



25GBASE-T1: Status and Way Forward

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February 09, 2021

LEADING NEW ICT

Overview

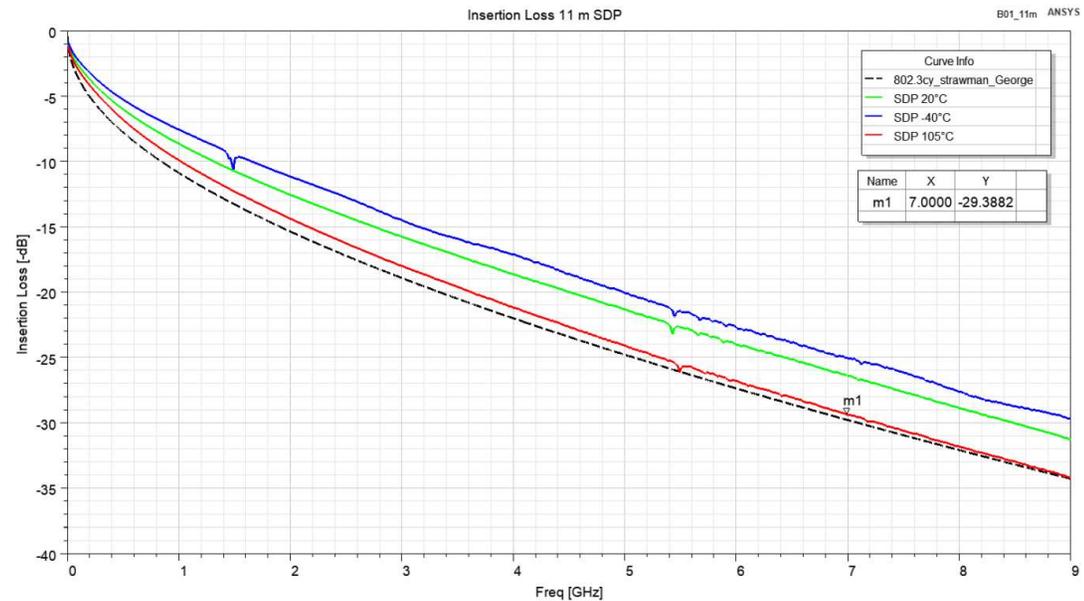
- Straw man proposal for 11m cable insertion loss [zimmerman 3cy 01a 1120.pdf](#) can be met including temperature effect [mueller 3cy 01 12 01 20.pdf](#)
- Previous results [sedarat 3cy 01 10 14 20.pdf](#) and [jonsson 3cy 01 1120.pdf](#) showed that 37dB channel loss [Kadry 3cy 02 0820.pdf](#) is infeasible
- Objective of having 11m reach link segment is a key for the success of this standard
- Board loss with components cannot be simply ignore given such tight limit on channel loss and there is an effort on going [diminico 3cy 01a 1 5 21.pdf](#)
- Few key measurements results on coupling attenuation and RF ingress are missing, resulting a difficulty to take decision on key PHY parameters

Assumption

- Data rate 25Gbit/s
- Channel code overhead 12%
- TX-PSD: 1Vpp Transmit voltage with ZOH
- Full duplex transmission
- Echo will be cancelled out completely
- Alien crosstalk noise
 - frequency extension of IEEE 802.3ch

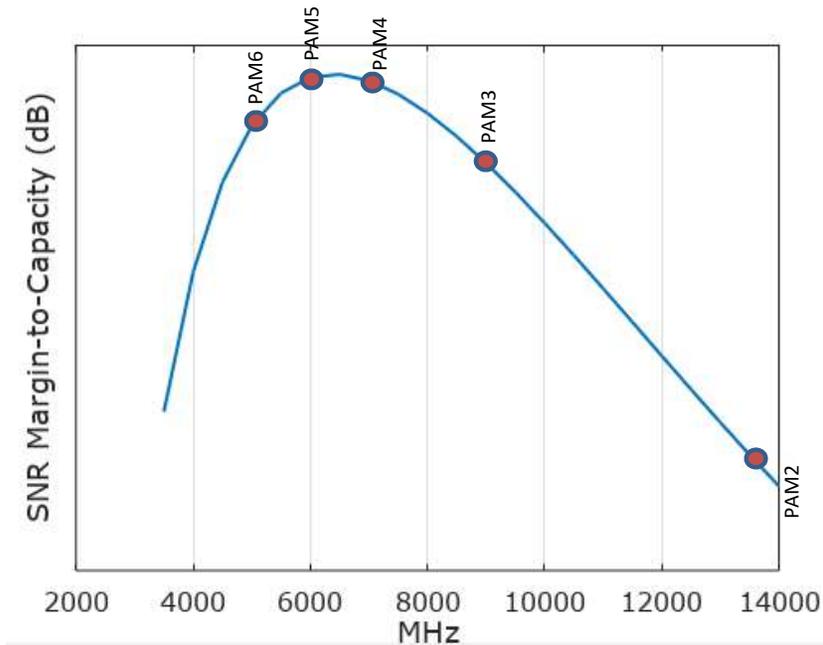
Channel Loss

- 11m cable
- Straw-man proposal as described in https://ieee802.org/3/cy/public/nov20/zimmerman_3cy_01_1120.pdf
- Measured 11m SDP cable loss as shown in https://www.ieee802.org/3/cy/public/adhoc/mueller_3cy_01_12_01_20.pdf



Margin to Capacity

- Both PAM4 and PAM5 seem to be an optimal in terms of operating frequency with highest margin
- Depending on noise floor their difference in margin is +/- 0.15dB (max.)
 - Low noise floor PAM4 gives highest margin
 - High noise floor PAM5 gives highest margin
- PAM5 has ~2.4dB lower eye height than PAM4
- Given a slight advantage on reduction in freq., PAM5 is still a less likely candidate
 - PAM5 needs a complex mapping (compare to PAM4) to get close to 2.3219 bits/symbol
 - PAM5 is more susceptible to RF interference

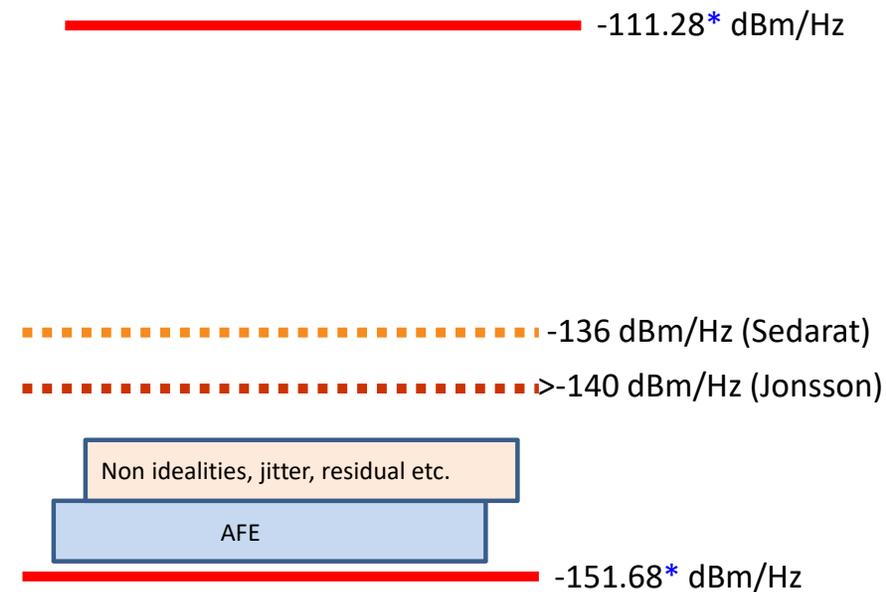


Noise Floor

- PAM4 modulation
- Alien-xtalk noise floor will be -151.68 dBm/Hz
- There is some room to improve the noise floor that is being discussed in task force
- Considering alien noise, PHY related noise and channel loss, it seems a PHY is feasible for 11m channel loss as data shown in

[mueller 3cy 01 12 01 20.pdf](#) assuming that

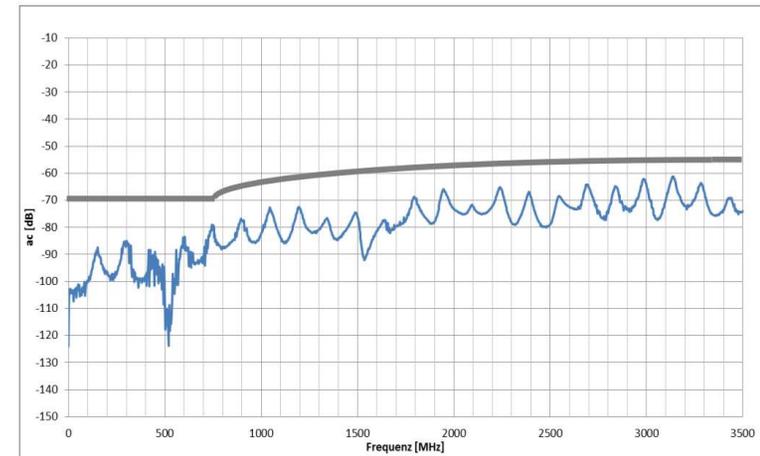
- RF ingress noise will not come as a huge surprise from the .3ch (5mV) value [mueller 3ch 03 0518.pdf](#)
- Board loss (including components) is <10% of the total loss (29.9dB)



**Note: These are not practical noise floor number, but shown here as an example.*

RF Ingress Noise Immunity

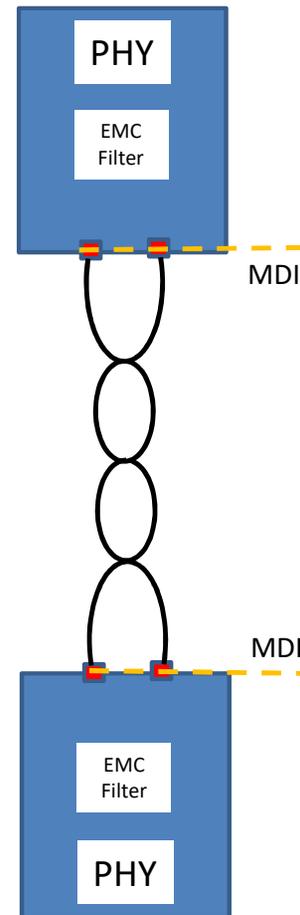
- FEC for RF Immunity? Answer is Yes and No
- Although it helps to relax noise floor, we cannot fully rely on FEC for NBI (Narrow Band Interference)
- Historically, FEC (Reed-Solomon) is not intended to solve NBI for all BASE-T1 PHYs
 - It is for the fast transient pulse
- Allocation of margin in dB for NBI is a relative value
 - Need absolute value
- Task force needs to agree on an absolute value of RF Ingress noise to backup the chosen insertion loss limit and modulation
 - Why not picking an extrapolated RF ingress noise amplitude based on .3ch data?



[mueller_3ch_02a_0518.pdf](#)

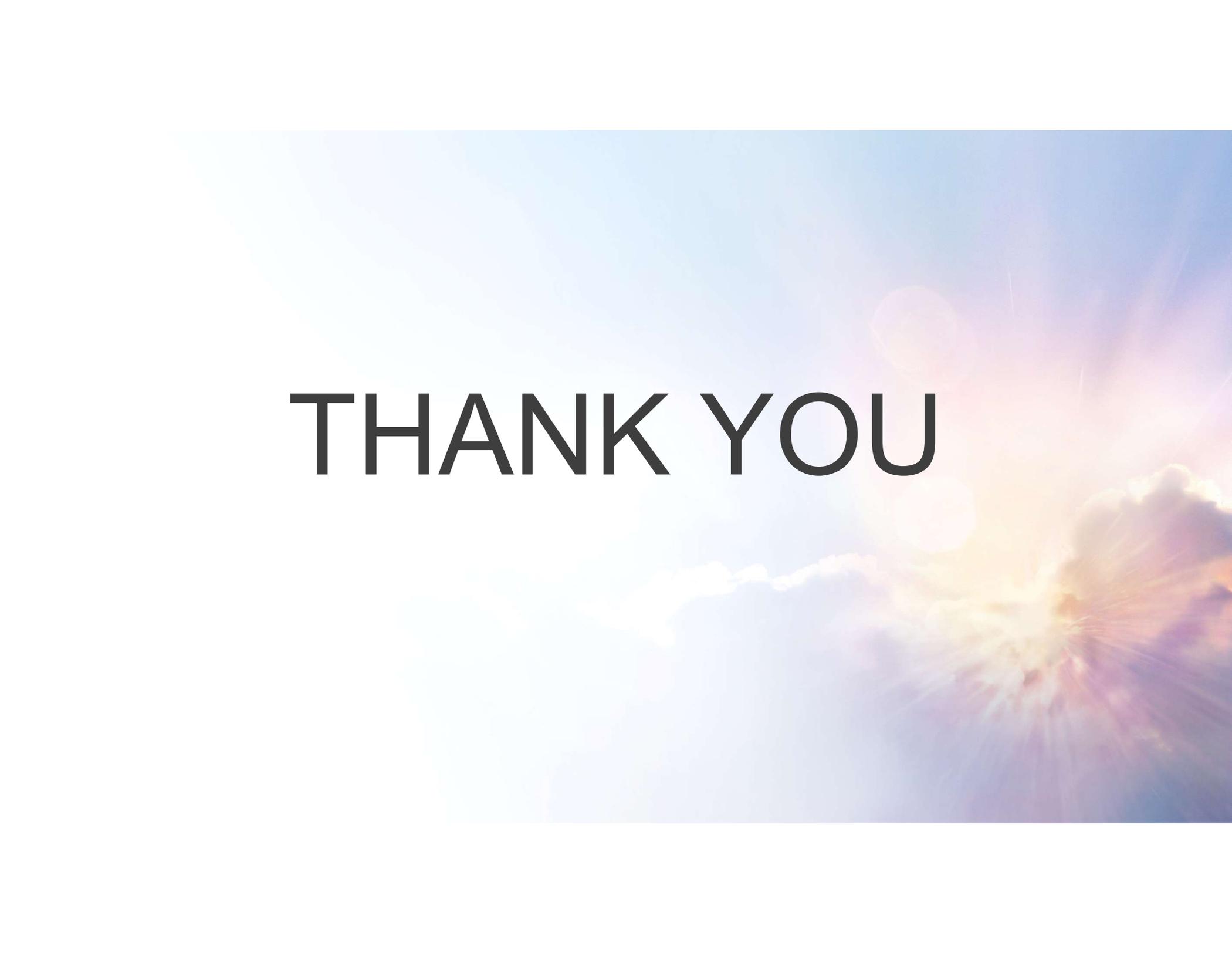
Interoperability ...

- In automotive, it is very common to use off-chip EMC filter at last minute
- TX-PSD mask definition at MDI allows to ignore the component loss of board at the transmitter side
 - Solves problems and also creates problems
- May need to boost the transmitter to overcome increased in board loss
 - This does not favor high speed device
- Signal may attenuate substantially due to its off-chip EMC filter
 - May run into problem of interoperability
- Board loss should not be taken as a “blanket” and cramming as many components as possible on board
- Must define total board loss limit considering off-chip components



Conclusions

- 11m reach link segment objective is a key for the success of this standard
- At this moment PAM4 modulation is the likely candidate
- 25GBASE-T1 will not be an easy PHY but it looks feasible for 11m link segment with insertion loss proposed in [zimmerman_3cy_01a_1120.pdf](#)
 - Board loss with components <10% max. insertion loss
 - RF ingress noise should be in a close proximity of .3ch
- At this stage, FEC coding gain should be decoupled with RF immunity
 - Can be explored through simulation in later stage
- Giving loss budget guideline for board including components is key to avoid any ambiguity on PHY interoperability



THANK YOU