Alien Crosstalk and Equiv AWGN Testing/models

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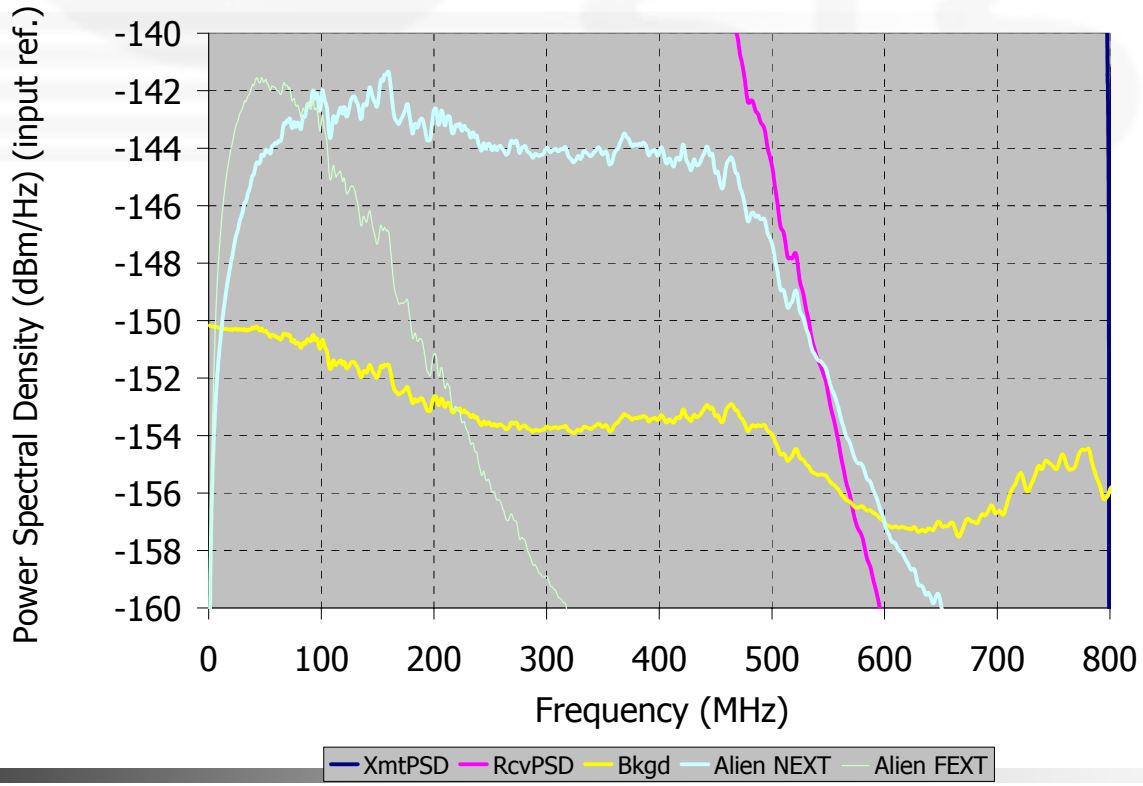
IEEE P802.3an, 26-28 January 2005

Specifying the Channel

- What is the Channel to be specified in IEEE?
  - Transmission parameters and Coupling paths for the signal transmitted in a 10GBASE-T link (IL, RL, NEXT, FEXT)
  - Noise environment in which that signal is to be received
- Example Alien crosstalk noise spectra
  - Addition of AFEXT on Models 1 & 2
- Alien Crosstalk in mixed 1G/10G environments
  - Implications for Power Backoff in Cat6
- Conclusions on testing and specification

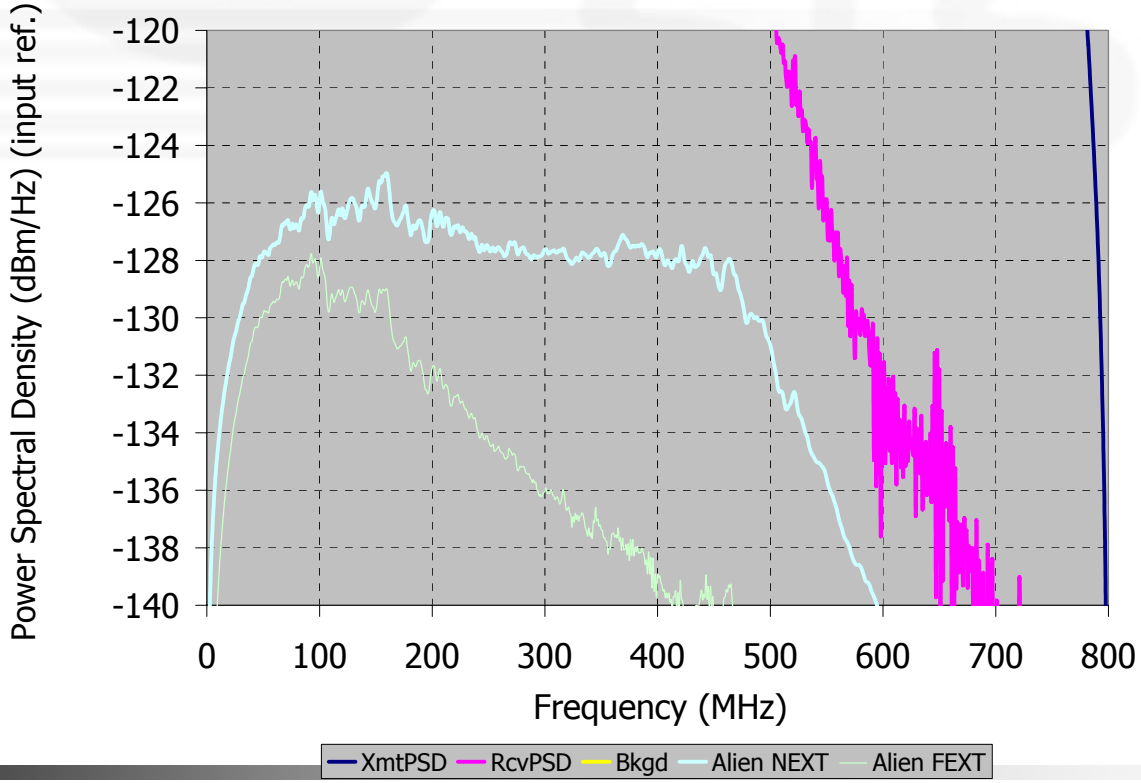
Alien Crosstalk, 100m Model 1

- 5 dBm TX power, 60 dB PSANEXT loss min at 100 MHz
- 40 dB PSAELFEXT loss min at 100 MHz and 100m
- Average levels, 2.5 dB lower, shown



Alien Background, 55m Model 2

- 5 dBm TX power, 47 dB PSANEXT loss min at 100 MHz
- 33 dB PSAELFEXT loss min at 100 MHz and 100m (55m=35.6 dB)
- Average levels, 2.5 dB lower, shown
  - Results are scaled for 55m Cat 6 line

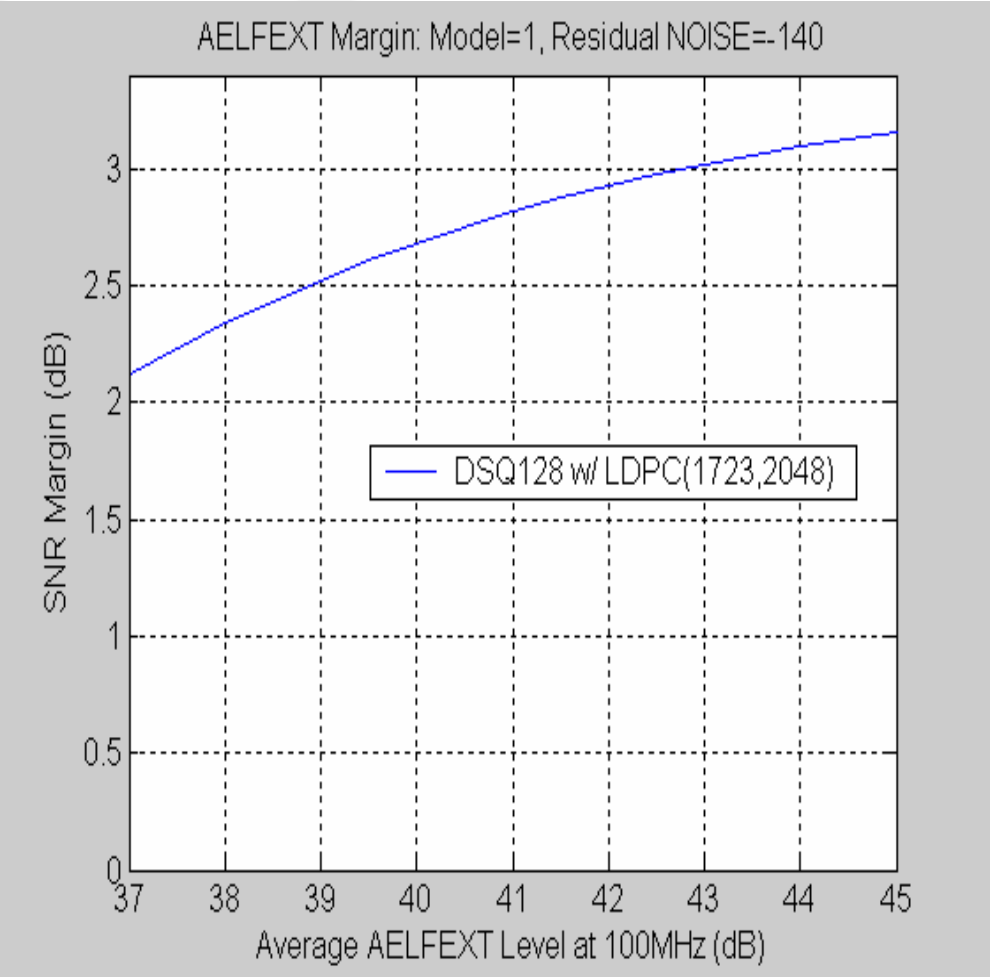


Additional PSAFEXT Results: Assumptions

- Draft 1.2, DSQ128+LDPC(1723,2048) at 800MHz
- Channel Model 1 and Model 2
  - Both cases include PSANEXT
- Residual Impairments:
  - -140 dBm/Hz AWGN
    - Models cable AWGN, residual Echo, NEXT, FEXT, analog ...
- PSAFEXT modeled by the equation
  - PSAFEXT(f,L) = X – 20*log10(f/100) - 10*log10(L/100) + IL(f,L)
  - Where f is frequency in MHz and L is length in meters and X if the PSAELFEXT 100MHz constant
- SNR margin computed from Salz Equation with impairments listed above
  - Salz analysis assumes ideal rx filter, linearity, sampling and equalizer

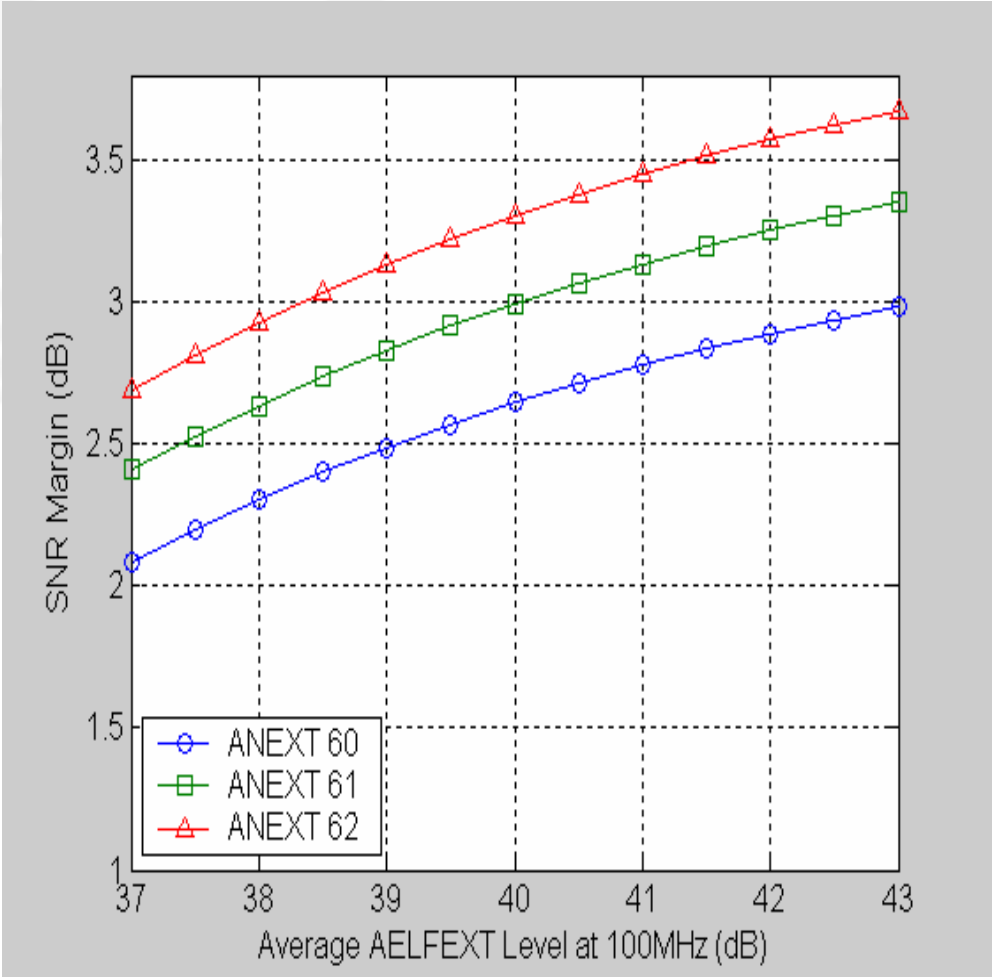
PSAELFEXT SNR Margin for Model 1

- Models 100m of Cat6Aug
- SNR margin vs average PSAELFEXT level
  - No PSAELFEXT, Margin = 3.4dB
  - X=45, Margin = 3.2 dB
  - X=40, Margin = 2.7 dB
  - X=37, Margin = 2.1 dB



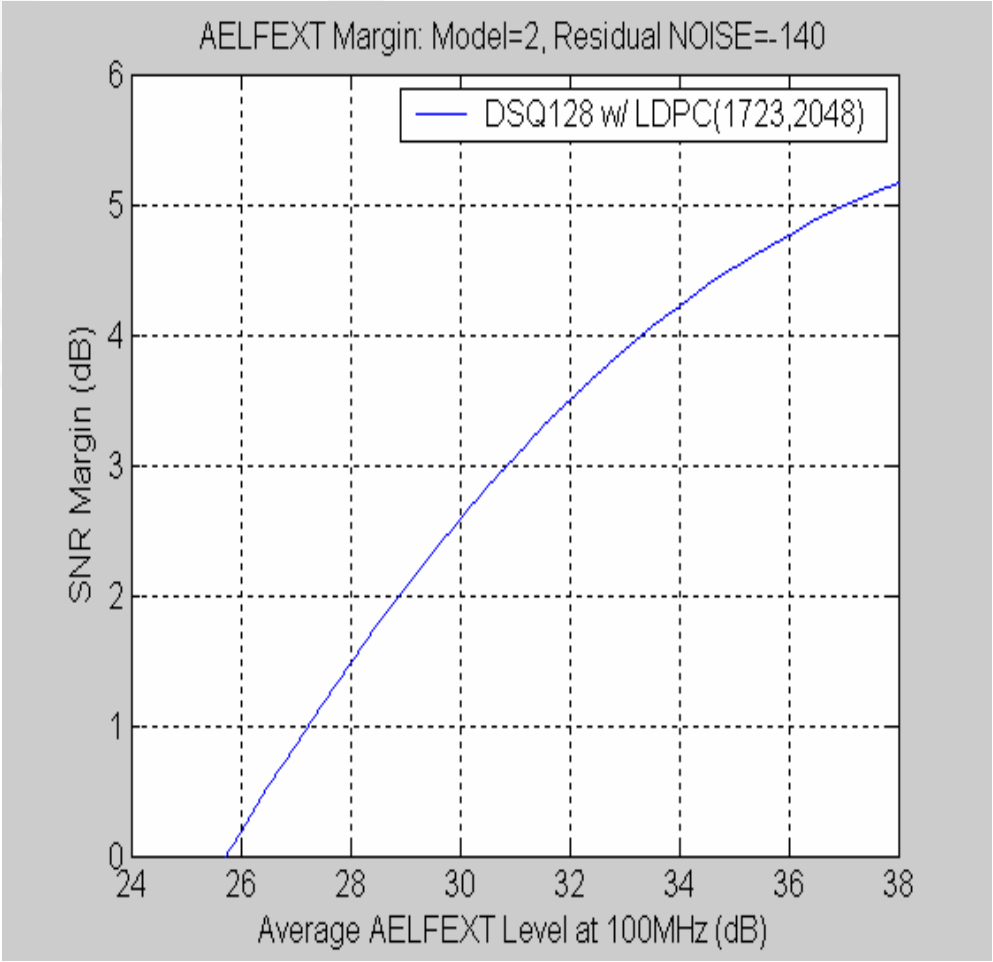
Tradeoff of PSAELFEXT and PSANEXT

- PSAFEXT level can be increased at the expense of lower PSANEXT
- SNR margin vs average PSAELFEXT level
  - PSANEXTpk=60, PSAELFEXTave=42, Margin=2.8dB
  - PSANEXTpk=61, PSAELFEXTave=41, Margin=3.1dB
  - PSANEXTpk=62, PSAELFEXTave=40, Margin=3.3dB



PSAELFEXT SNR Margin for Model 2

- Models 55m of Cat 6
- SNR margin vs average PSAELFEXT level
  - No PSAELFEXT, Margin = 5.9dB
  - X=35, Margin = 4.5 dB
  - X=33, Margin = 3.9 dB
  - X=30, Margin = 2.6 dB
  - *X=25, No Margin*



AWGN Levels for Channel Specification

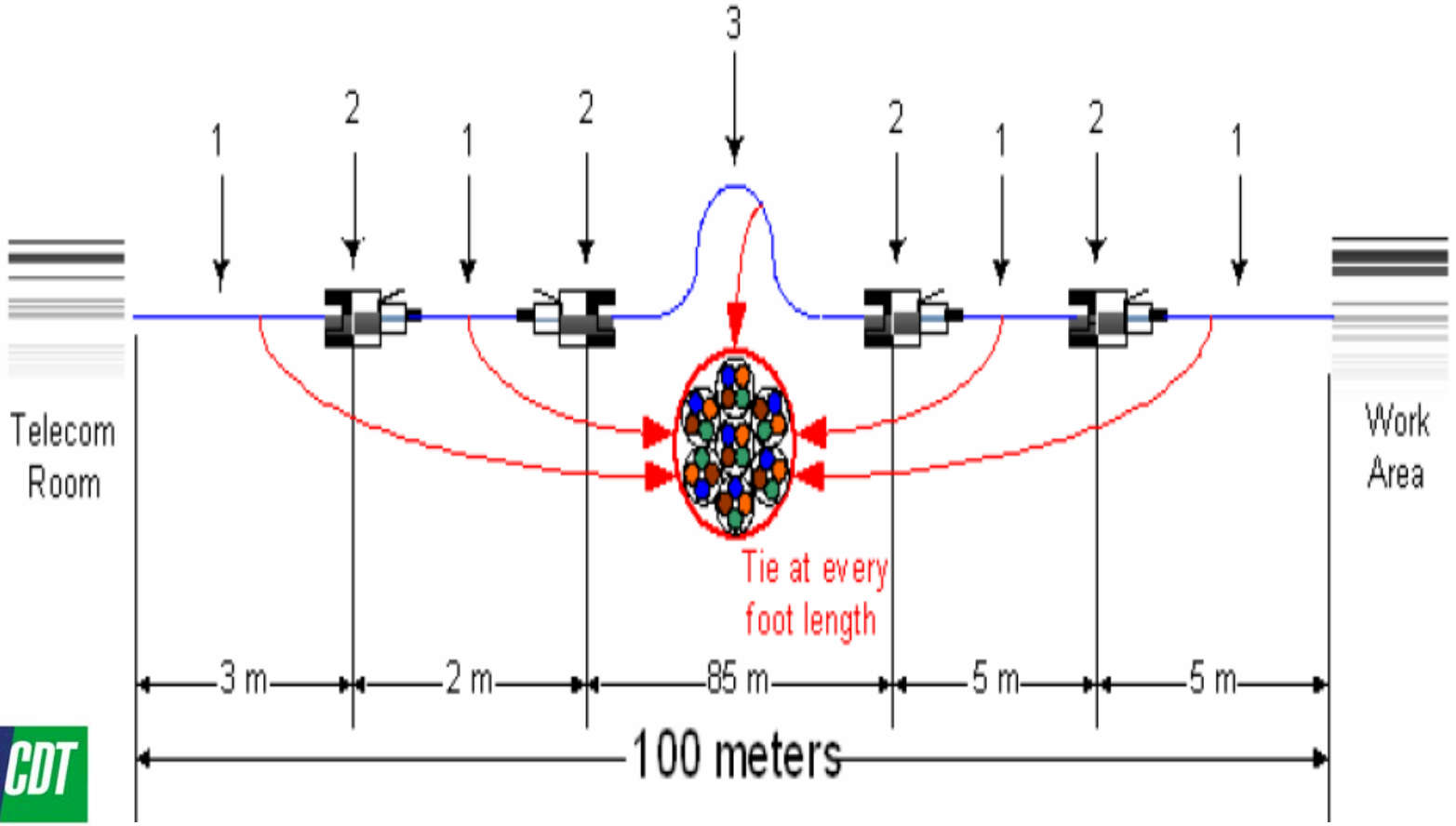
- 5 dBm TX Power
- Actual PSANEXT/PSAFEXT variation across frequency is < 4 dBpp
- 500 MHz broadband sources readily available

Channel	PSANEXT loss (100 MHz min)	PSAELFEXT loss (100MHz min, 100m)	Margin for DSQ system	Equivalent AWGN at MDI
Model 1 (Cat 6aug, Class F IL, 100m)	60 dB	40 dB	4.51 dB	-138.9 dBm/Hz
Model 1 (Cat 6aug, Class F IL, 100m)	61 dB	39 dB	4.76 dB	-139.2 dBm/Hz
Model 1 (Cat 6aug, Class F IL, 100m)	62 dB	38 dB	5.30 dB	-139.8 dBm/Hz
Model 2 (Cat6, 55m)	47 dB	30 dB	3.21 dB	-125.5 dBm/Hz
Model 2 (Cat6, 55m)	47 dB	33 dB	4.06 dB	-126.3 dBm/Hz

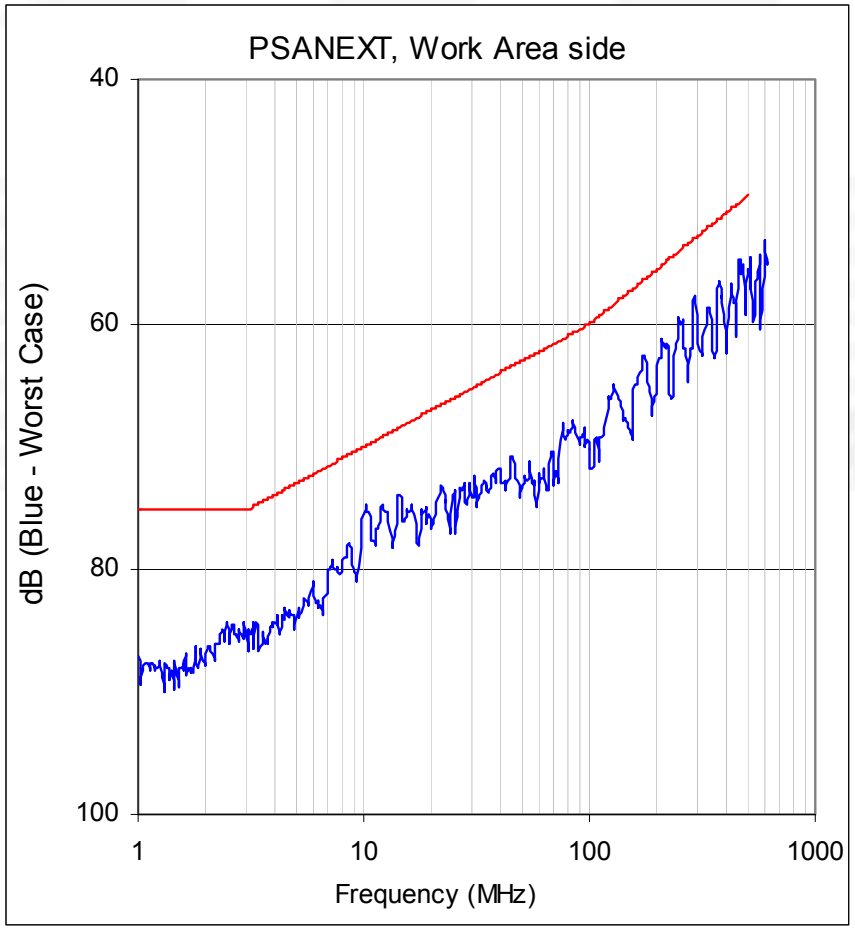
Channel Configuration: Measurement Data

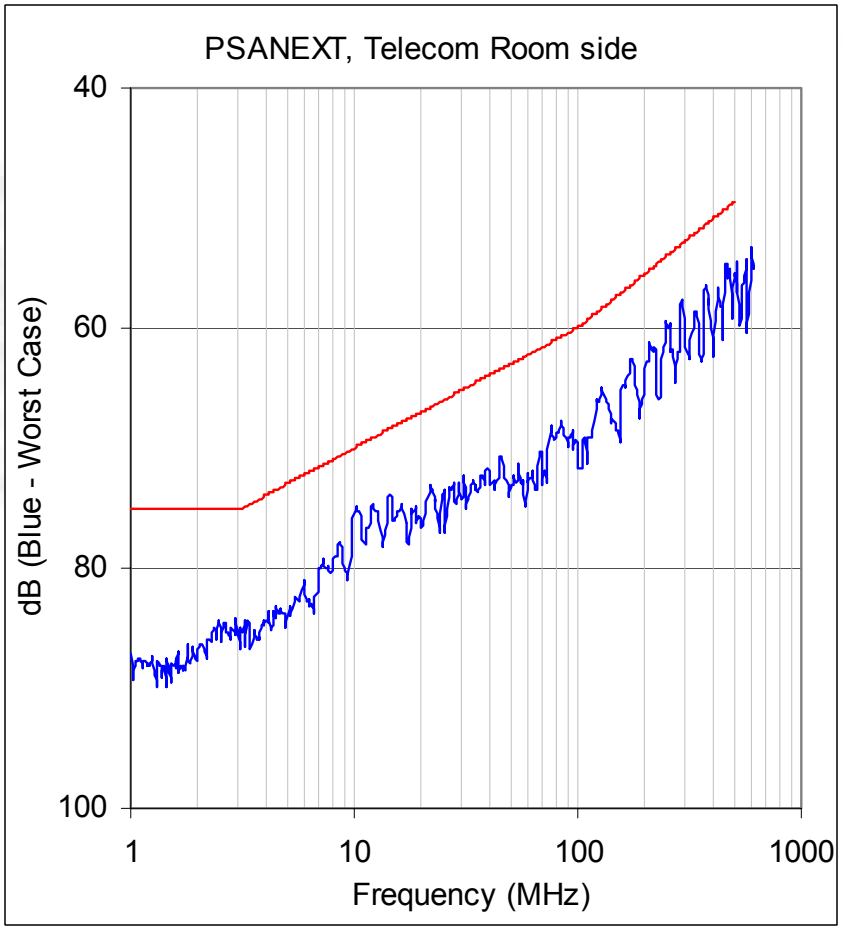
SAMPLE DESCRIPTION:

Channel Configuration (4 Connector)

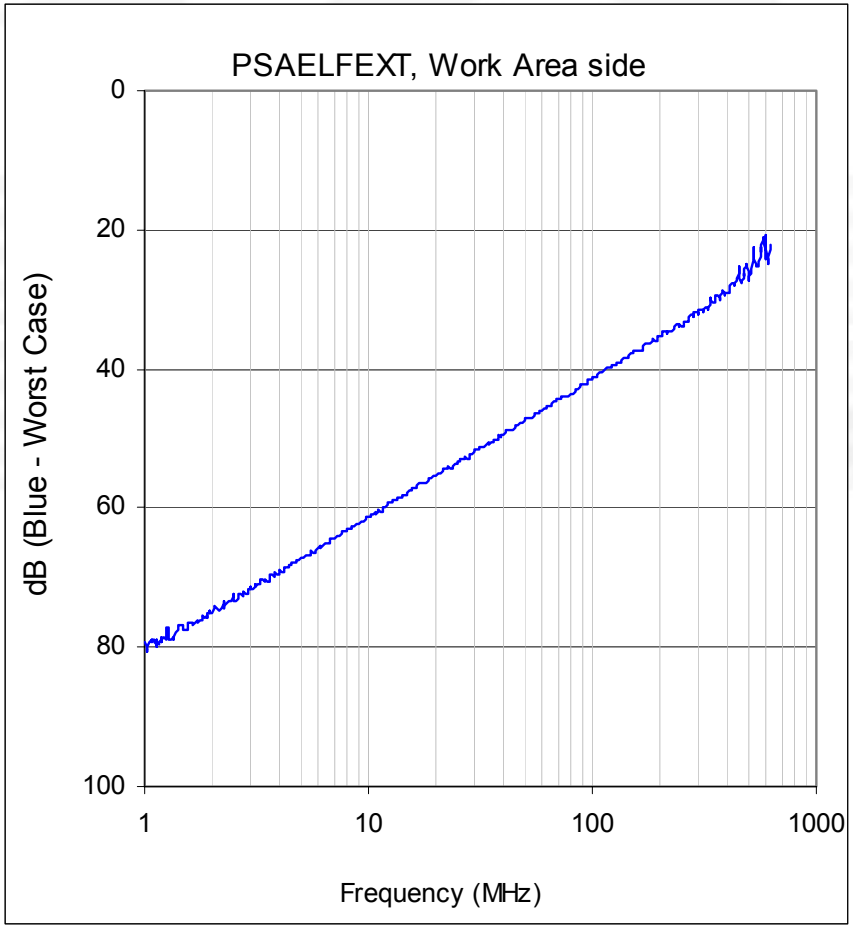


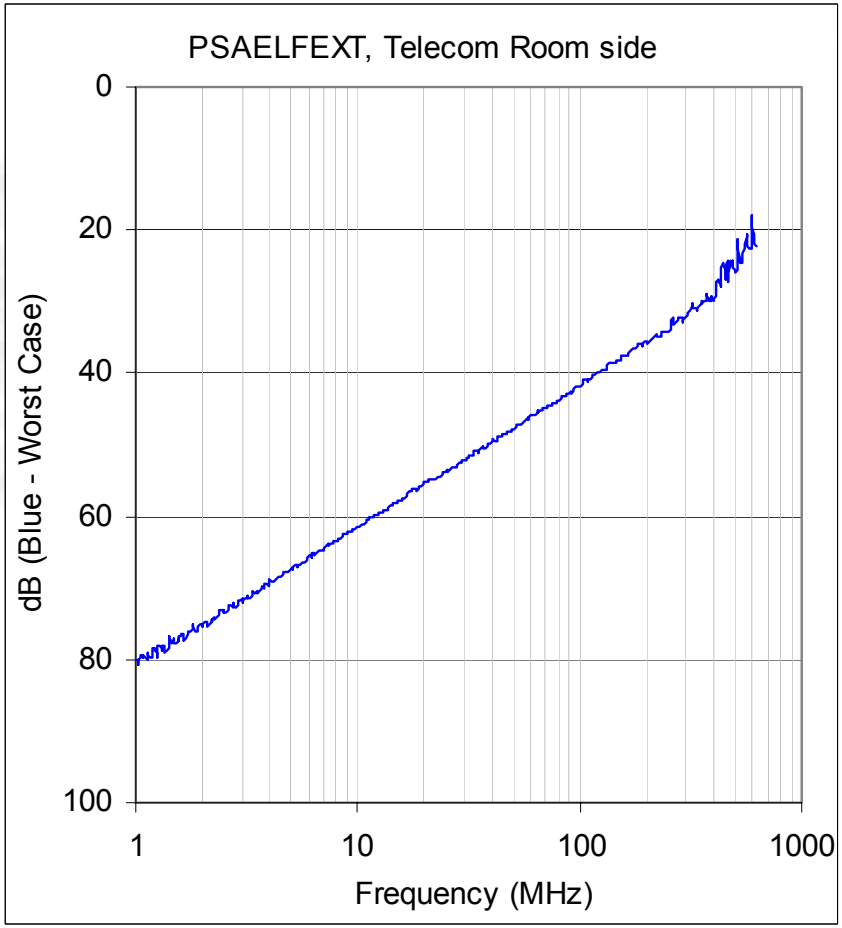
Power Sum Alien NEXT





Power Sum Alien ELFEXT

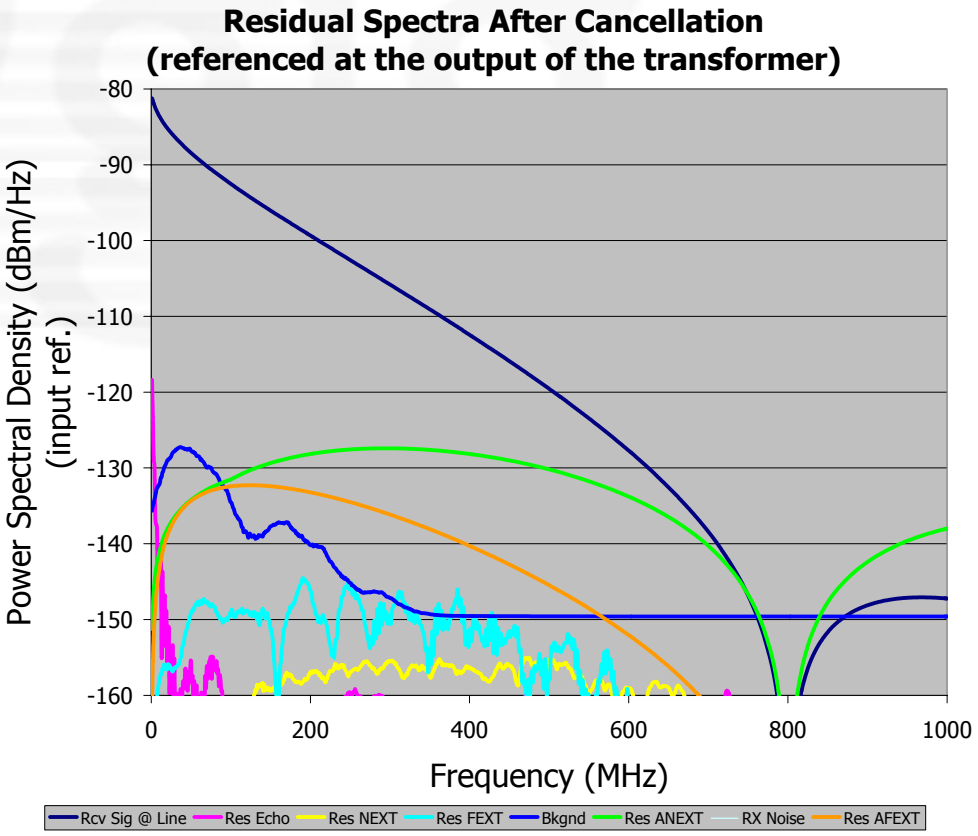




Note: Noise floor limitations above 400 MHz

Model 2: 55m Cat 6, Mixed Xtalk

- Half 10G, Half 1000BASE-T Disturbers
- 1000 BASE-T crosstalk based on data-center measurements
  - Scaled to represent PSANEXT/PSAFEXT specs under discussion
- 10GBASE-T Crosstalk
  - Scaled -1.8 dB for half-fill
  - 5 dBm TX power



Limitations on Power Backoff

- 1000BASE-T source limits power backoff
- PSANEXT of the max level transmitter must be tolerated
  - PSAFEXT level from 10GBASE-T is allowed to be backed off
- On Cat 6, greater than 4 dB power reduction at 55m makes system vulnerable to 1000BASE-T ANEXT
- No specific proposal at this time

Proposals

- Proposal 1: Specify a noise level, not PSANEXT/PSAFEXT transfer functions
- Proposal 2:Leave it to the cabling groups to divide up the PSANEXT and PSAFEXT
- Proposal 3: Recommend choice of 60/40, 61/39, or 62/38 for PSANEXT/PSAELFEXT on Cat6aug cabling to appropriate bodies
- Proposal 4: PSANEXT immunity test: specify signal source as 500 MHz AWGN generator