Loop Reach Feasibility: Class D and Class E UTP Cables

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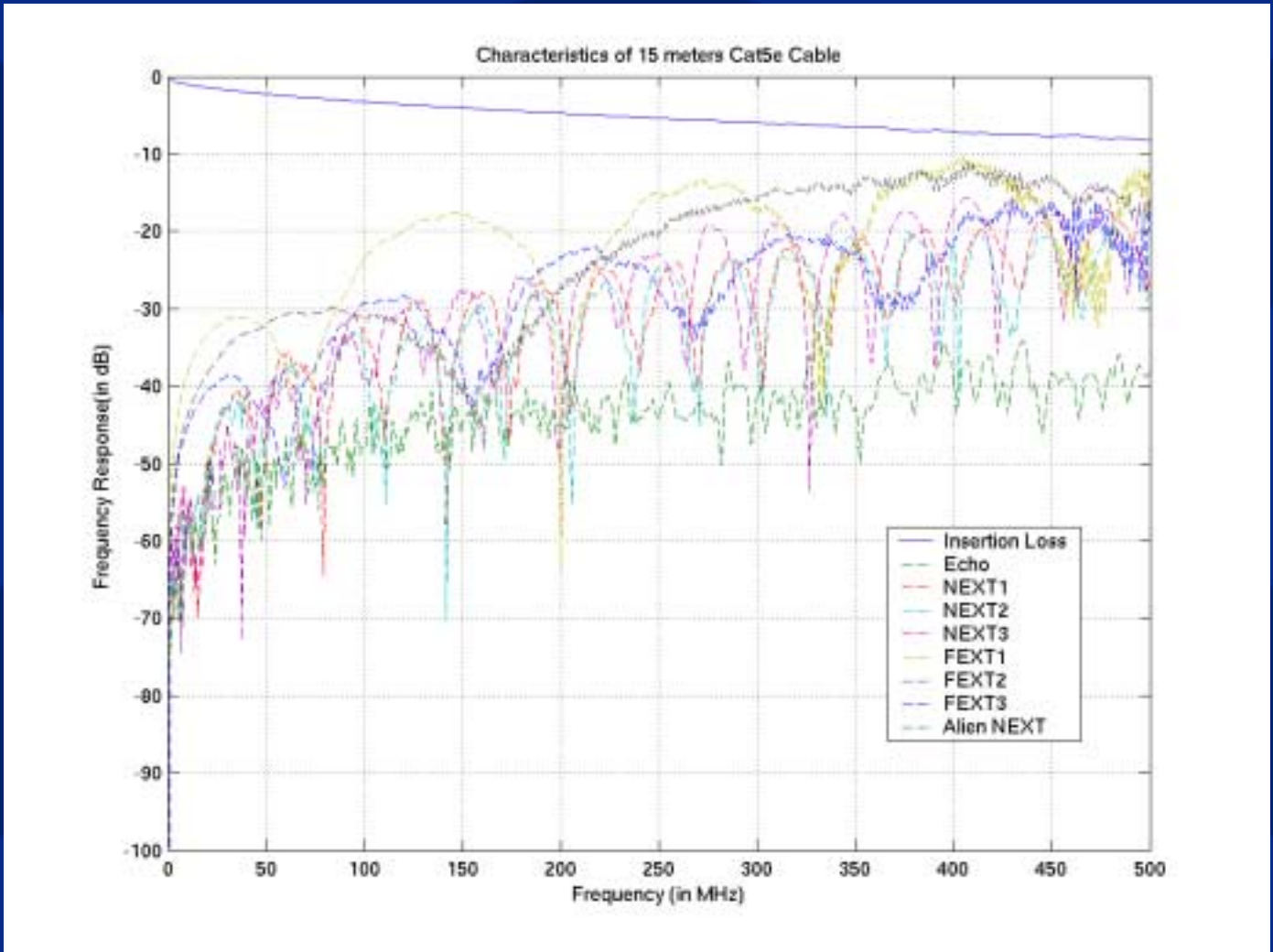
Outline

- Loop Reach Feasibility
  - Assumptions used for models
  - MATLAB simulation description
  - Results for Class D (Cat5e)
  - Results for Class E (Cat6)
- Proposal for Objectives

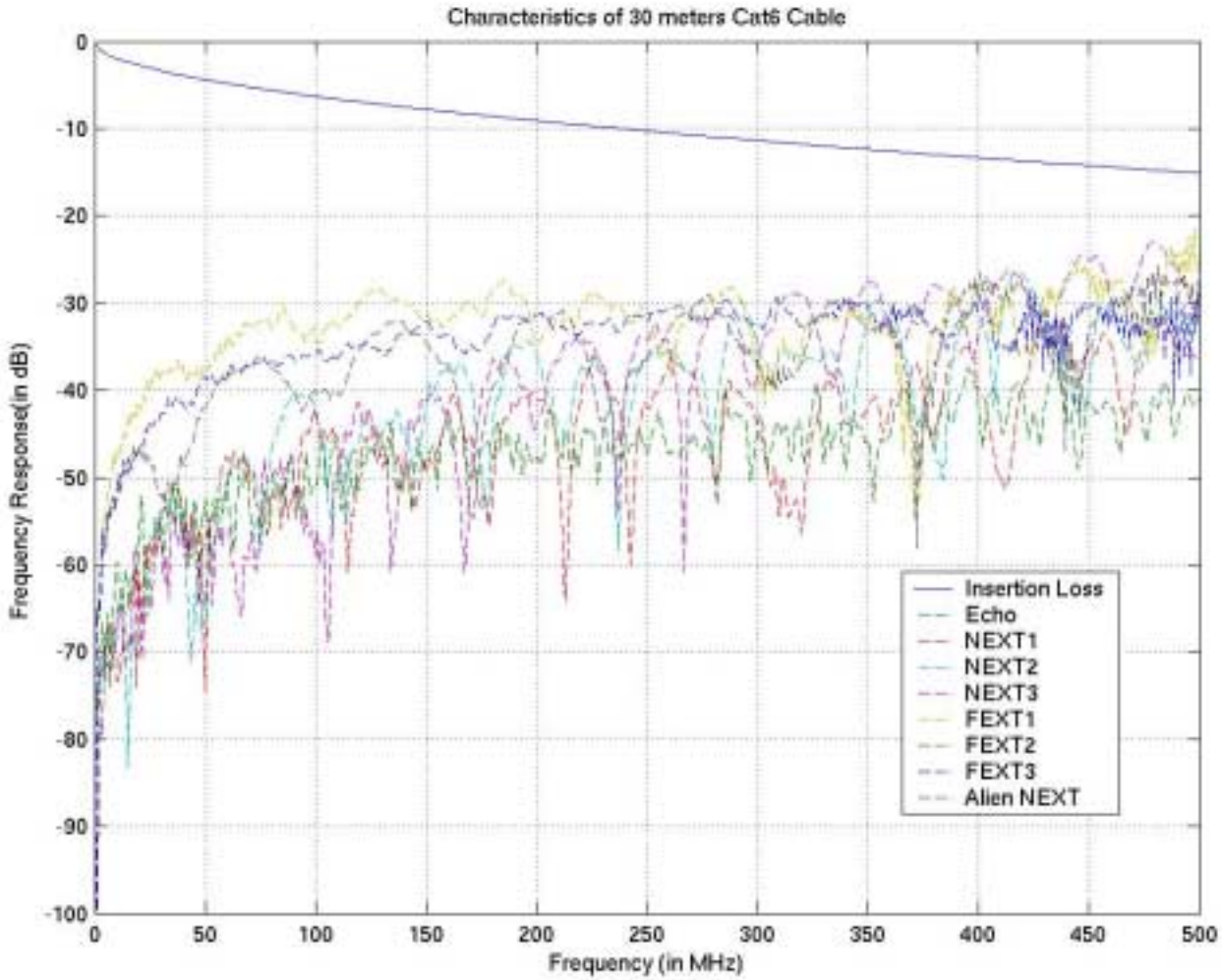
Models

- Cable Data taken from the 10GBASE-T public archive
  - Cat 5e IL, RL, NEXT, FEXT: Chris Diminico, 15 May ‘03
  - Cat 5e Alien NEXT: Chris Diminico, 30 April ‘03
  - Cat 6 IL, RL, NEXT, FEXT: Chris DiMinico, 22 May ’03
  - Cat 6 Alien NEXT = Cat 5e Alien NEXT – 3dB

Models (Example of 15m Cat5e)



Models (Example of 30m Cat6)



Assumptions & Simulation Parameters

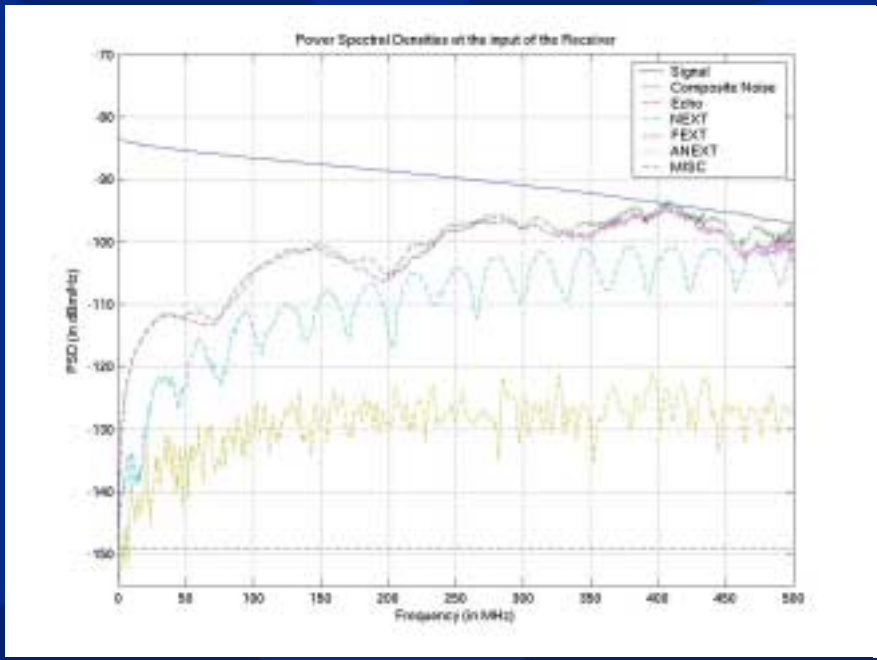
- BER = 1e-11
- Transmit spectrum: square pulse shape*
- PAM-10 with equi-probable symbols
- Signaling rate: 833.33 MBaud
- Launch Voltage: 2Vpp*, Power = 6.1 dBm
- 30x Oversampling Rate (smooth extrapolation beyond measured data)
- FFE/DFE design based on MMSE optimization (Lee & Messerschmitt, Proakis)
- Alien NEXT interferer: 10GBASE-T
- Background noise: -150dBm/Hz

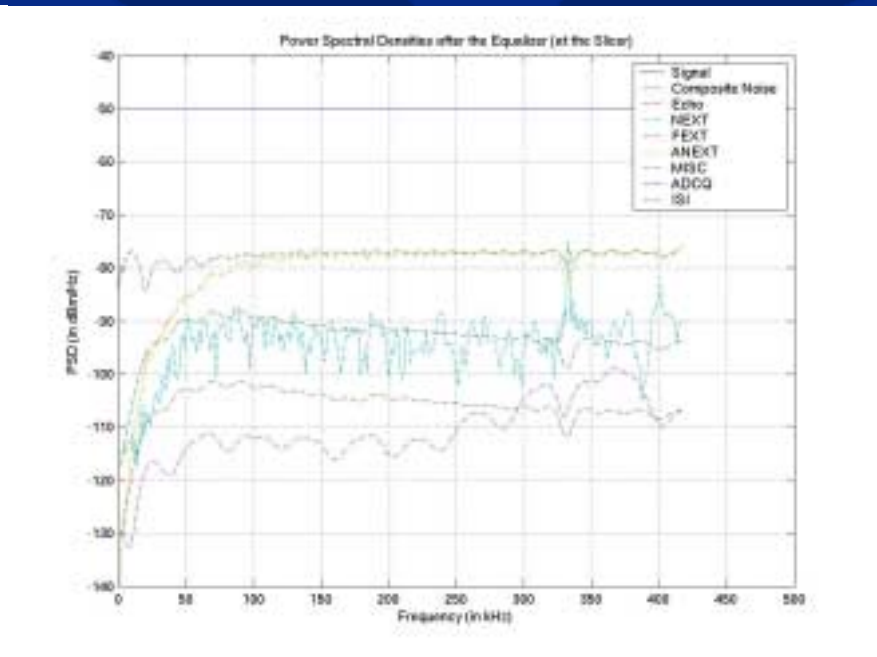
*not critical because it affects signal and Echo, NEXT, FEXT, ANEXT equally

Receiver Parameters

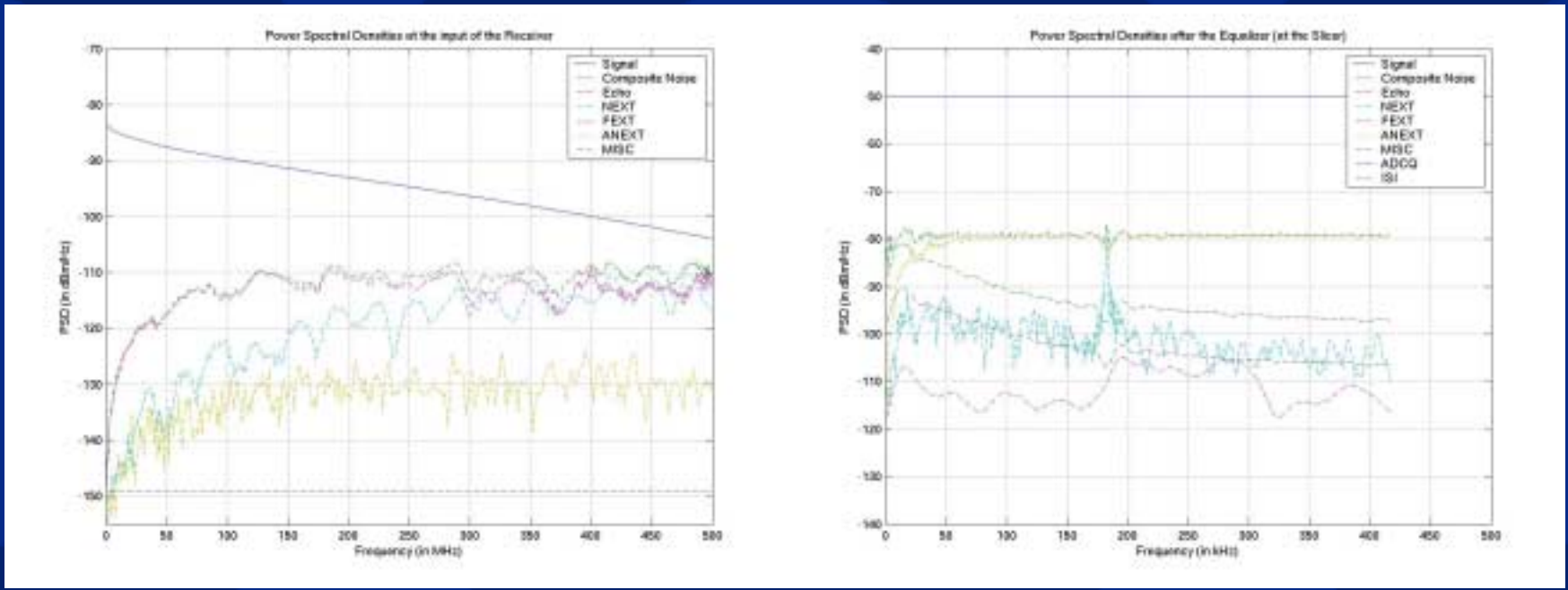
- Transmit and Receive LPF: 2nd order, fc=400MHz
- ADC: 9 ENOB @ 833.33 Msps
- VGA adjusted to reduce clipping probability < 1e-6
- FFE/DFE: 64/200 (Residual ISI > 35dB below signal)
- Echo Cancellers: 600 taps (> 60dB cancellation)
- NEXT Cancellers:150 taps (> 35dB cancellation)
- FEXT Cancellers: 30 taps (> 40 dB cancellation)
- Trellis Decoder : 6 dB ideal coding gain

Sample Simulation Results (Cat5e)

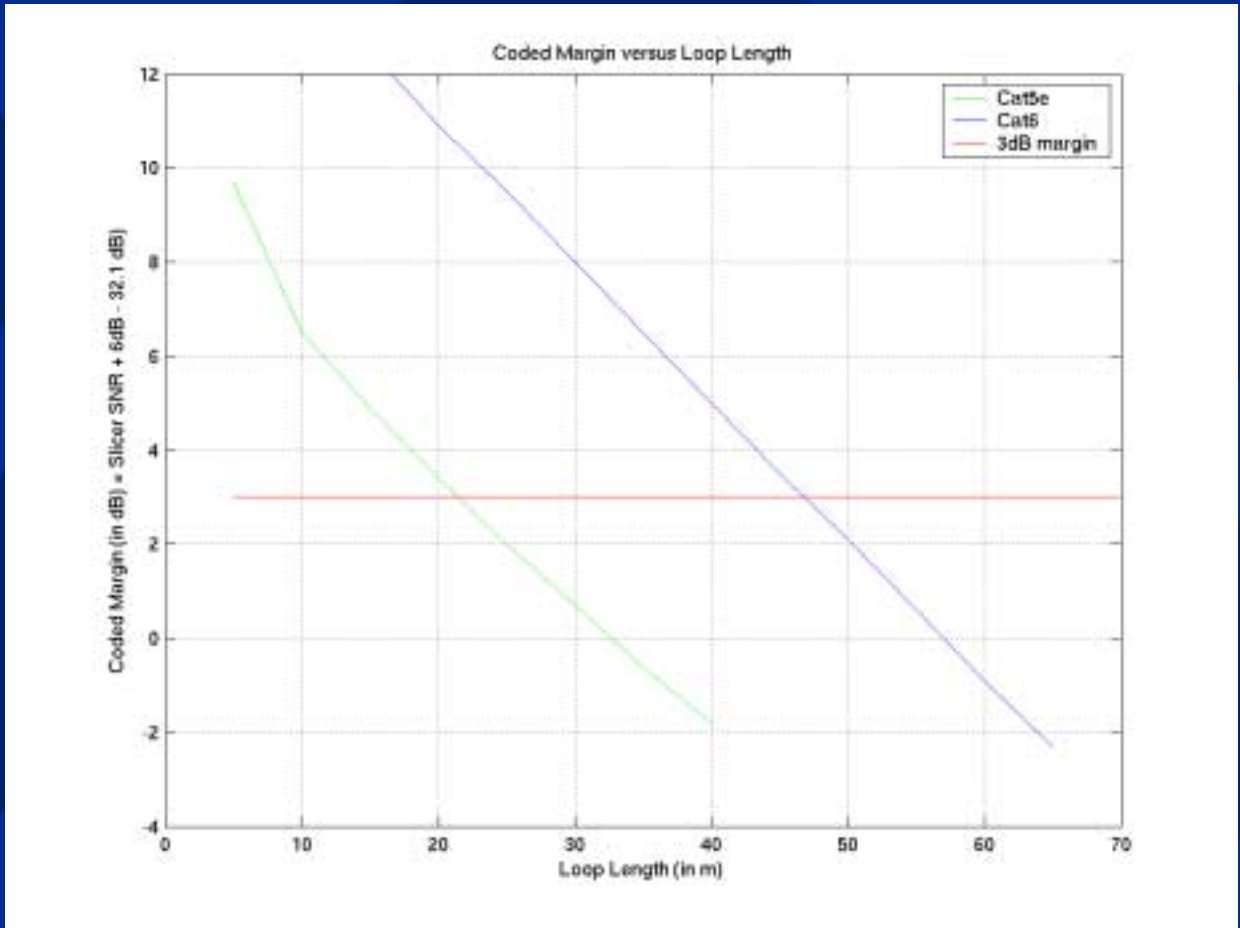




Sample Simulation Results (Cat6)



Simulation Results Summary



Loop Reach Results

- Margin is required to account for
  - Sampling phase jitter
  - Filter adaptation noise
  - Non-linearities
  - DFSE Coding Gain Loss (can be as high as 1.5dB)
- Allowing 3dB margin,

CAT5e Loop Reach = 20m

Cat6 Loop Reach = 45m

Proposal

- Cat5e and Cat6 loop reach is much lower than the Study Group objective of 100m.
- Remove reference to Cat5e and Cat6 from the objectives
- Specify the target media to be Cat7 (Class F) or shielded Cat6?