Extreme Return Loss Examples

Contribution to 802.3dm Task Force

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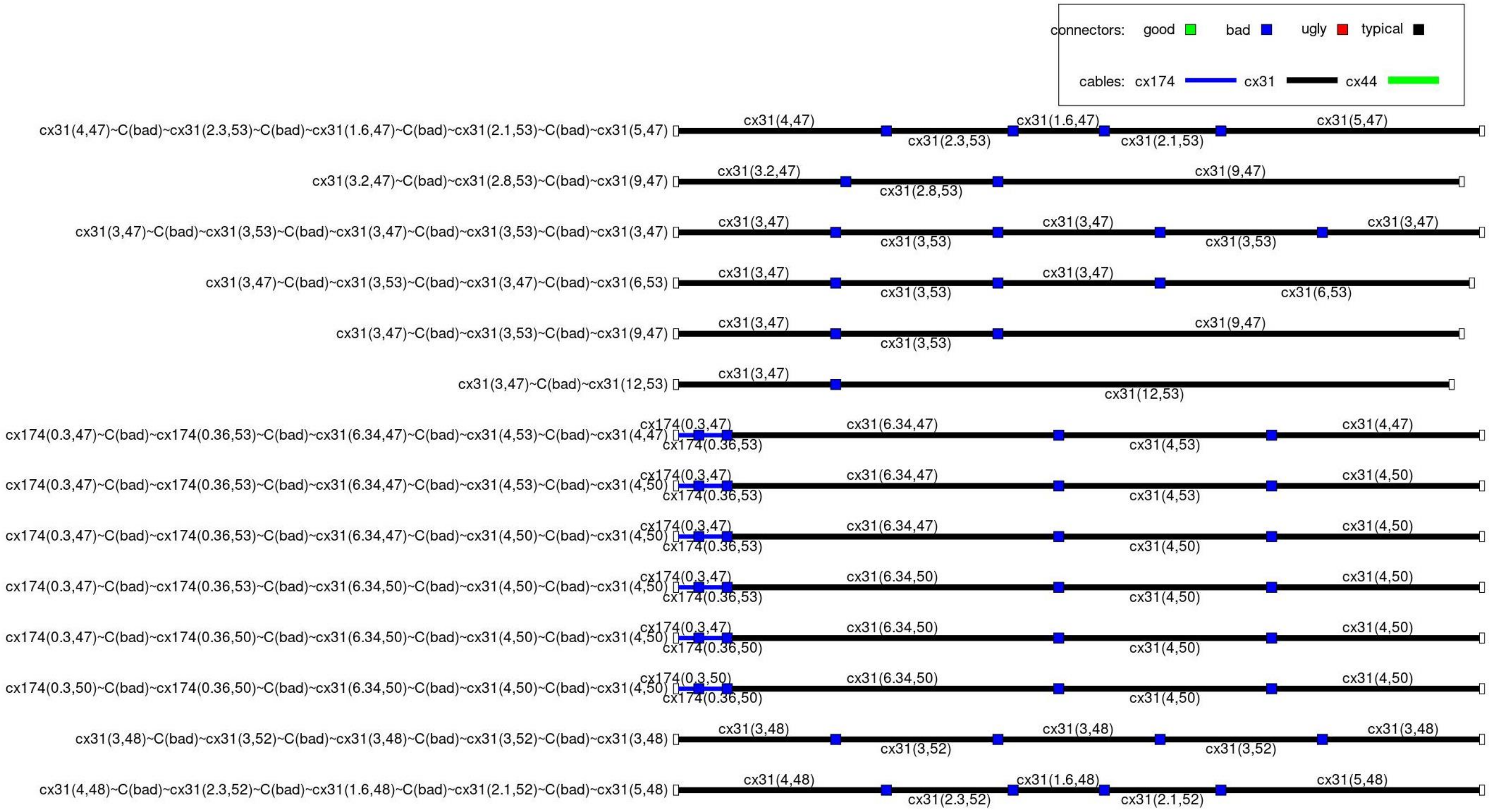
Introduction

- This presentation shows simulated Return Loss (RL) for **extreme cases**
- The following RL simulations will demonstrate the impact of
  - Number of connectors (cable segments)
  - Number of large impedance mismatches (how many cable segments have bad impedance mismatch)
  - Topology and the composition of cable segments of different length
  - Magnitude of the impedance mismatch

- The RL simulations in this presentation represent **extreme cases** and real live cables have significantly less echo

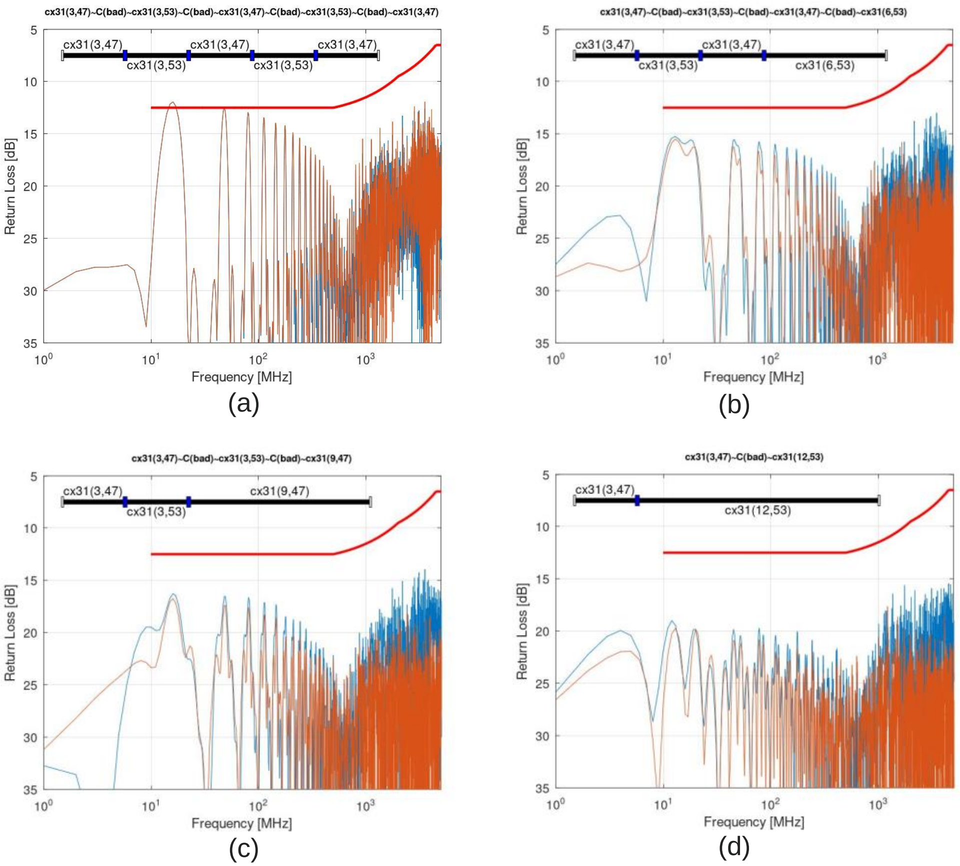
Real live cables have significantly less echo than the following **extreme RL cases**

Simulated Cables



Number of Inline Connectors

- The plots on the right show the Return Loss (RL) for cables with different number of inline connectors
- The cable segments alternate between 47Ω and 53Ω, for maximum low frequency echo
- The five-segment echo violates the Zerna RL limit, but all the other cases have more than 15dB RL
- The worst case for two inline connectors is about 17dB RL

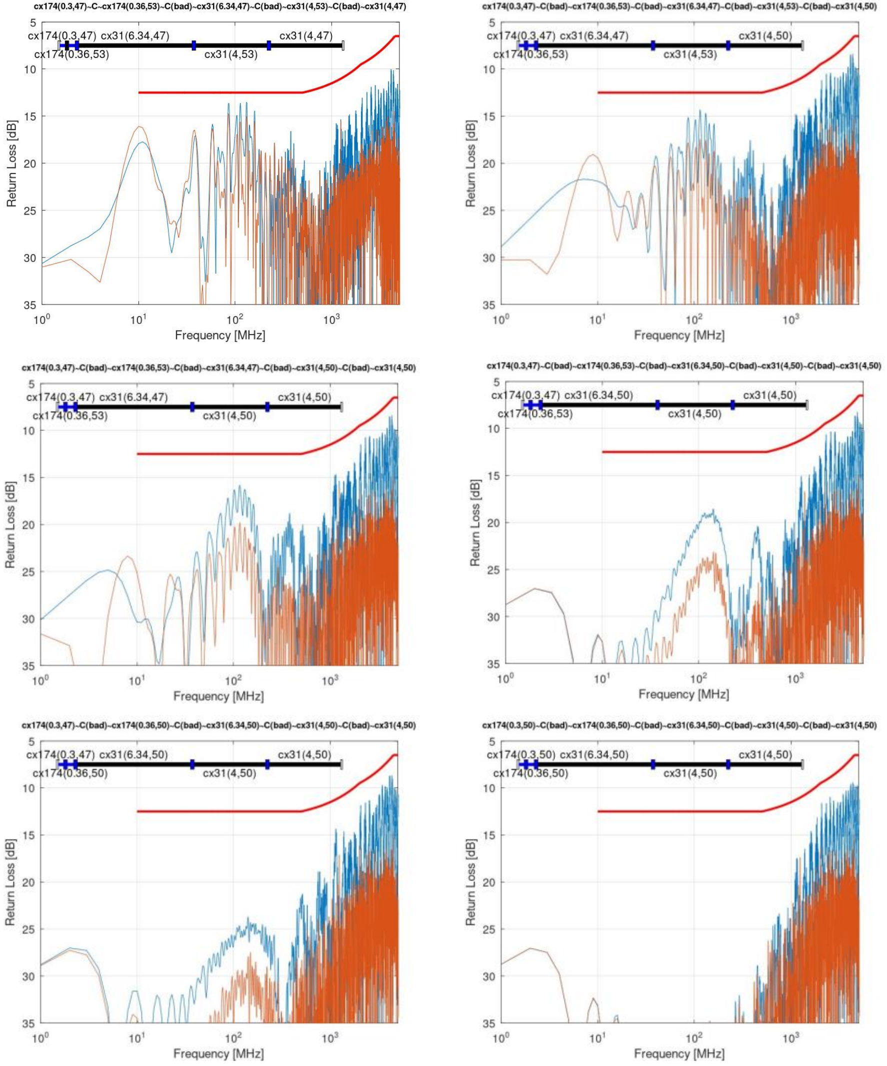


(a) (b) (c) (d)

The red line is the extreme RL limit from [Zerna_802.3dm_01b_240717_IL_RL_Limits.pdf]

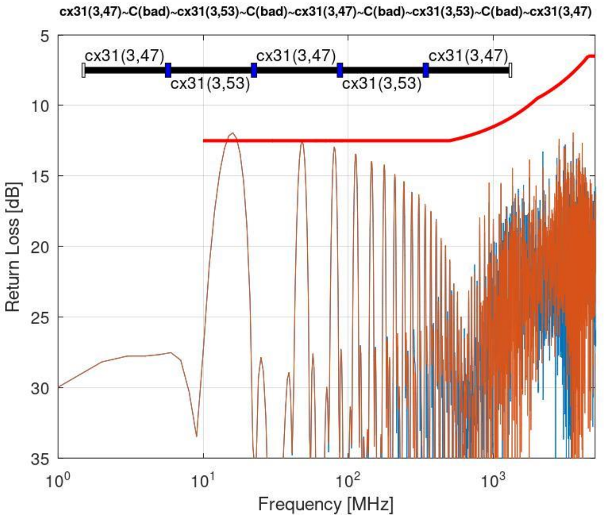
Number of Impedance Mismatches

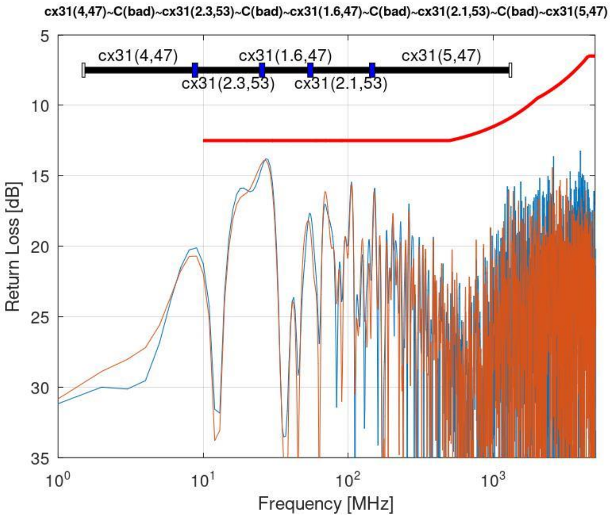
- The plots on the right show the Return Loss (RL) for cables with different number of impedance mismatch between segments
- The bad cable segments alternate between 47Ω and 53Ω, for maximum low frequency echo
- The low frequency echo for five mismatching segments is ~13dB
- The low frequency echo drops significantly with fewer mismatching segments



Impact of Topology

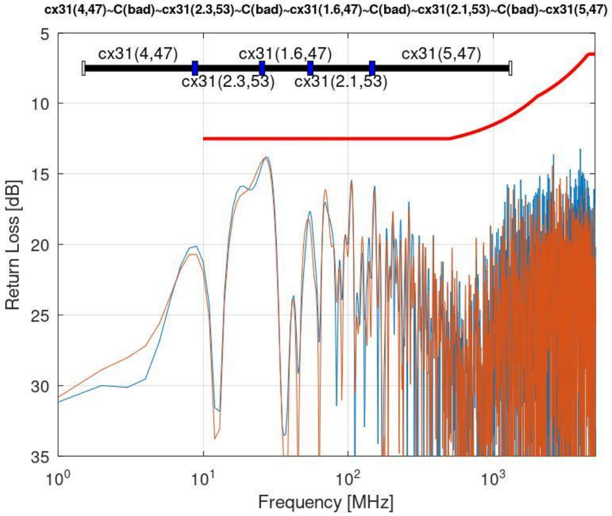
- The plots on the right show the Return Loss (RL) for cables with different length cable segments
- The cable segments alternate between 47Ω and 53Ω, for maximum low frequency echo
- The difference in topology has significant impact on the low-frequency echo
- For the better cable the RL is more than 15dB in the frequency range 30MHz-200MHz

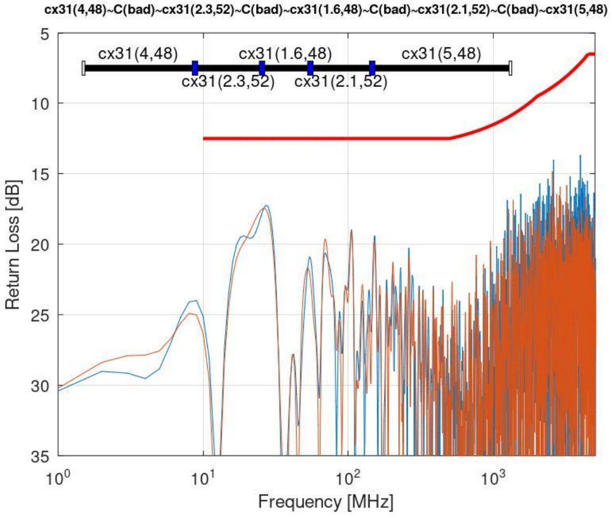




Impact of Z_0 Mismatch

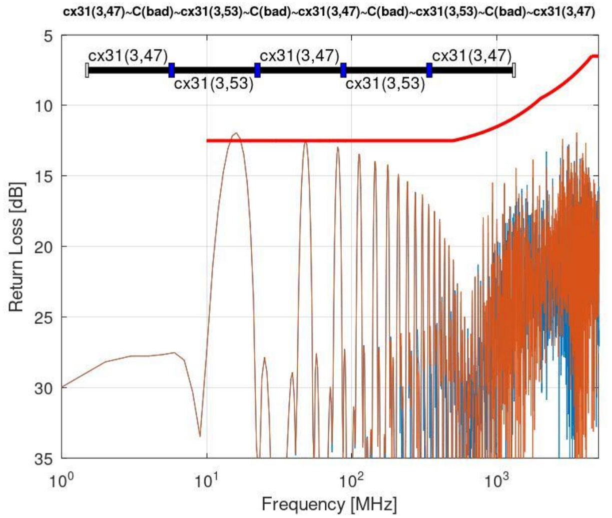
- The plots on the right show the Return Loss (RL) for cables with different impedance mismatch between cable segments
- In the top plot the cable segments alternate between 47Ω and 53Ω, while the bottom plot shows alternation between 48Ω and 52Ω
- The bottom plot is close to being the worst real case ever possible and the RL is more than 19dB in the frequency range 30MHz-200MHz

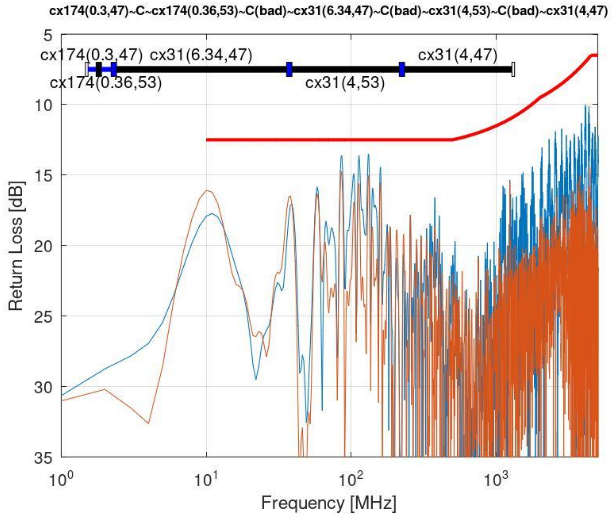




The RL Transfer Function is Not Smooth

- The plots on the right show the two worst case RL from previous slides
- It is important to note that the RL transfer function is characterized by peaks and valleys
- The average RL is much higher than the RL limit
- Real life echo is always less than it would be if the RL transfer function would be the RL limit





Summary

With two exceptions, even the simulated extreme RL cases in this presentation are significantly below the extreme RL limit from Zerna_802.3dm_01b_240717_IL_RL_Limits.pdf

Camera links have been deployed in multiple millions per year for over a decade, using RL limits like what is presented on slide 6 of boyer_sharma_3dm_xx_10_10_24.pdf

The simulations in this presentation show that unrealistic worst-case assumptions are needed to construct the simulated extreme echo cases and these do not represent real cables

The use of extreme worst-case RL simulations do not justify significantly tighter RL limits than the proven RL limits used in the industry today

There is no need for significantly tighter RL limits than what is used in the industry today

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