Channel Data Capacity Analysis for B10GAUTO

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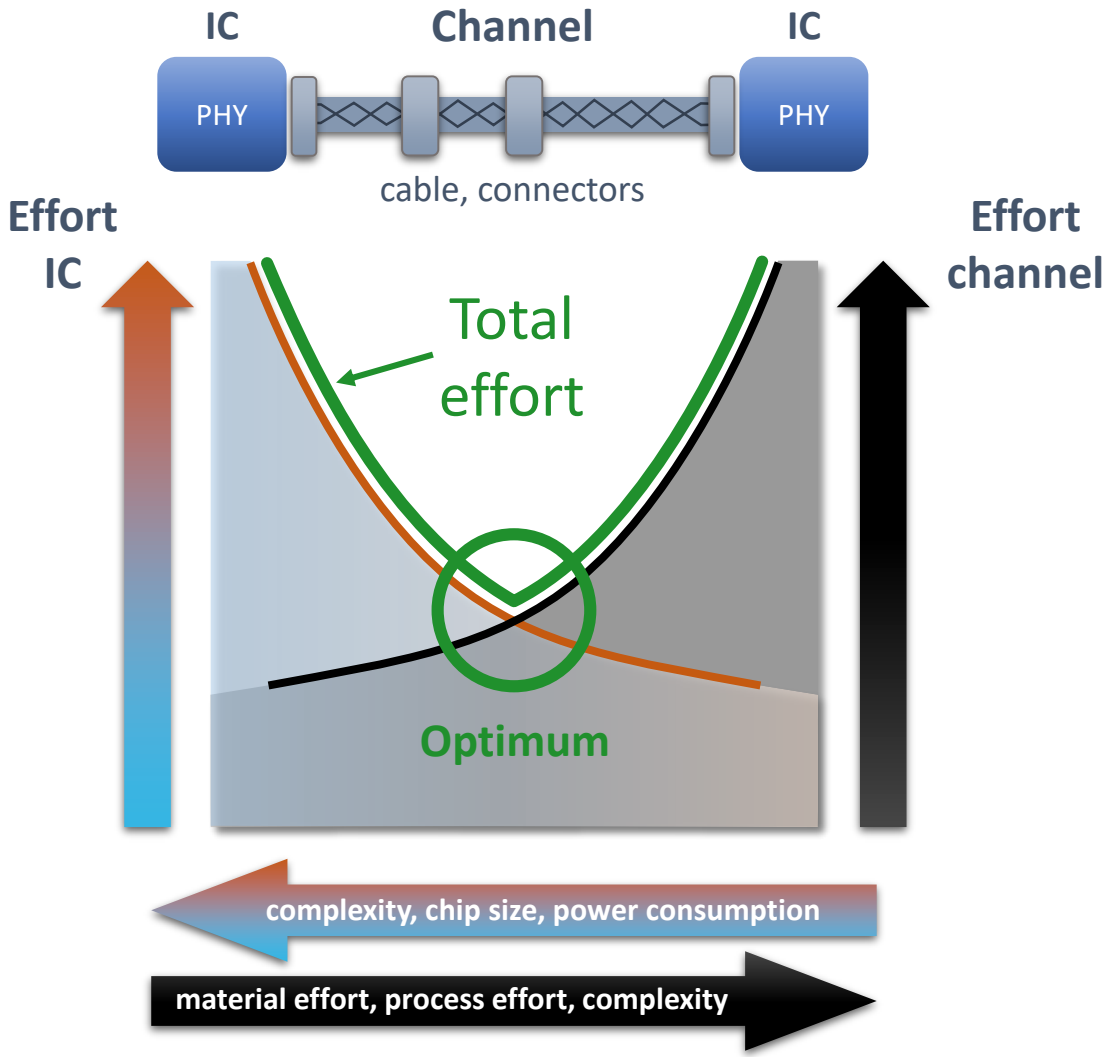
Data Capacity of Automotive Data Cabling
How fast can we go?

- Identify physical limits
- Estimate maximum data rate
- Consider robust system design and automotive requirements
- Propose possible system solutions for data rates up to 25 Gbps



Calculation of Achievable Data Rates

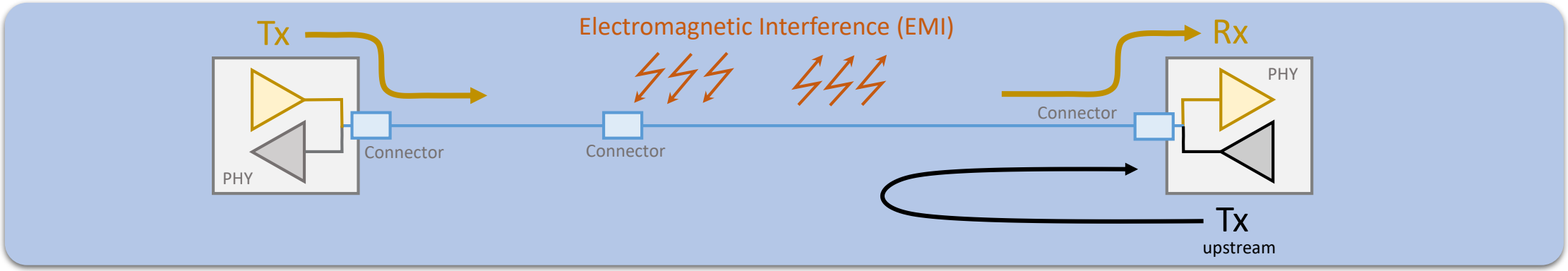
Considerations:

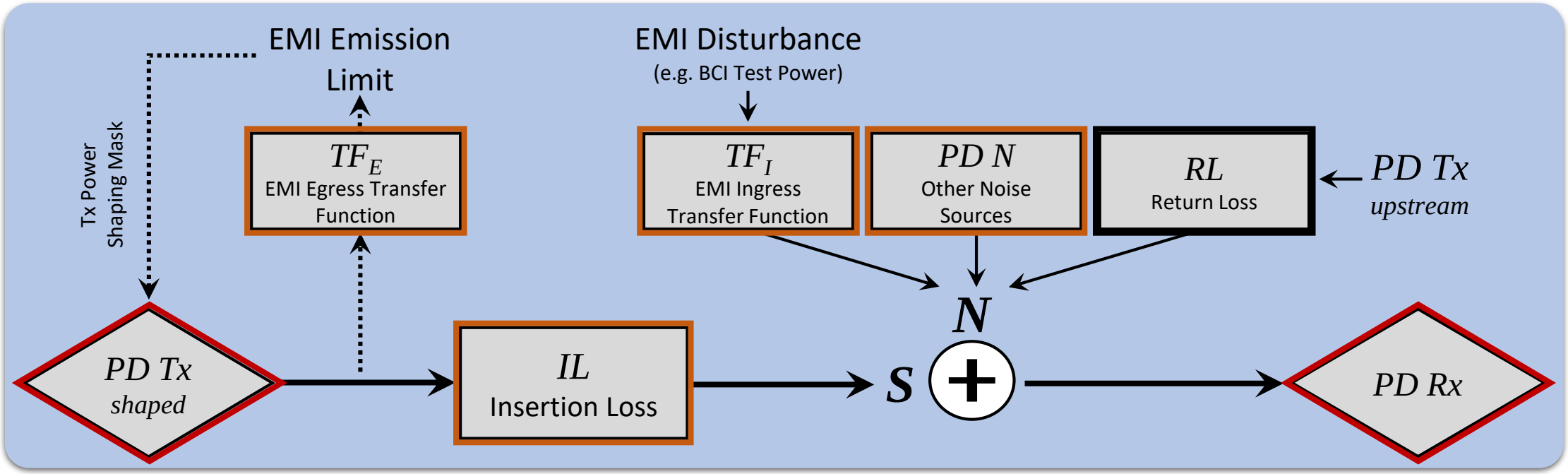
- Baseband signaling on
  0.14 mm² STP cabling
- Channel transmission parameter
  Return Loss, Insertion Loss
- Environmental degradation
- Electromagnetic emission limits
- Electromagnetic immunity
- PHY dependent transmission power limits, receiver noise, etc.

Shannon-Hartley theorem:
(for White Gaussian Noise)

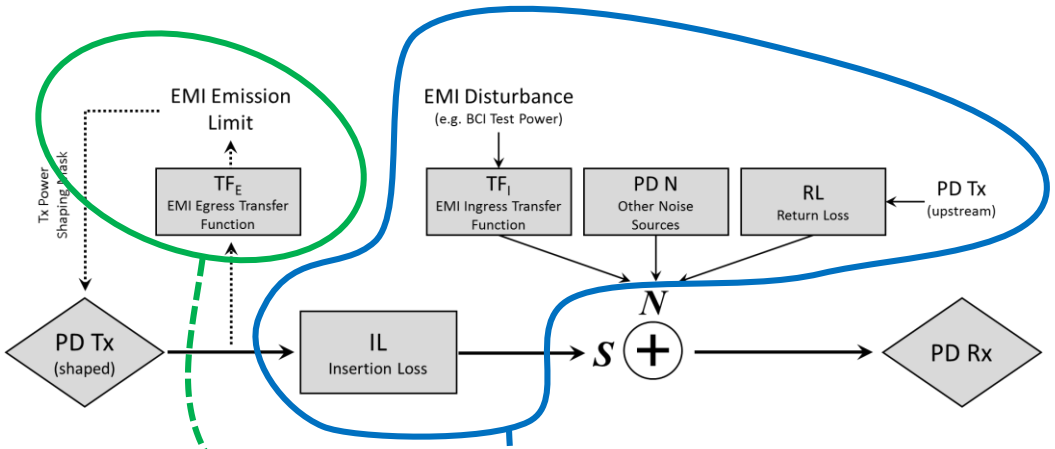
$$\text{Data Capacity} = \text{Bandwidth} \cdot \text{ld}\left(1 + \frac{\text{Signal}}{\text{Noise}}\right)$$

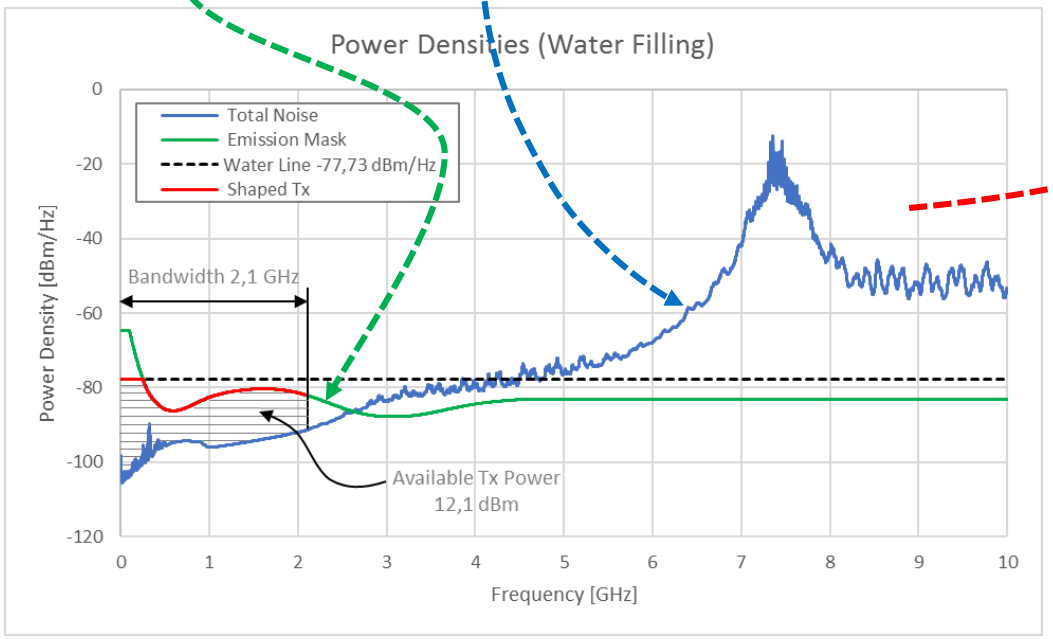
Channel Model Including EMI



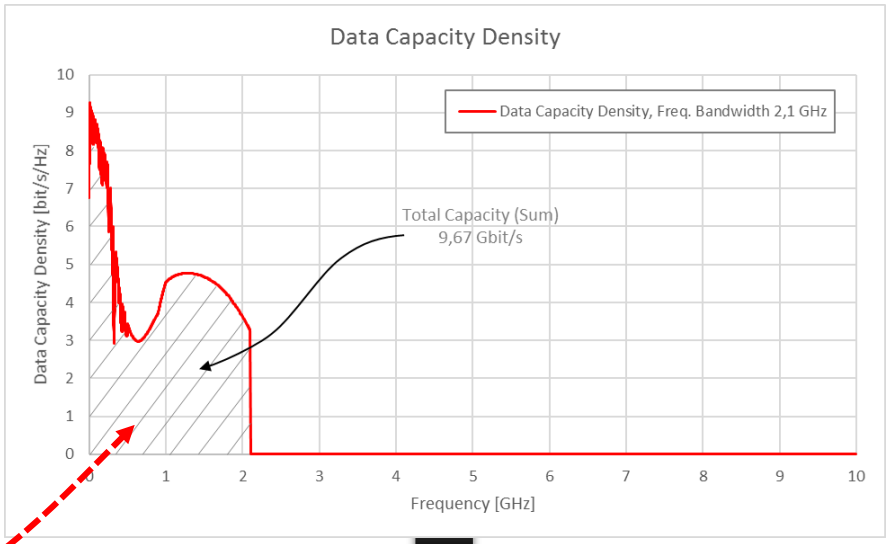


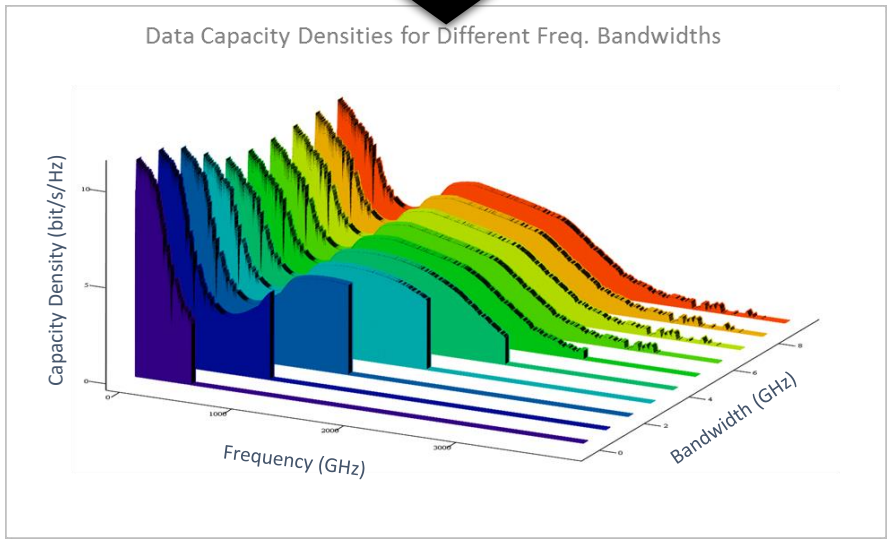
Channel Capacity – Methodology (Example Only)



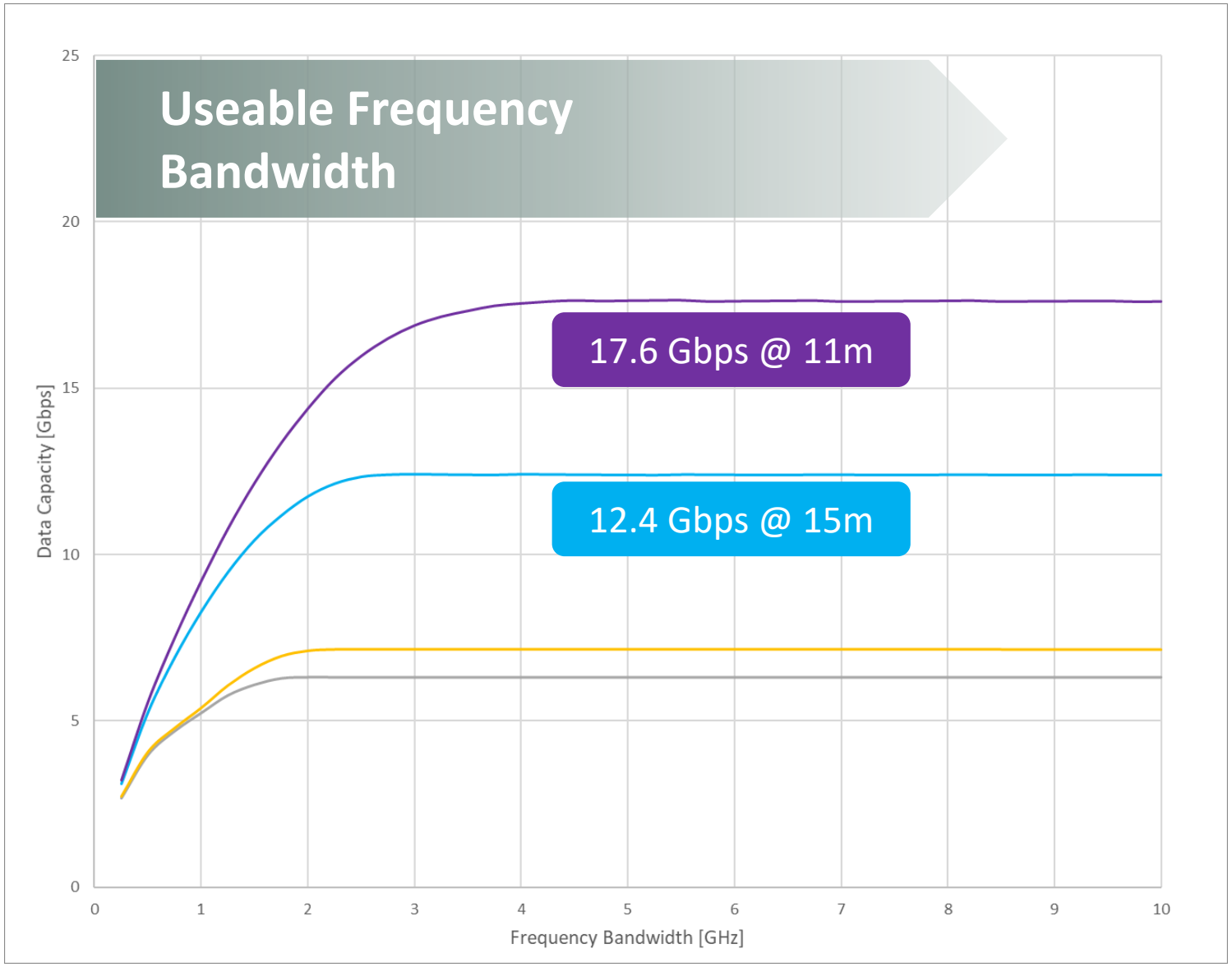


$$BW \cdot \mathrm{ld}\left(1 + \frac{S}{N}\right)$$





Channel Data Capacity Results



Assumptions:

- -125 dBm/Hz (Rx System Noise)
- 2 dBm TX Power

- Original STP link (0.14 mm², 15m Cable Length
- Increased RL (-30dB) & 15m Cable Length
- Increased RL (-30dB), reduced EMI (-15dB) & 15m Cable Length
- Increased RL (-30dB), reduced EMI (-15dB) & 11m Cable Length

Channel Capacity Analysis – Conclusions

- Data rates > 10 Gbps possible on single shielded pair
- Improvements by increased return loss and shielding
  → *appropriate connectors and cables*
- Insertion loss is primary limiting parameter
- Useable frequency bandwidth << 10 GHz

Channel Capacity Analysis
Options for Robust 25+ Gbps Systems

- Decreased insertion loss
  → *reduced length, improved STP/SPP*
  → *alternative media (e.g. coax)*
- Multiple number of Tx/Rx pairs
  → *multi lane solutions should be investigated*
- *Comparison with similar analysis from others would be important to confirm assumptions*

Thank You!!!