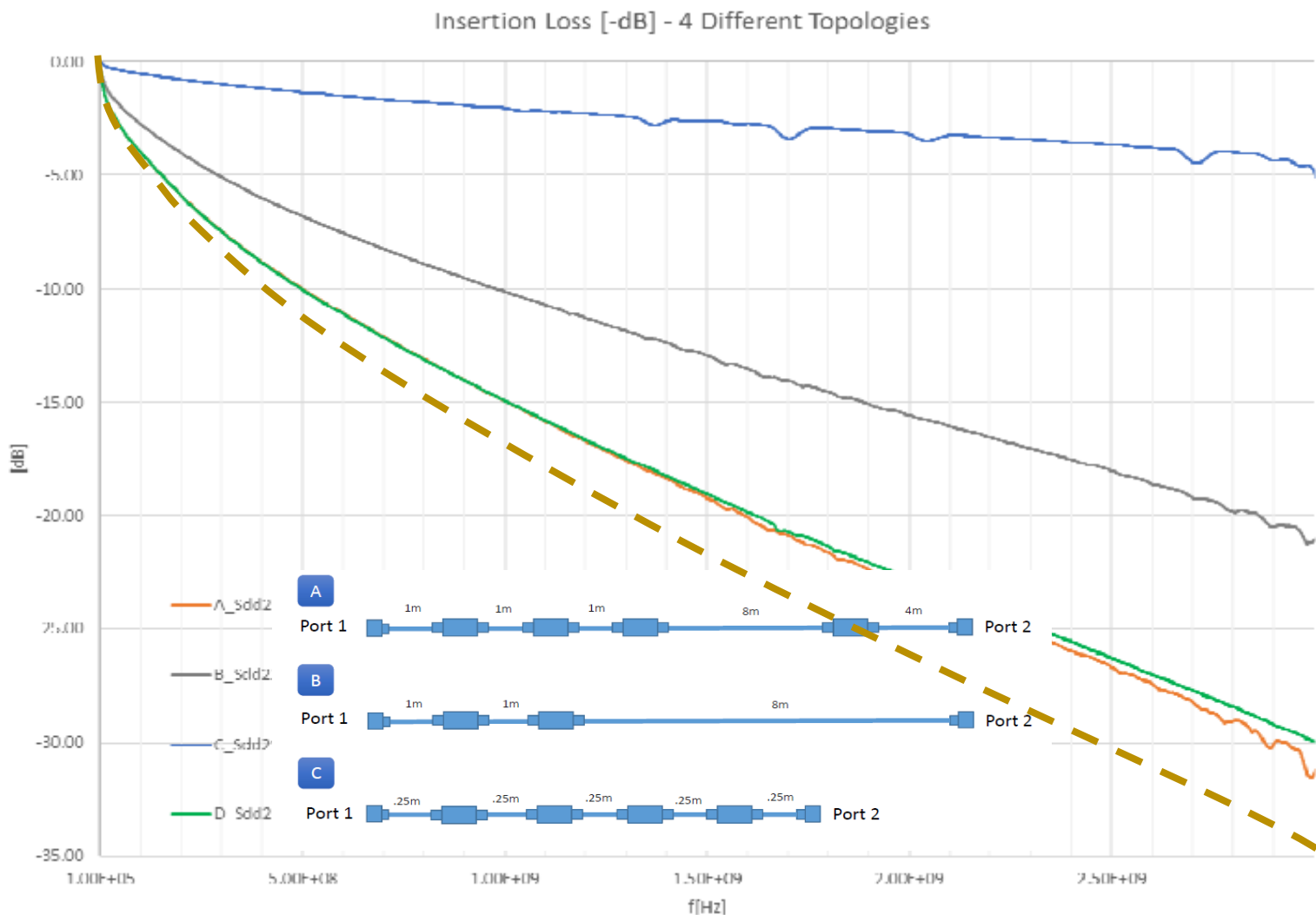
The background features a dark blue gradient with several concentric, glowing circular rings in shades of cyan and light blue. A large, stylized, light blue arrow points from the left towards the center. The overall aesthetic is technical and futuristic.

# Channel Requirements for Optimum/Robust PHY Design 10GBASE-T1

Ramin Farjadrad  
Aquantia Corp.

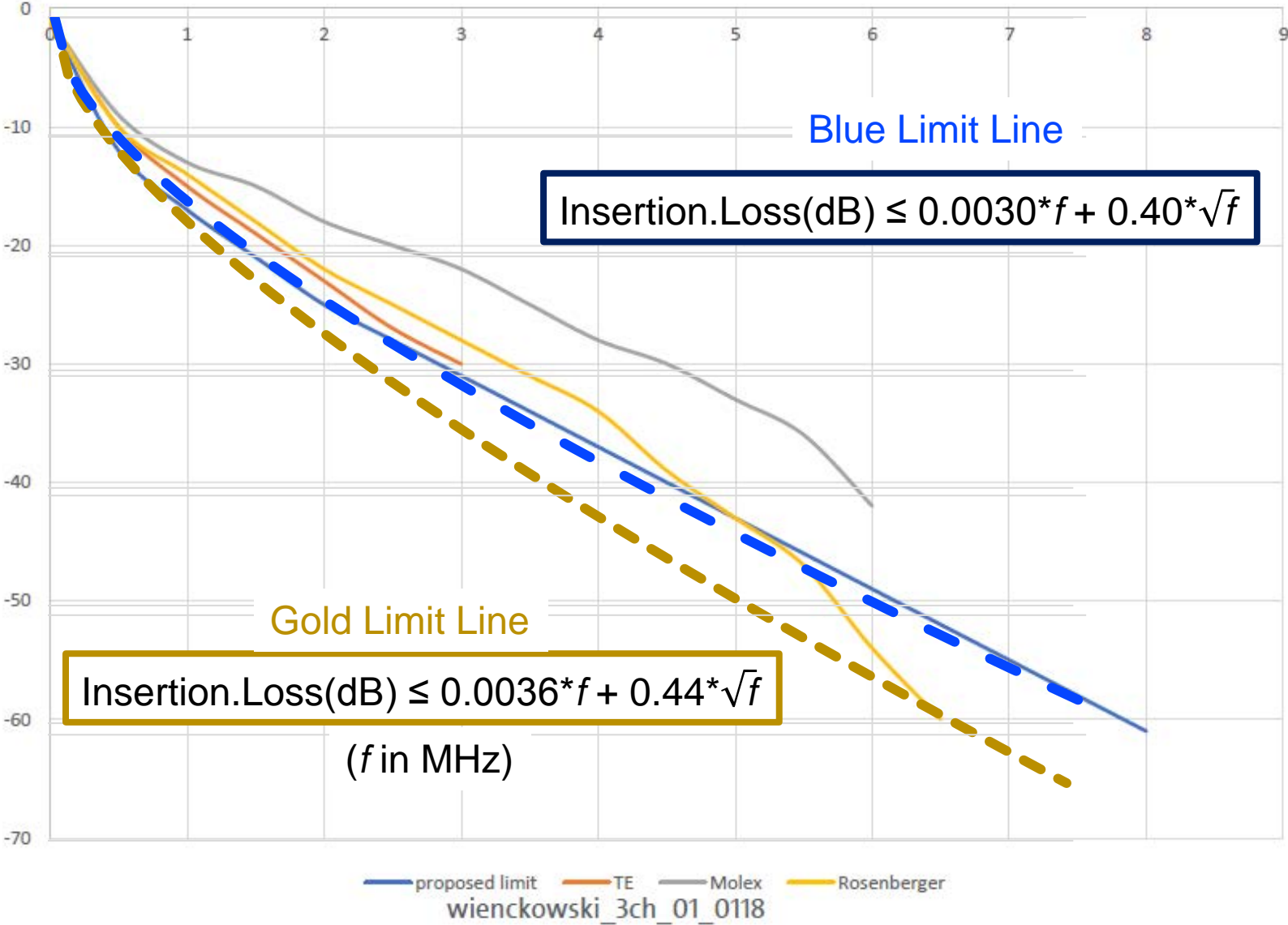
# Group 10G: Insertion Loss



- DiBiaso Channel A: Worst-case target STP proposed at Sept. 2017 IEEE 802.3ch Standards meeting
  - 15m STP + 4 inline Connectors
  - Cross Section=0.09mm<sup>2</sup> (28AWG)
  - Certified up to 3GHz
  - Potential 20% degradation at 105C
  - Highly preferred for
    - Low Costs
    - Availability
    - Maturity

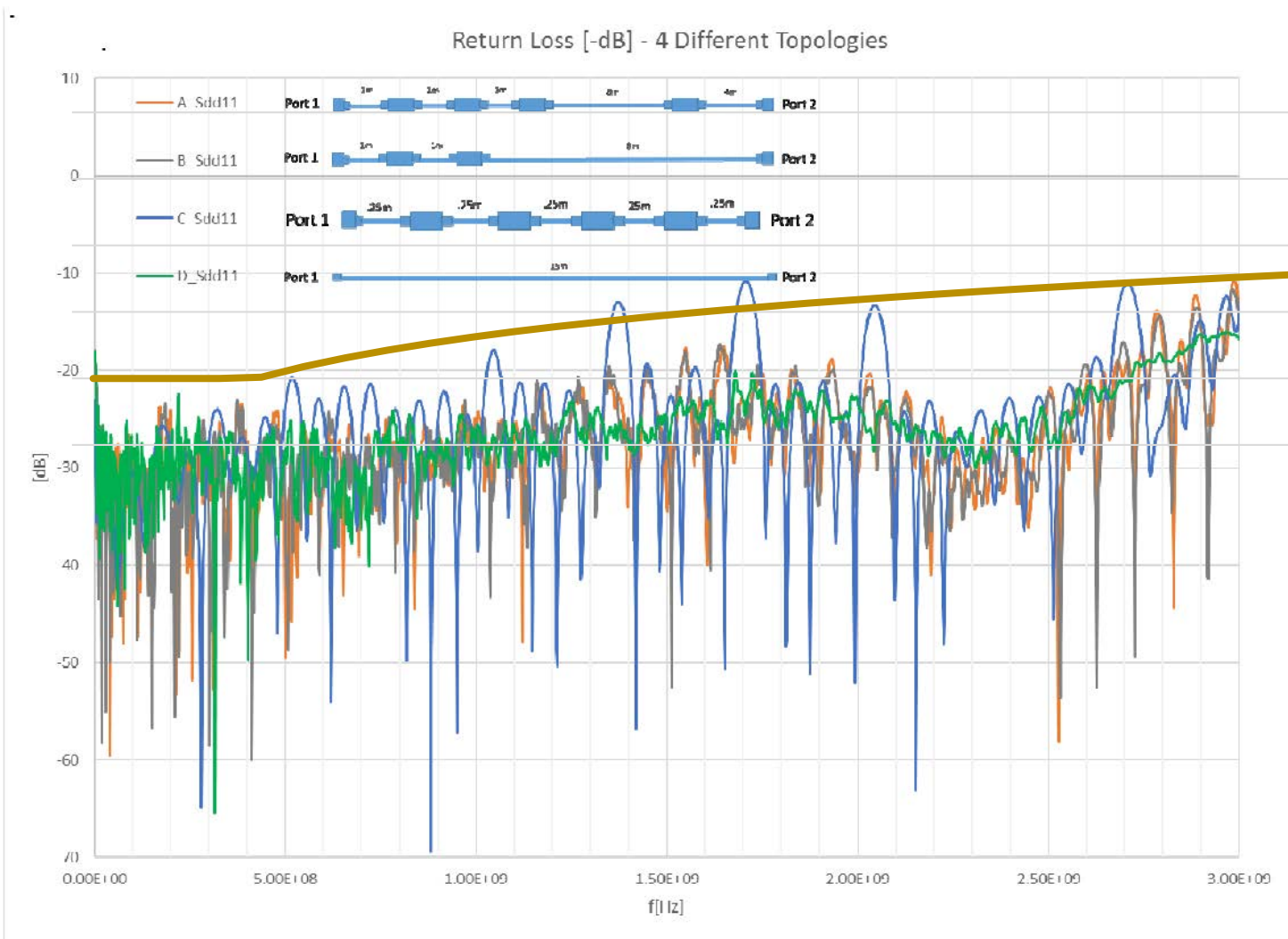
Bergner & DiBiaso, IEEE Sept. 11 2017 (DiBiaso\_3ch\_01a\_0917)

# Group 10G: Insertion Loss Limit Line



*5MHz < f < 5500MHz  
(Frequency in MHz)*

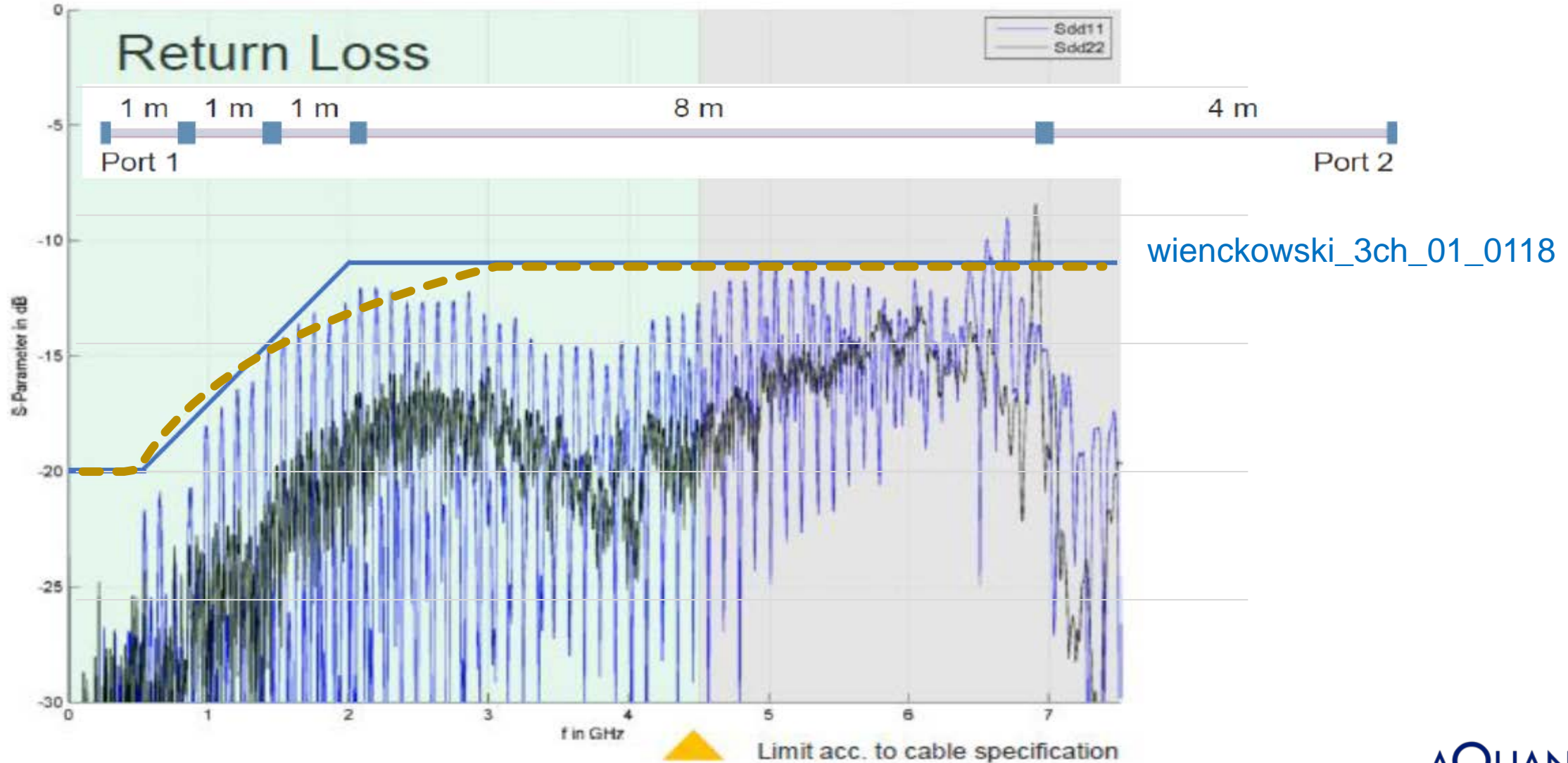
# Group 10G: Return Loss (HMD Connectors)



- DiBiaso cable assembly combinations used as an initial reference for cable and connectors for Return Loss as well
- Channel C with 4 inline connectors but very short reach (~1.25m) shows as an outlier that can be ignored
  - Short cables with same impedance mismatches always demonstrate worse return loss because lower IL reduces the RL as well
  - Higher RL for short cables are non issues, as link SNR is already high

# Group 10G: Return Loss (H-MTD Connectors)

## H-MTD connector and STP cable

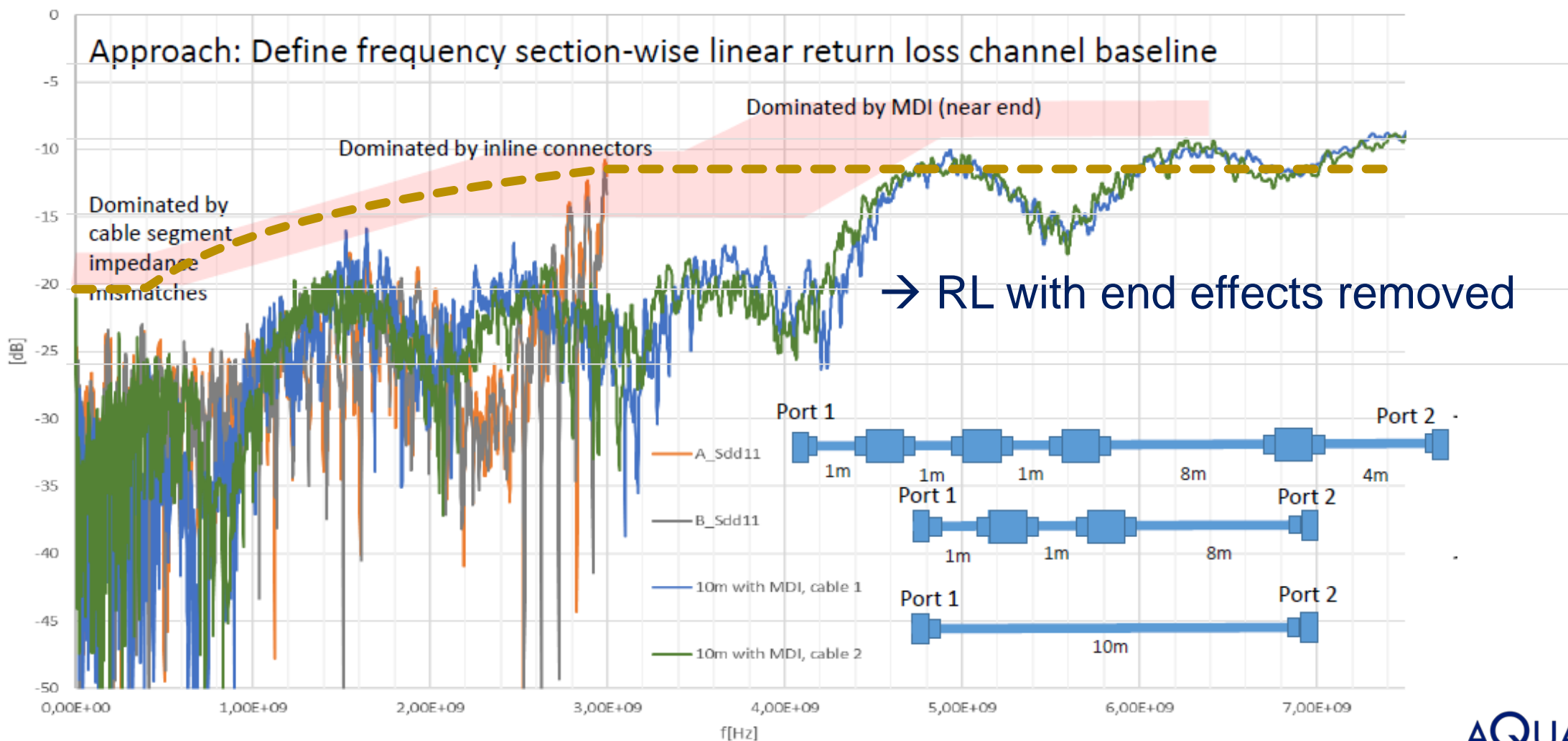




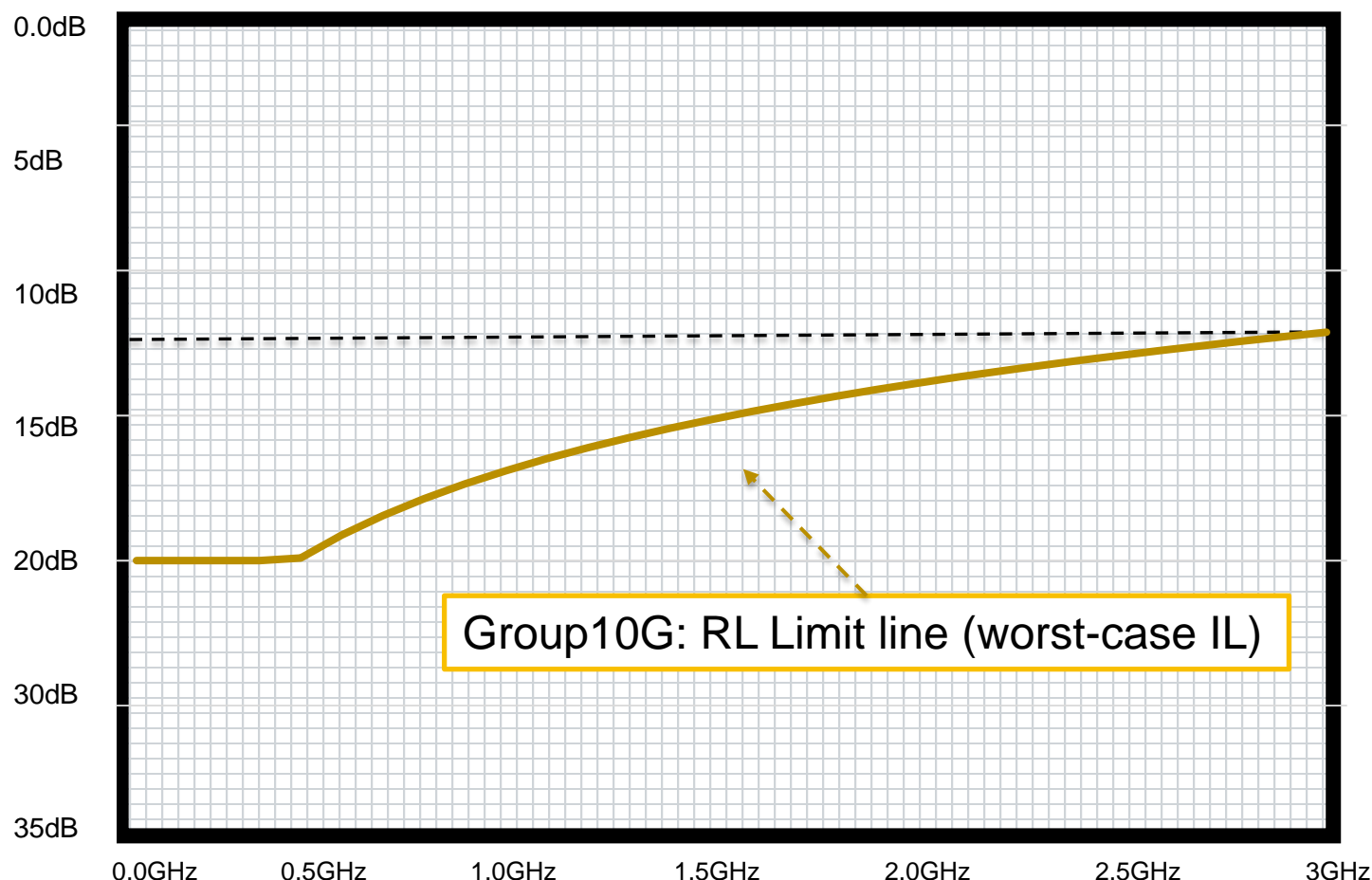
# Group 10G: Return Loss (HMD Connectors)

Return Loss [-dB] - 3 Topologies

Bergner\_DiBiaso\_3ch\_01b\_0118



# Group 10G: Return Loss Limit Line



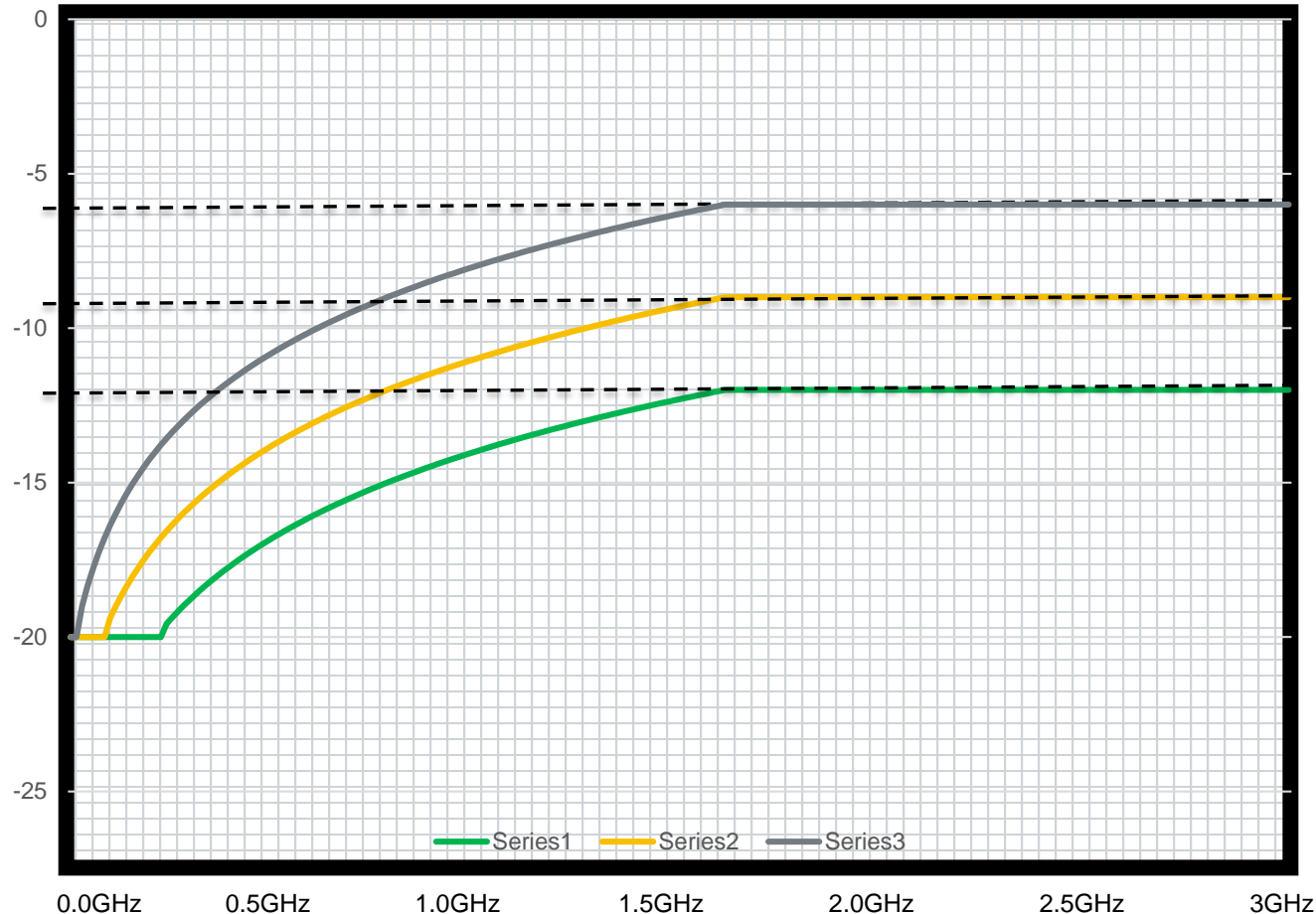
- To limit the reflected signals power due to the channel impedance mismatches, the cable assembly must meet the following return loss spec

- For cable with worst-case IL (limit line)

$$\text{Return.Loss(dB)} \leq \begin{cases} 20\text{dB} & 5 \leq f < 500 \\ 46.9 - 10\log(f) & 500 \leq f < 3000 \\ 12\text{dB} & 3000 \leq f < ?? \end{cases} \quad (f \text{ in MHz})$$

- We should better define RL limit line above 3GHz once we pick an optimum modulation for 10GBASE-T1 that determines the signaling bandwidth, otherwise we'll be setting unnecessary RL requirement on the cable

# Group 10G: Return Loss Limit Line (Adjusted with IL)



- $IL_{3GHz} > 20dB \rightarrow N=0$
- $10dB < IL_{3GHz} < 20dB \rightarrow N=1$
- $IL_{3GHz} < 10dB \rightarrow N=2$

$$\text{Return.Loss(dB)} \leq \begin{cases} 20\text{dB} & 5 \leq f < 500/2^N \\ 12-3N - 10\log(f/3000) & 500/2^N \leq f < 3000 \\ 12-3N & 3000 \leq f < 5500 \end{cases}$$

*(f in MHz)*

Contributions from :  
 Garret den Besten  
 Bert Bergner  
 James Withey  
 Masood Shariff





Thank You