

Insertion loss and return loss limits

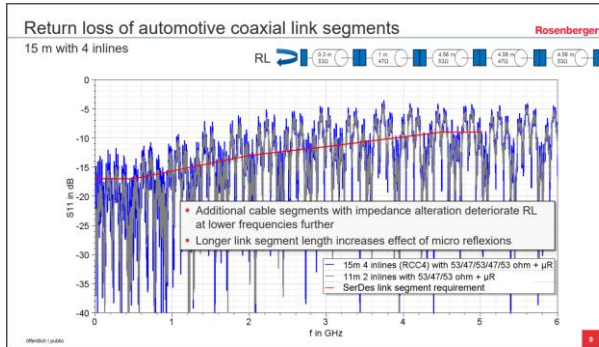
Contribution to 802.3dm Task Force

Ragnar Jonsson - Marvell

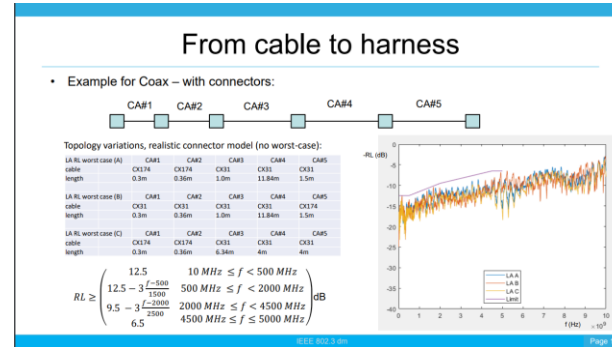
September 16, 2024

Introduction

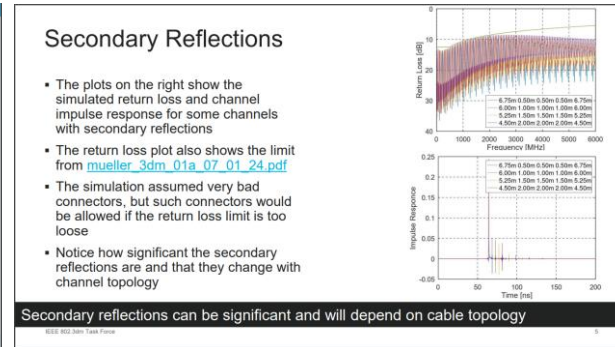
- It has been suggested to relax significantly the return loss limit
- It has been shown that this can cause secondary reflections that will make equalization harder
- This presentation evaluates the impact of secondary reflections on equalizer performance



From https://www.ieee802.org/3/dm/public/0724/mueller_3dm_01a_07_01_24.pdf



From https://www.ieee802.org/3/dm/public/0724/Zerna_802.3dm_01b_240717_IL_RL_Limits.pdf

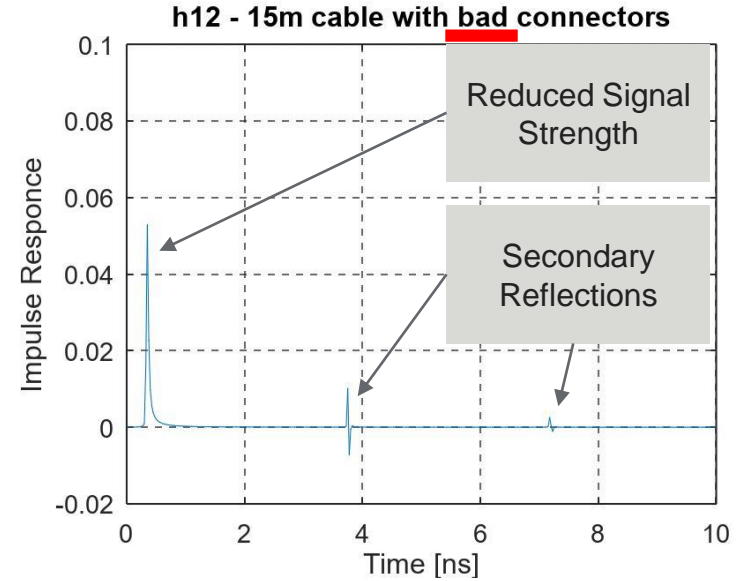
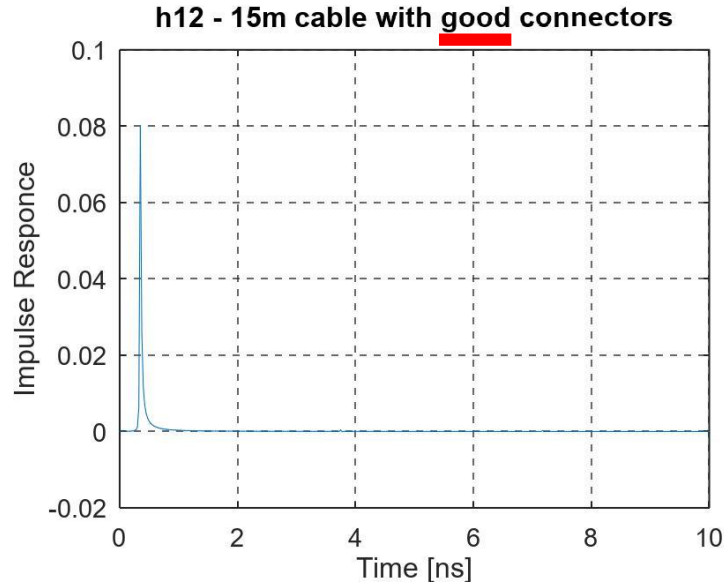


From https://www.ieee802.org/3/dm/public/adhoc/082824/jonsson_3dm_01a_08_28_24.pdf

Evaluating the Impact of Bad Connectors

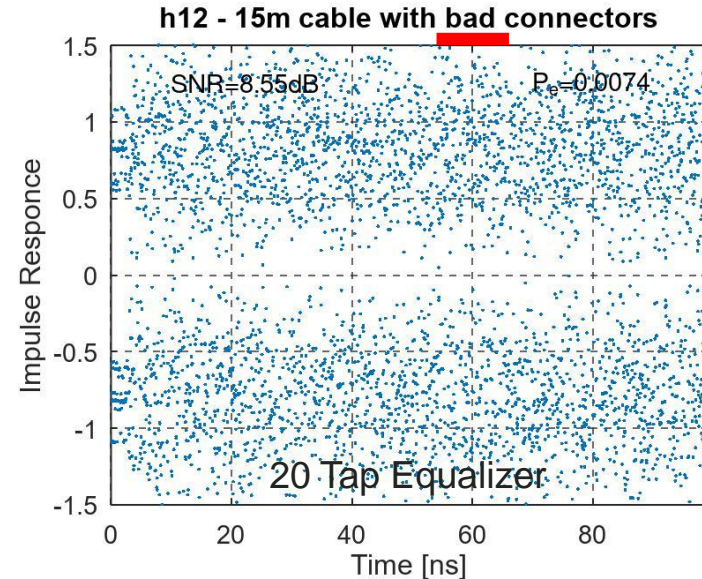
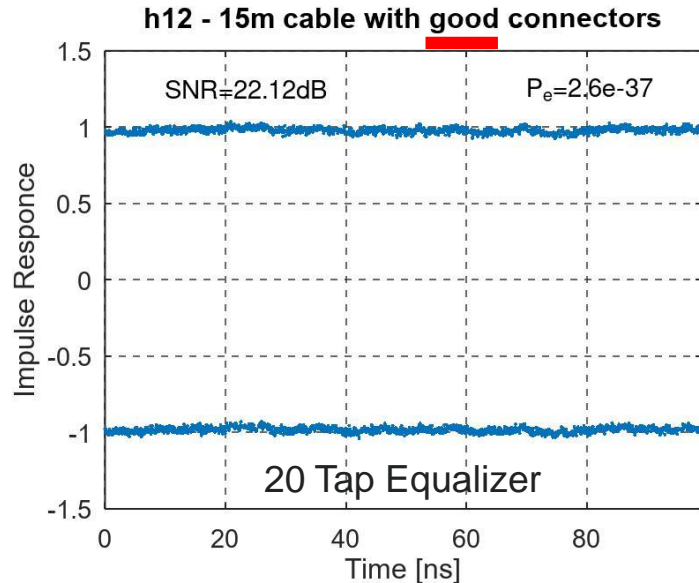
- The following slides show simulation results comparing PHY Equalizer performance for good and bad connectors
- The simulations are based on TDD system similar to 5Gbps ASA-MLE
- Simulation assumptions:
 - Line rate is 8Gbps (see [1])
 - PAM2 base-band modulation
 - Symbol rate of 8Gbps
 - Noise free with only Inter-Symbol Interference (ISI)
 - RTK044 cable with four inline connectors: 4.5m+2m+ 2m+ 2m+4.5m
- Since the simulation assumes TDD, there is no echo present on the link

Good vs Bad Connectors – Impulse Response



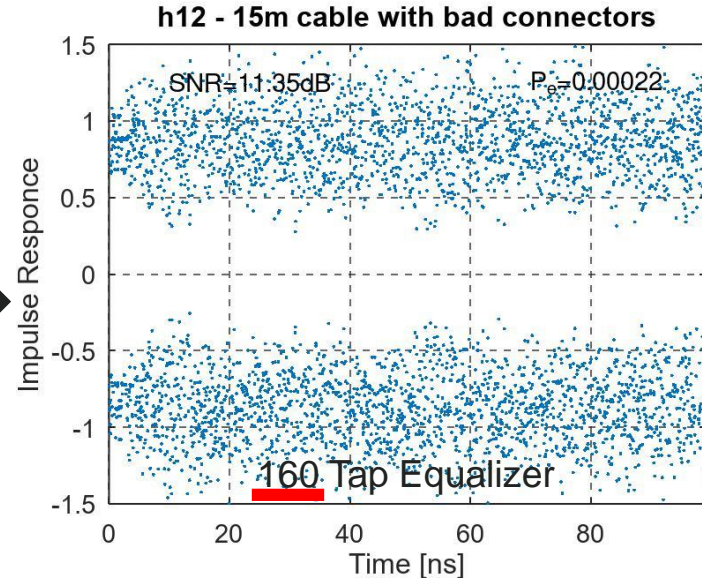
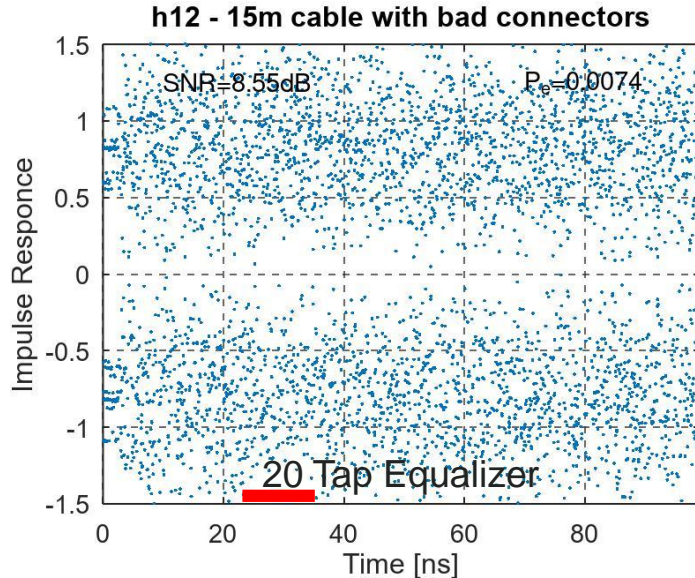
Bad connectors can cause secondary reflections that arrive after the main signal

Good vs Bad Connectors – Equalized Signal



The plots show the equalized signal for cables with good and bad connectors
The bad connectors significantly degrade the EQ performance (about 14dB)

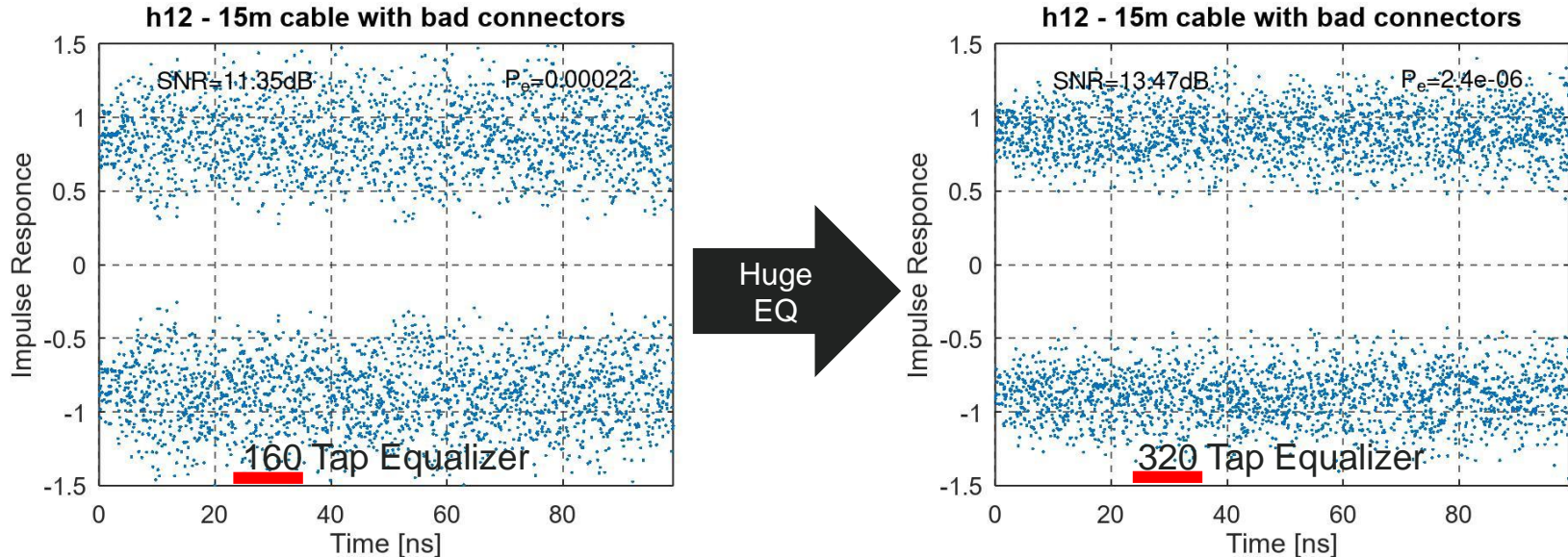
Good vs Bad Connectors – Longer Equalizer



Longer EQ can help mitigate the problem, somewhat

This drives up the relative cost and the power consumption of the PHY

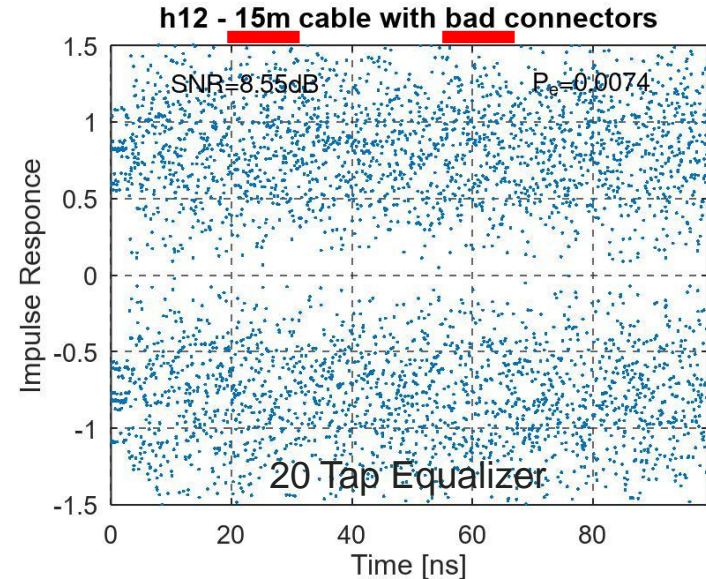
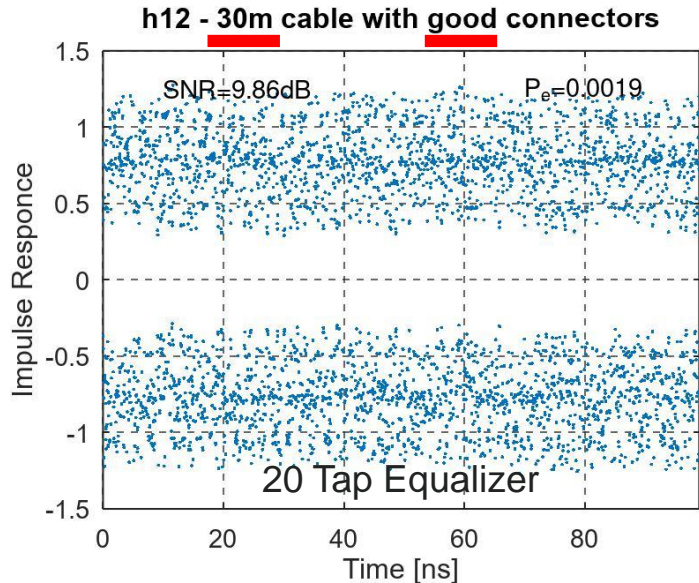
Good vs Bad Connectors – Huge Equalizer



Even longer EQ can help bring the SNR to levels where the link may stay up

Requiring over 300 equalizer taps at 8GHz sampling will never be viable

Right Tradeoff: Long Cables or Bad Connectors?



Comparing 30m cable with good connector to 15m cable with bad connectors
It is better to support longer cables with good connectors

Summary

- The worst-case return loss discussed in two presentations in the July meeting are too pessimistic
- Too relaxed return loss limit can result in secondary reflections in the channel insertion loss impulse response
- The secondary reflections will increase equalizer complexity and will drive up the relative cost of the PHY
- Rather than relaxing the return loss limit too much, it is better to relax the insertion loss limit to allow longer cables

Allowing bad connectors has little value, but drives up the relative cost of the PHY



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