Preliminary PHY Analysis on Updated Link Segment Specifications in graber_3dg_xx_03152023

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IEEE P802.3dg ad hoc

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Introduction

- New Link Segment Parameters have been provided in graber_02_03152023 and graber_03_03152023.
- This presentation provides preliminary PHY analysis to help consider those parameters
  - It is NOT a PHY baseline proposal at this time

PHY Modeling

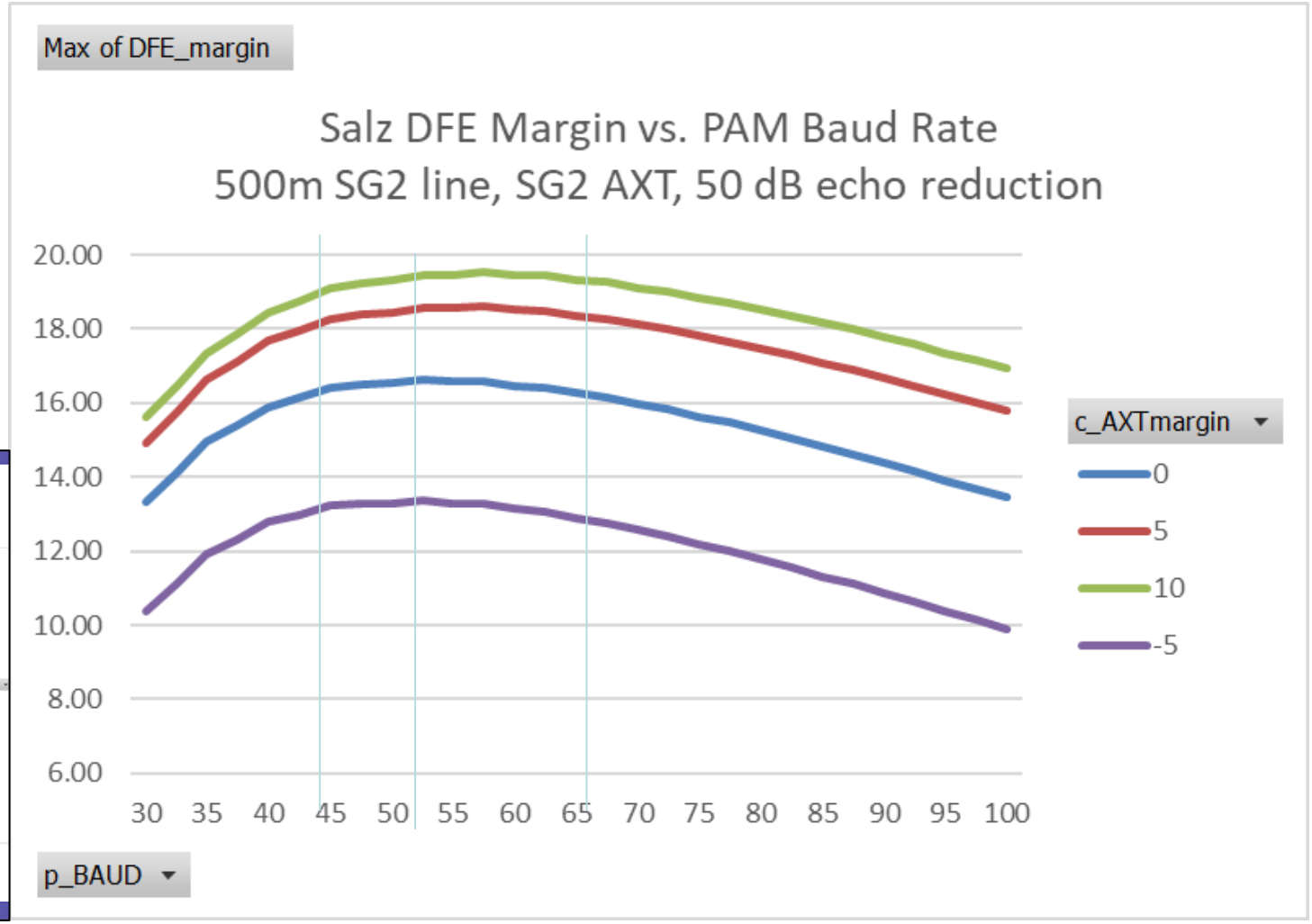
- Modeling is as previously in zimmerman_3dg_01_11022022
  - Desire to be implementation independent – use theoretical limitations, established, proven technique for Salz modeling
    - Extensible to PAM/QAM, shown to be equivalent to geometric SNR for multicarrier
    - Experience shows > 6 dB SNR margin needed, 8 dB reasonable, more than 10 dB often not realized
      - Relative to uncoded SNR (12.27 dB SNR gap)
        - » Coding Gain does not change shape of margin curve
      - Good indication that a system can be designed provided implementation-specific issues satisfied – not necessarily that any given PHY design with a given modulation works on a link segment
  - Model includes residual components from echo & receiver noise
    - Assume high degree of echo cancellation, good AFE
    - For this presentation use receiver parameters within technology, but high enough not to limit performance – focus on link segment - 50 dB echo, 12 bits ENOB (overkill)

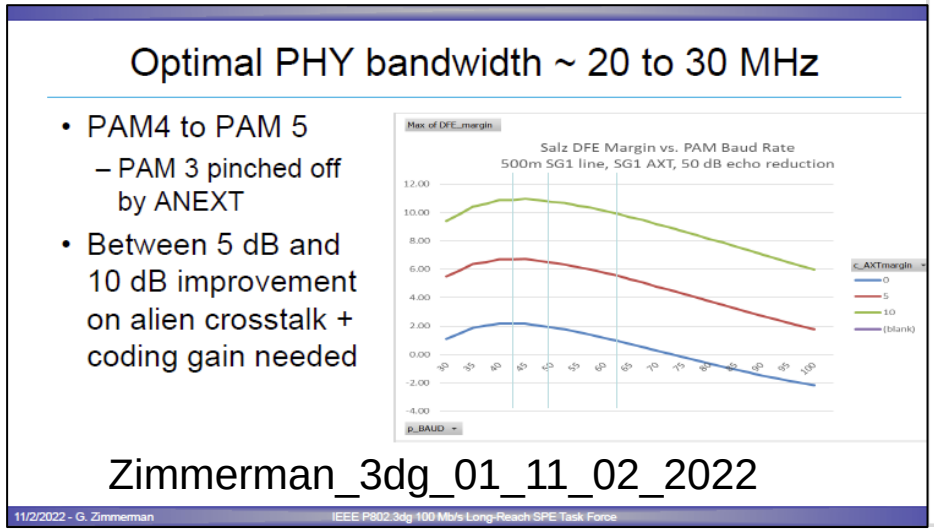
Link Segment Transmission Models –
IL & Alien Crosstalk from graber_03_03152023, slide 8

- Insertion Loss: $5.42*SQRT(f_{MHz})+0.044*f_{MHz}+1.76/SQRT(f_{MHz}))+5*0.02*SQRT(f_{MHz})$
- Return Loss: (graber_01_03152023 slide 14)
- $9+8* f_{MHz}$ dB ($f_{MHz} < 0.5$ MHz) , 13 dB ($0.5 \le f_{MHz} < 20$ MHz)
  $13-10*LOG10(f_{MHz}/20)$ ($20 \le f_{MHz} \le 100$ MHz)
- Alien NEXT: $55 + 5*N$ dB, ($f_{MHz} < 10$ MHz), $55 + 5*N - 15*LOG10(f_{MHz}/10)$ (10 MHz $\le f_{MHz}$)
  - N = 0 for *IL(20 MHz)* < 16 dB, N = 1 for 16 dB ≤ *IL(20 MHz)* < 21 dB, N= 2 for 21 dB ≤ *IL(20 MHz)*
- Alien FEXT: (PSAACR-F)
  $55 + 5*N$ dB, ($f_{MHz} < 2$ MHz), $41 + 5*N - 20*LOG10(f_{MHz}/10)$ (2 MHz $\le f_{MHz}$)
  - N = 0 for *IL(20 MHz)* < 16 dB, N = 1 for 16 dB ≤ *IL(20 MHz)* < 21 dB, N= 2 for 21 dB ≤ *IL(20 MHz)*

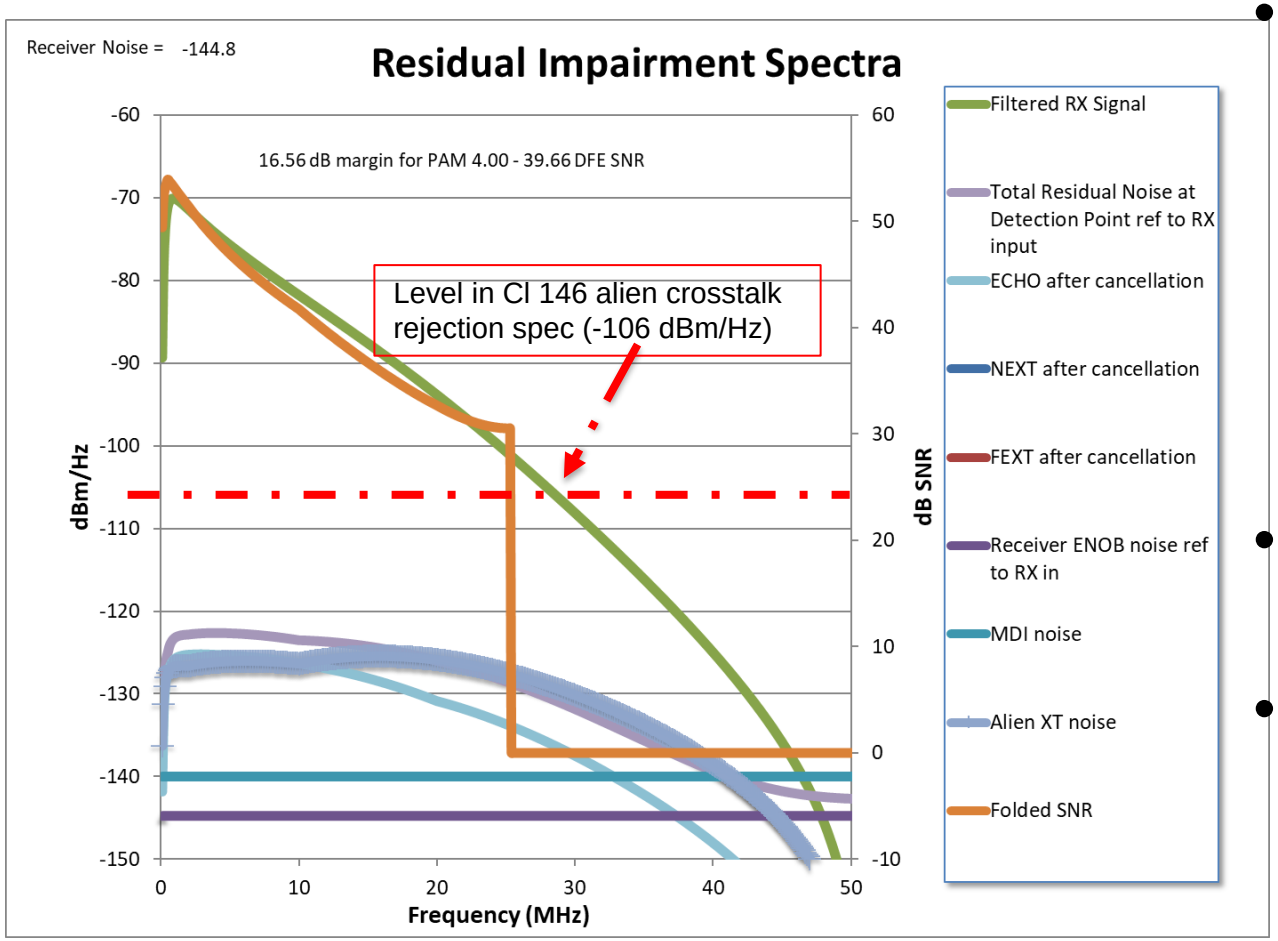
Optimal PHY bandwidth remains 20 to 30 MHz

- PAM3 to PAM5 all viable
- No further AXT or coding gain needed
- Sufficient margin for PHY implementation tradeoffs





Relative level of Alien Crosstalk is now near optimistic implementation levels



- Example shows alien crosstalk similar to optimistic cancelled echo levels
  - Minimal value on further reduction of alien noise
  - Implementation margin for complexity reduction
  - Noise level is almost 20dB less than Cl 146
- Alien crosstalk is less limiting to overall performance
- BUT, low residual noise levels come with increased risk of sensitivity to nonstationary, EMC, and unmodeled noise

Conclusions

- New proposals from Graber provide needed improvement in alien crosstalk margin
- PAM 3, 4, and 5 are all viable with the new proposal

THANK YOU