Channel Discussion Summary

Contribution to 802.3dm Task Force Cabling Ad Hoc

August 1, 2024

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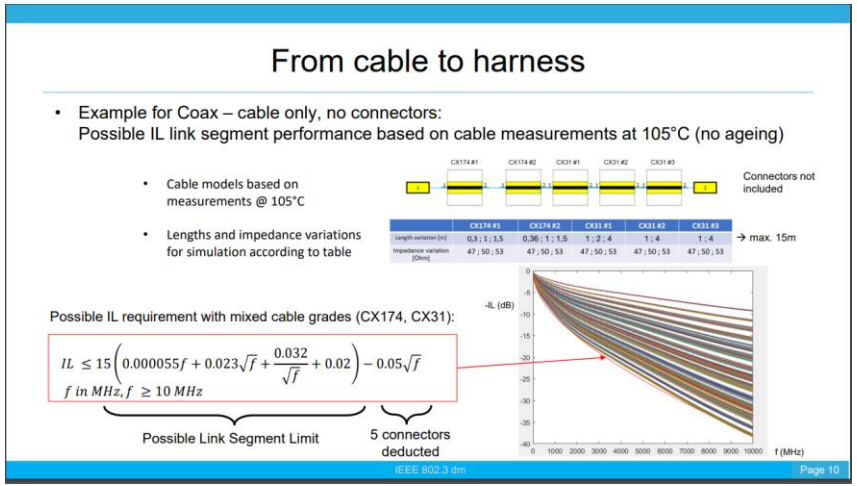
Introduction

- This slide deck is intended to summarizes the channel characteristics discussion in the 802.3dm task force so far
- Key things that have been discussed
  - Insertion loss limits
  - Return loss limits
  - Noise models
  - MDI return loss requirements
- This slide deck also has a short summary of key points from each presentation on channel characteristics

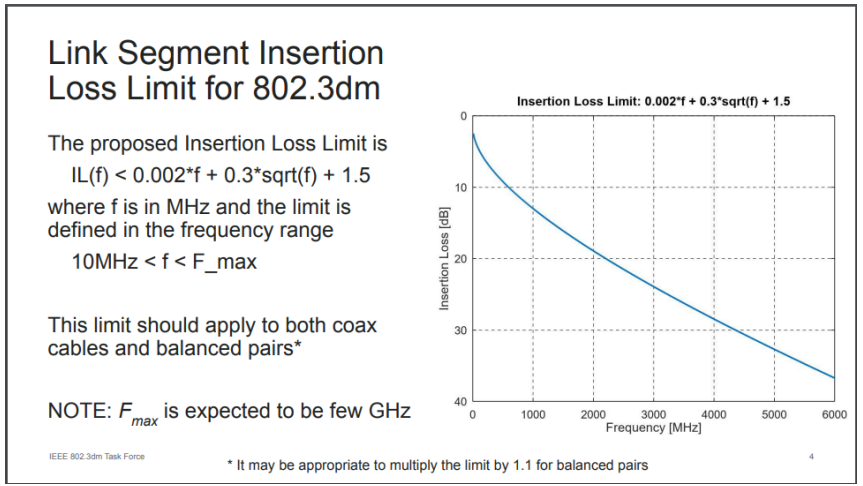
All comments and corrections are greatly appreciated

Insertion Loss Limits

From “IL & RL limits for STP and Coax cable harnesses” by Bert Bergner, David Cliber, Jonathan Silvano de Sousa, and Conrad Zerna
https://www.ieee802.org/3/dm/public/0724/Zerna_802.3dm_01b_240717_IL_RL_Limits.pdf

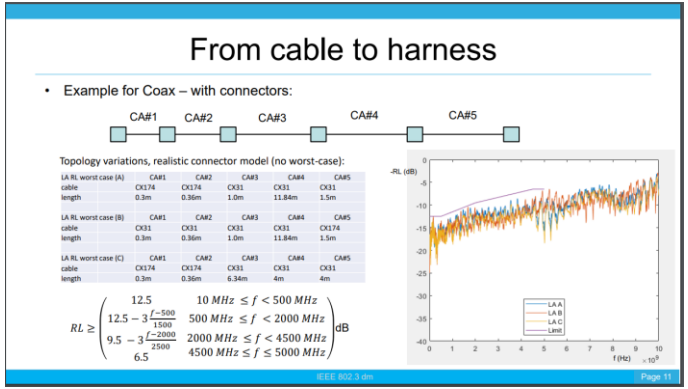


From “On Insertion and Return Loss” by Ragnar Jonsson and TJ Houck
https://www.ieee802.org/3/dm/public/0724/jonsson_houck_3dm_01_07_15_24.pdf

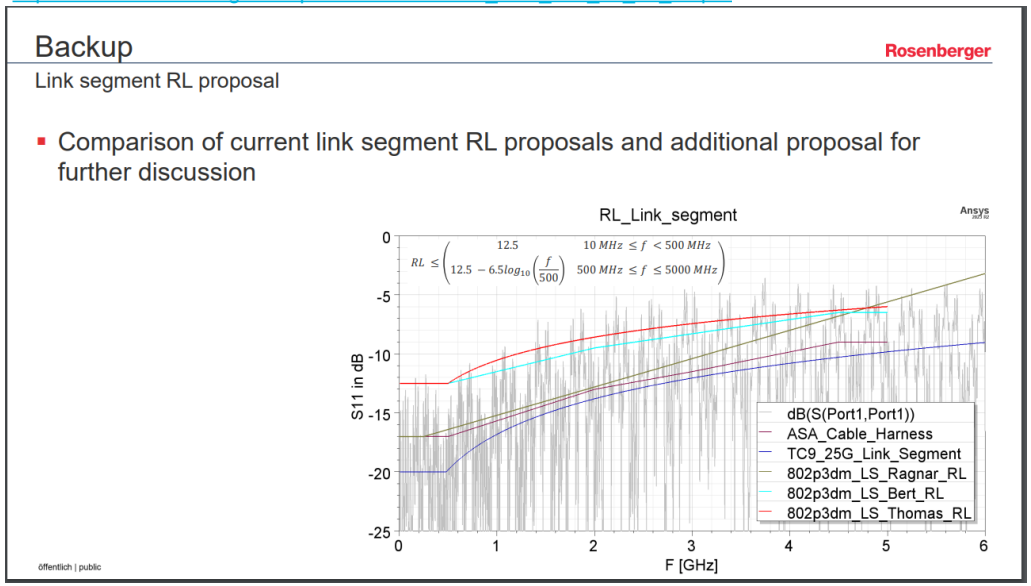


Return Loss Limits

From "IL & RL limits for STP and Coax cable harnesses" by Bert Bergner, David Cliber, Jonathan Silvano de Sousa, and Conrad Zerna
https://www.ieee802.org/3/dm/public/0724/Zerna_802.3dm_01b_240717_IL_RL_Limits.pdf



From "Return loss of automotive coaxial link segments" by Thomas Müller, Stephan Kunz and Philipp Grimm
https://www.ieee802.org/3/dm/public/0724/mueller_3dm_01a_07_01_24.pdf



From "On Insertion and Return Loss" by Ragnar Jonsson and TJ Houck
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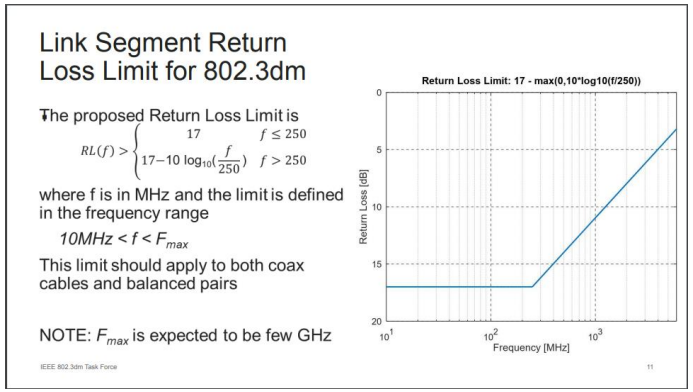
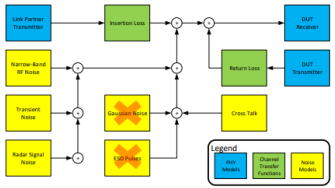


Noise Models

From “Noise Environment Characteristics” by Ragnar Jonsson
https://www.ieee802.org/3/dm/public/0724/jonsson_3dm_01_07_15_24.pdf

Summary

- This presentation describes model of the environmental noise that may impact 802.3dm line code evaluation
- Specific models have been proposed to describe the environmental noise
- The model is intended to be comprehensive enough to describe the relevant noise sources, without over complicating the model
- Noise modeling may require dedicated ad hoc meeting



All feedback and suggested improvements are greatly appreciated

From “Automotive Noise Consideration for IEEE 802.3dm” by Ahmad Chini and Mehmet Tazebay https://www.ieee802.org/3/dm/public/0524/Chini_Tazebay_3dm_01a_0524.pdf

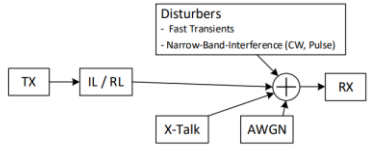
Final Message

- The relative intensity of received noise in automotive applications varies significantly by many factors including the cable length, thermal and mechanical aging of cables, installation choices and board design.
- Transient noises are mostly in lower frequency band and are attenuated using a high pass receiver.
- Given all the known and unknown noise types and intensity, the 802.3dm project should allow for highest practical ingress noise for each target data rate while observing complexity and power limitations.
- It is not sufficient to optimize the link based on **AWGN noise** when dominant noise type is narrowband noise. While some CW noises may be rejected by a good receiver design, not all noise types can be rejected by the receiver and need to be considered in 802.3 spec development.

From “IL & RL limits for STP and Coax cable harnesses” by Bert Bergner, David Cliber, Jonathan Silvano de Sousa, and Conrad Zerna
https://www.ieee802.org/3/dm/public/0724/Zerna_802.3dm_01b_240717_IL_RL_Limits.pdf

System and Physical Layer perspective

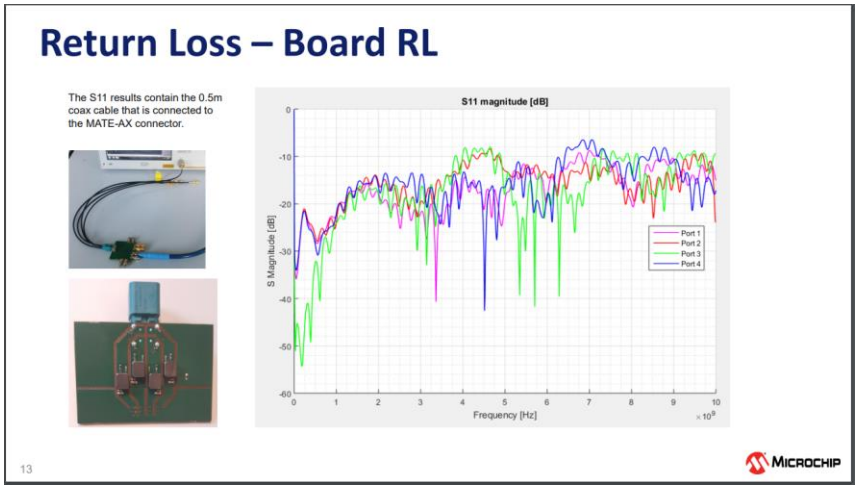
- Channel / System perspective
- Beyond IL / RL, other channel parameters are also different
  - X-Talk
  - Disturber Fast Transient
  - Disturber NBI
- Comparison is for signal component
  - STP has also common mode signal, which will show higher X-Talk and disturber levels
  - Coax is single-ended system
- For most cost-efficient system, the PHY should not be over-/under-specified for one cable type (or the other)



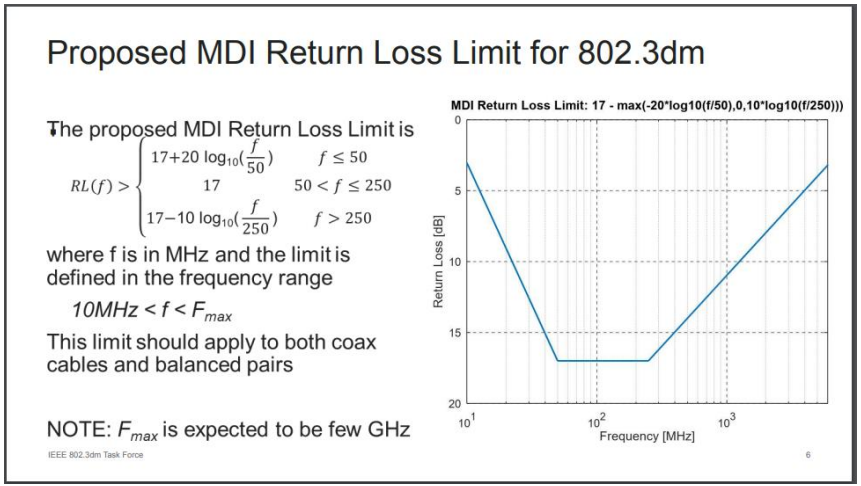
	X-Talk	Fast Transients	NBI
Coax	LF higher HF lower	Larger amp Longer tail	LF higher HF similar
STP	LF lower HF higher	Lower amp Shorter tail	LF lower HF similar

MDI Return Loss Requirements

From “4-Port MATE-AX PCB; Near End Receiver Crosstalk Measurement Results” by Zjef Van de Poel and Akos Felso
https://www.ieee802.org/3/dm/public/0524/felso_3dm_01_2405.pdf



From “On MDI Return Loss and Power Delivery” by Ragnar Jonsson and TJ Houck
https://www.ieee802.org/3/dm/public/0724/jonsson_houck_3dm_02_07_15_24.pdf



High-level summary of channel characteristics presentations

Annapolis Presentations on Channel Characteristics

Title	Presenter(s)	Affiliation(s)
Coaxial Cables Performance	Jonathan Silvano de Sousa	Gebauer & Griller Kabelwerke Gesellschaft m.b
Coaxial Unbalanced Media for Automotive Applications	David Cliber	TE Connectivity
4-Port MATEX-AX PCB: Near End Receiver Crosstalk Measurement Results	Akos Felso	Microchip
Automotive Noise Consideration for IEEE 802.3dm	Ahmad Chini Mehmet Tazebay	Broadcom

Coaxial Cables Performance

The presentation “Coaxial Cables Performance” by Jonathan Silvano de Sousa (see https://www.ieee802.org/3/dm/public/0524/Coax_Cables_Silvano_de_Sousa_ISAAC_Interim_may_2024(002).pdf) discusses Coax cable insertion loss, screening attenuation, and impedance

The key points in this presentation are:

1. Data for 2 types of cables: Standard RTK 031 (CX31a) and Flexible Case RG 174 (CX174d)
2. Long term ageing effects and performance decay after bending stresses are discussed

Coaxial Unbalanced Media for Automotive Applications

The presentation “Coaxial Unbalanced Media for Automotive Applications” by David Cliber and Bert Bergner (see https://www.ieee802.org/3/dm/public/0524/03May24_802.3dm_Cliber.pdf) discusses Coax cable topology and insertion loss

The key points in this presentation are:

1. Use 3 m flexible cable (CX174d/e) and 12 m low loss (CX31a) cable for link segment insertion loss analysis
2. Consider USCAR 17 and USCAR 49 connectors for calculation of return loss requirements (link segment and MDI)

4-Port MATE-AX PCB; Near End Receiver Crosstalk Measurement Results

The presentation “4-Port MATE-AX PCB; Near End Receiver Crosstalk Measurement Results” by Zjef Van de Poel and Akos Felso (see https://www.ieee802.org/3/dm/public/0524/felso_3dm_01_2405.pdf) discusses PCB return loss and crosstalk measurements

The key points in this presentation are:

1. Measurements of reference PCB boards with PoC
2. Measurements results for PCB insertion loss, MDI return loss, and PCB crosstalk

Automotive Noise Consideration for IEEE 802.3dm

The presentation “Automotive Noise Consideration for IEEE 802.3dm” by Ahmad Chini and Mehmet Tazebay (see https://www.ieee802.org/3/dm/public/0524/Chini_Tazebay_3dm_01a_0524.pdf) discusses automotive noise

The key points in this presentation are:

1. It is important to consider EMC when evaluating 802.3dm solutions
2. Things to consider include radiated emission, transient noise immunity, and radiated noise immunity

Montreal Presentations on Channel Characteristics

Title	Presenter(s)	Affiliation(s)
IL & RL limits for STP and Coax cable harnesses (01b)	Conrad Zerna Bert Bergner David Cliber Jonathan Silvano de Sousa	Aviva Links TE TE G&G
On Insertion and Return Loss	Ragnar Jonsson TJ Houck	Marvell Marvell
On MDI Return Loss and Power Delivery	Ragnar Jonsson TJ Houck	Marvell Marvell
Noise Environment Characteristics	Ragnar Jonsson	Marvell
Return loss of automotive coaxial link segments (01a) (late)	Thomas Mueller	Rosenberger

[802.3_ISAAC] Insertion Loss Limits for 802.3dm

There was email exchange on the 802.3_ISAAC reflector in late May and early June, that was prompted by email from Ragnar on “[802.3_ISAAC] Insertion Loss Limits for 802.3dm” (see https://ieee802.org/3/ISAAC/email/msg00104.html)

The initial email in this thread raised two main questions:

1. Should the insertion loss limit be based of combinations of CX174d/e (flexible) and CX31a (low loss) cable grades
2. Should there be single insertion loss limit for Coax and Differential Pair or should these have two separate insertion loss limits

The following email exchange reflected more than one view on these questions

IL & RL limits for STP and Coax cable harnesses

The presentation “IL & RL limits for STP and Coax cable harnesses” by Bert Bergner, David Cliber, Jonathan Silvano de Sousa, and Conrad Zerna (see https://www.ieee802.org/3/dm/public/0724/Zerna_802.3dm_01b_240717_IL_RL_Limits.pdf) discusses link insertion loss and return loss

The key points in this presentation are:

1. There is need for separate insertion loss limit for Coax vs STP
2. Possible Coax insertion loss requirement is identified (see slide 10)
3. Possible Coax return loss limit is suggested (see slide 11)
4. It is suggested to take differential pair reference data from Open Alliance (TC9) and ASA and take Coax reference data from ASA and ISO

On Insertion and Return Loss

The presentation “On Insertion and Return Loss” by Ragnar Jonsson and TJ Houck (see https://www.ieee802.org/3/dm/public/0724/jonsson_houck_3dm_01_07_15_24.pdf) discusses link insertion loss and return loss

The key points in this presentation are:

1. Single insertion loss limit is proposed for both Coax and differential pair (see slide 4)
2. Single return loss limit is proposed for both Coax and differential pair (see slide 11)

On MDI Return Loss and Power Delivery

The presentation “On MDI Return Loss and Power Delivery” by Ragnar Jonsson and TJ Houck (see https://www.ieee802.org/3/dm/public/0724/jonsson_houck_3dm_02_07_15_24.pdf) discusses MDI return loss

The key points in this presentation are:

1. The MDI return loss limits should not be too constrictive for PoC design
2. MDI return loss limit is proposed (see slide 6)

Noise Environment Characteristics

The presentation “Noise Environment Characteristics” by Ragnar Jonsson (see https://www.ieee802.org/3/dm/public/0724/jonsson_3dm_01_07_15_24.pdf) discusses noise environment for modulation evaluation

The key points in this presentation are:

1. The automotive noise environment should be considered when evaluating modulation and coding candidates
2. Specific noise models as suggested as starting points for further discussion

Return loss of automotive coaxial link segments

The presentation “Return loss of automotive coaxial link segments” by Thomas Müller, Stephan Kunz and Philipp Grimm (see https://www.ieee802.org/3/dm/public/0724/mueller_3dm_01a_07_01_24.pdf) discusses link return loss

The key points in this presentation are:

1. Share simulation results on automotive coaxial link segment return loss (RL) to support defining appropriate RL requirements
2. The Coax link segment return loss is significantly lower (worse) than what was defined in previous projects

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