

Investigations of Category 5e Cabling for 2.5 and 5Gbps PAM Transmission using 10GBASE-T derived Technology

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Supporters

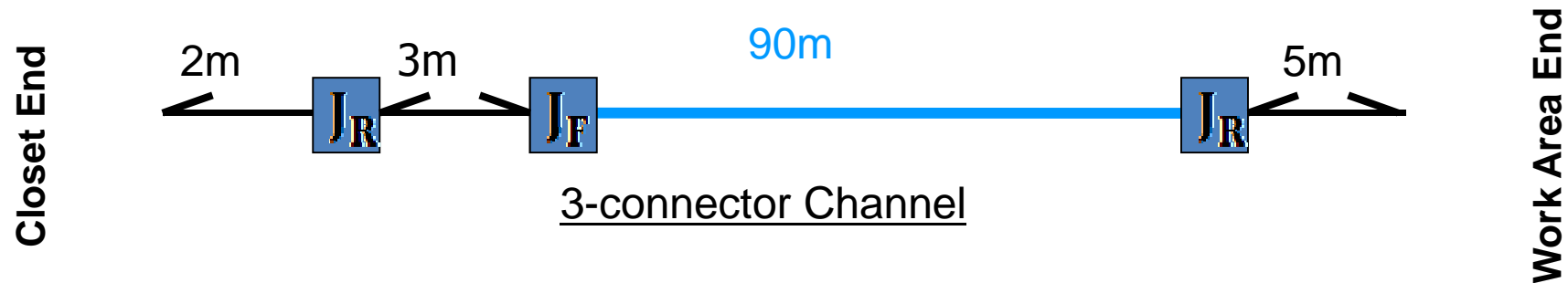


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Tom Souvignier, Broadcom
Andrew Jimenez, Anixter
Alan Flatman, LAN Technologies
Peter Jones, Cisco
Peter Wu, Marvell
Benson Huang, Realtek
Yan Zhuang, Huawei

- Test Configurations
- Alien Crosstalk Results
- Category 5e Alien Crosstalk margins relative to Category 6A Alien Crosstalk Limits
- Preliminary Alien-limited Salz SNR analysis for 2.5G and 5G PAM systems using 10GBASE-T-derived technology
- Next Steps

Test Configurations

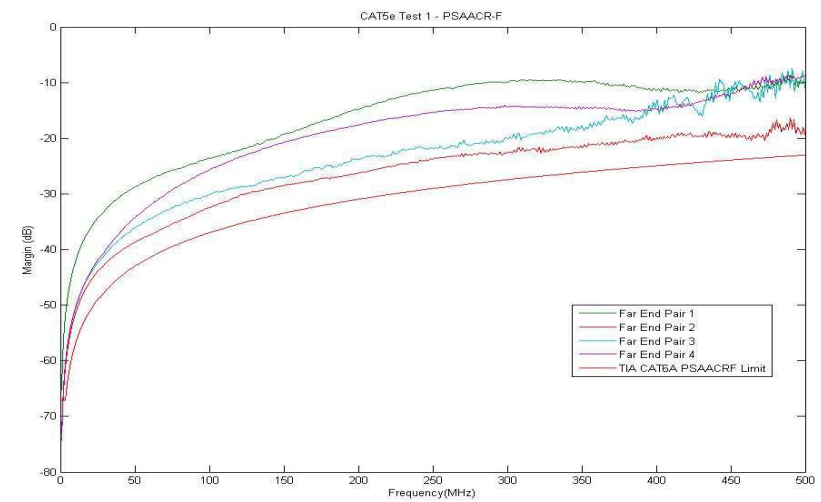
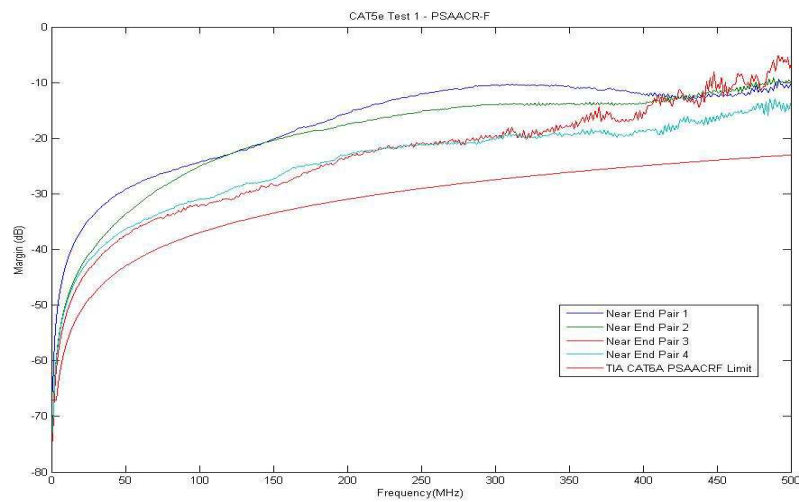
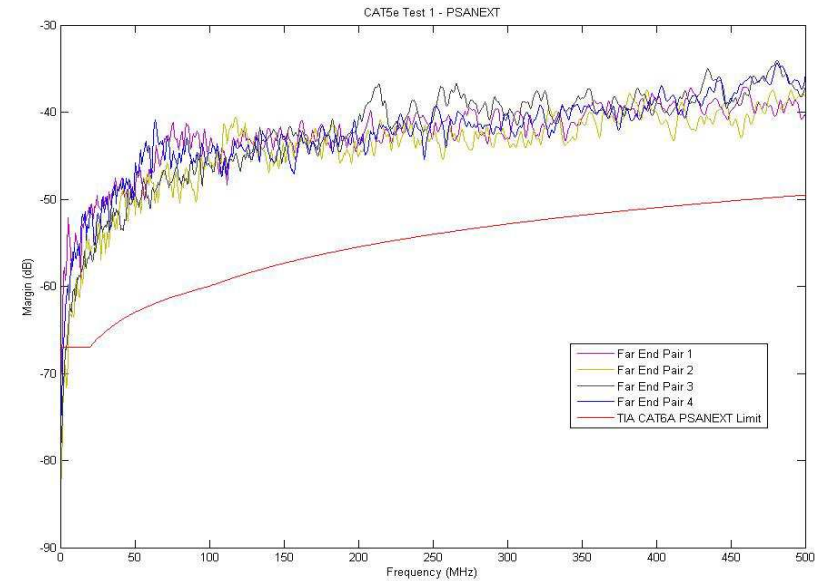
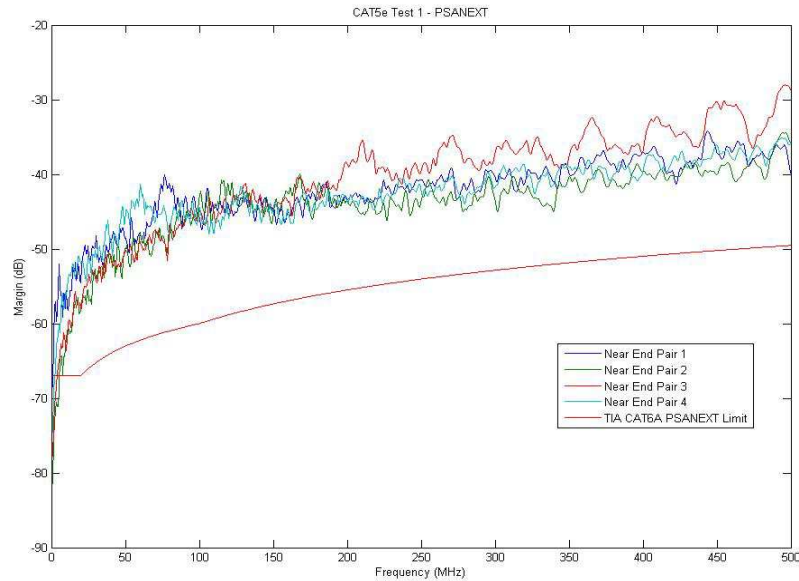
- 100m Category 5e channels consisting of SYSTIMAX® products were used to evaluate Alien Crosstalk
- 3-connector channels were chosen for more realistic implementation of WAP application in commercial buildings



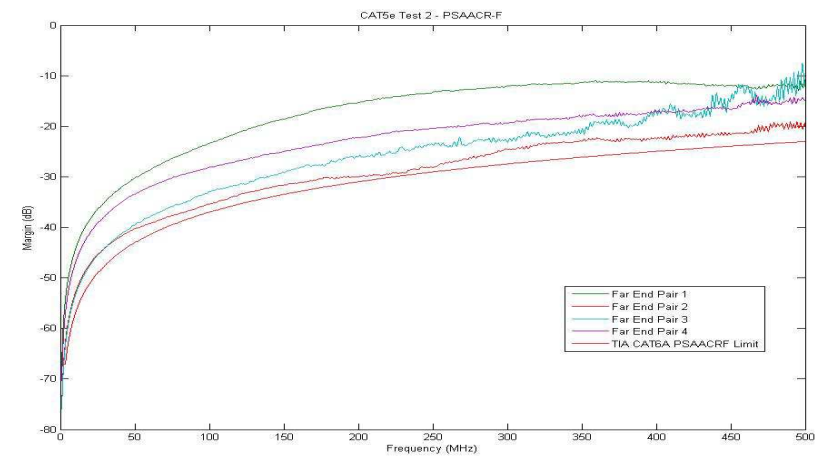
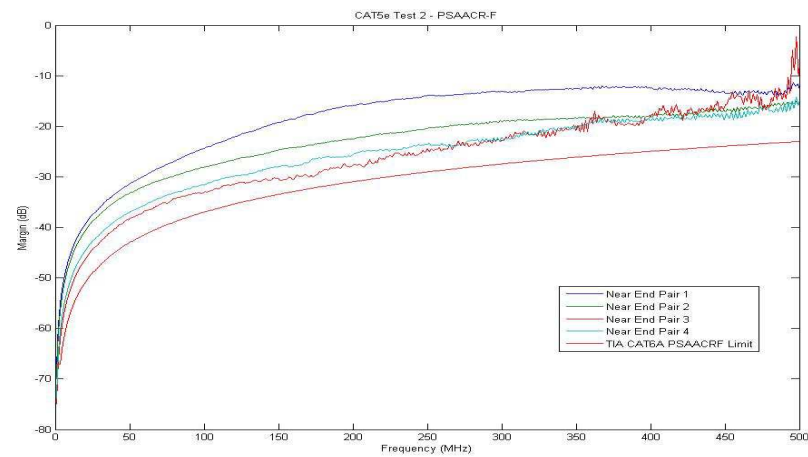
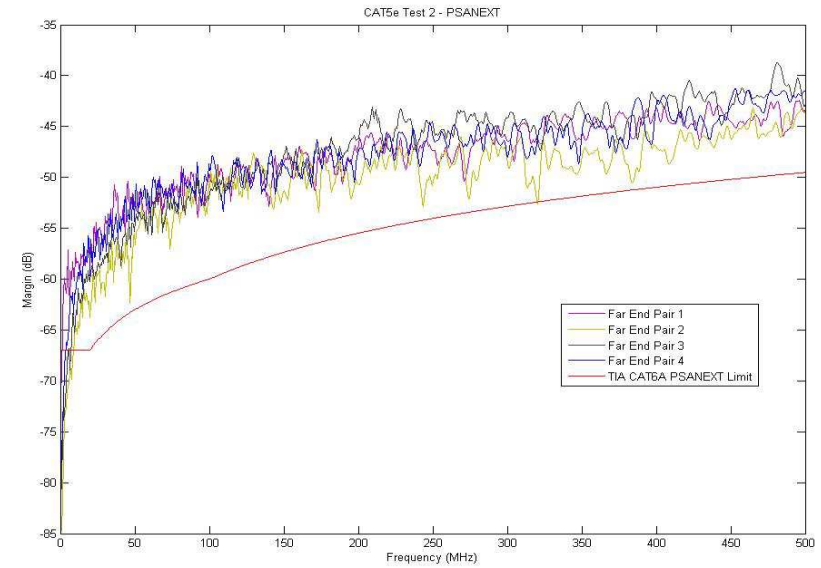
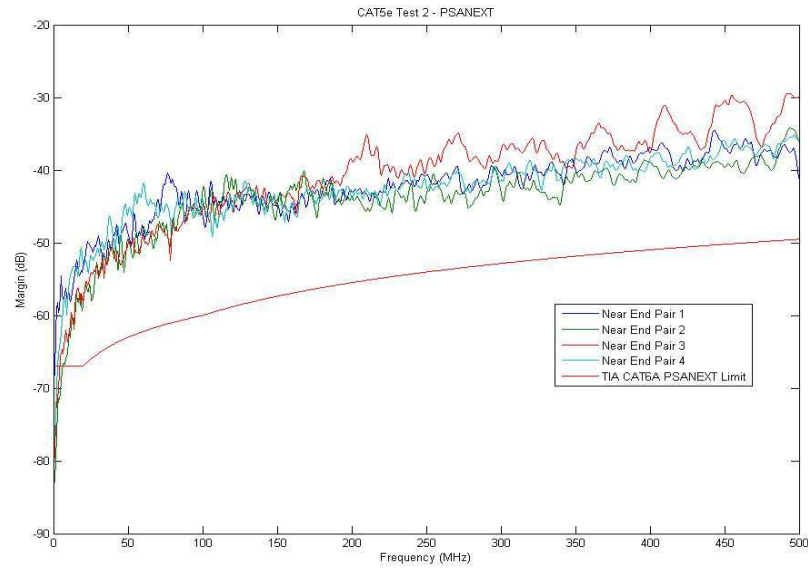
Test Configurations cont...

- Each Channel underwent 4 tests for 6 around 1 PSANEXT and PSAACR-F
 - Test 1: Fully Bundled from end to end
 - Test 2: 50m were bundled from the Closet End. (50m of the Work Area was unbundled)
 - Test 3: 10m were bundled from the Closet End. (90m of the Work Area was unbundled)
 - Test 4: The complete channel was unbundled
- Insertion loss data was also taken
- The following slides contain the results of the testing in frequency swept graphs.
- Worst case alien crosstalk margins were compared to Category 6A limits

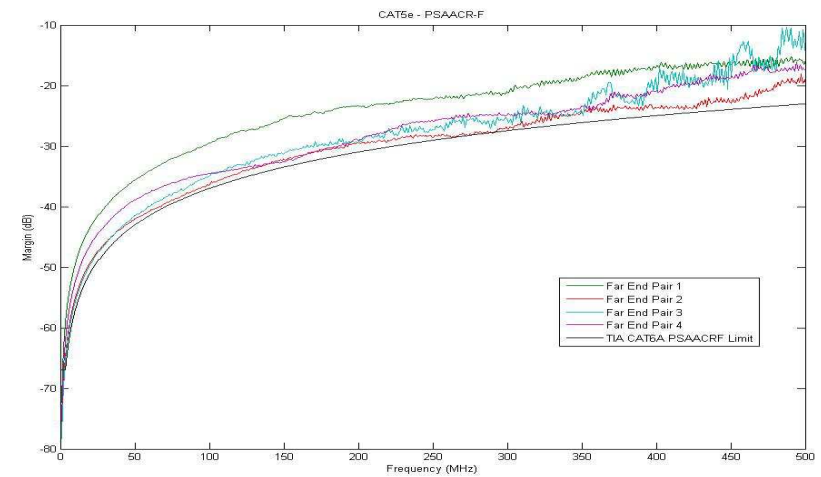
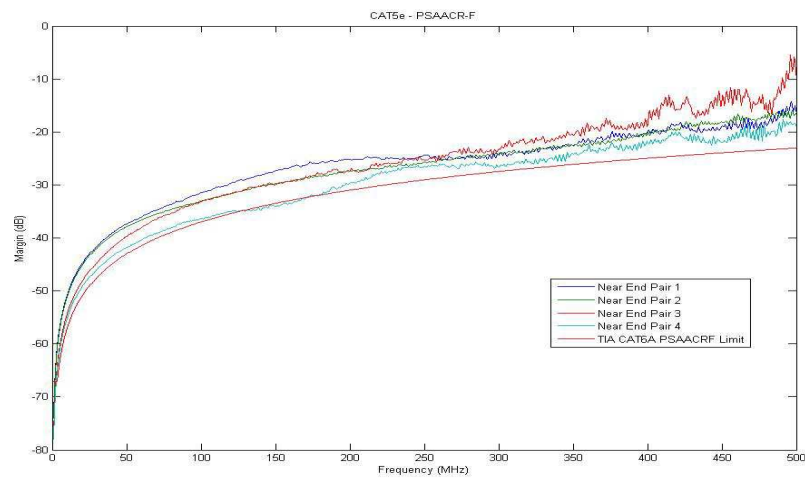
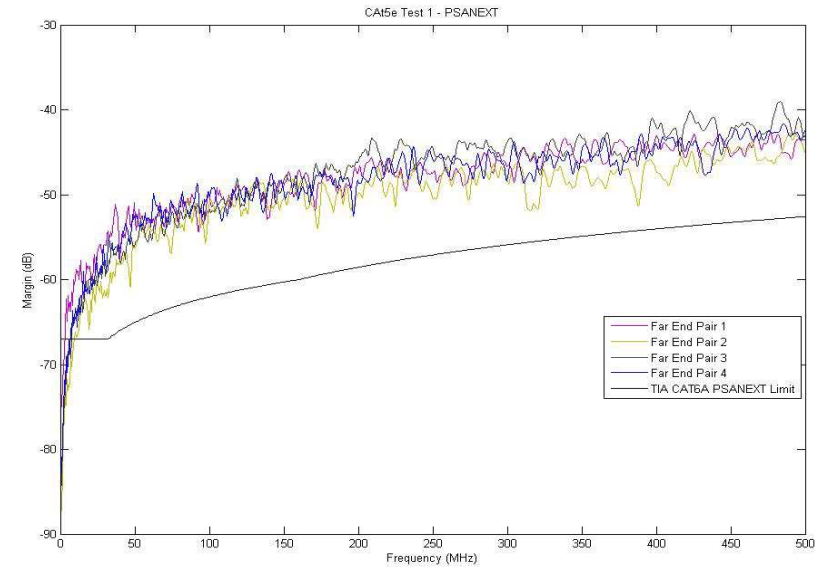
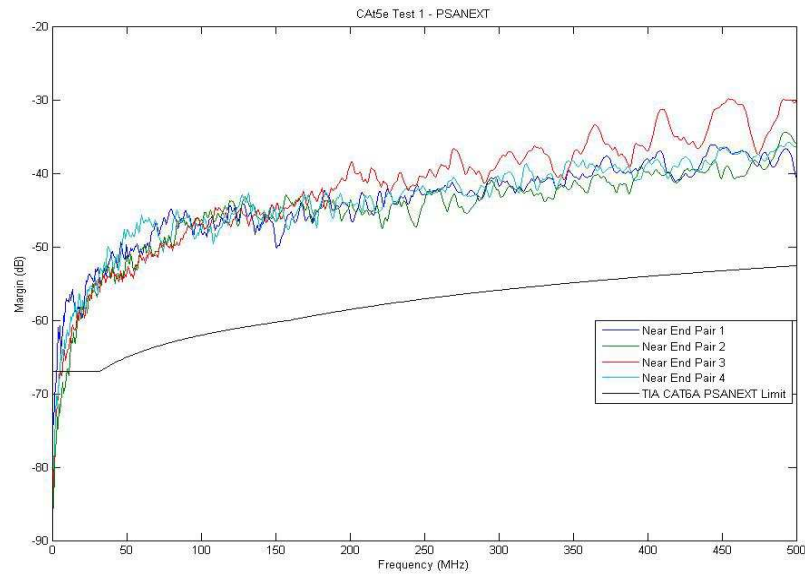
CAT5e - Test 1 (full 100m bundling)



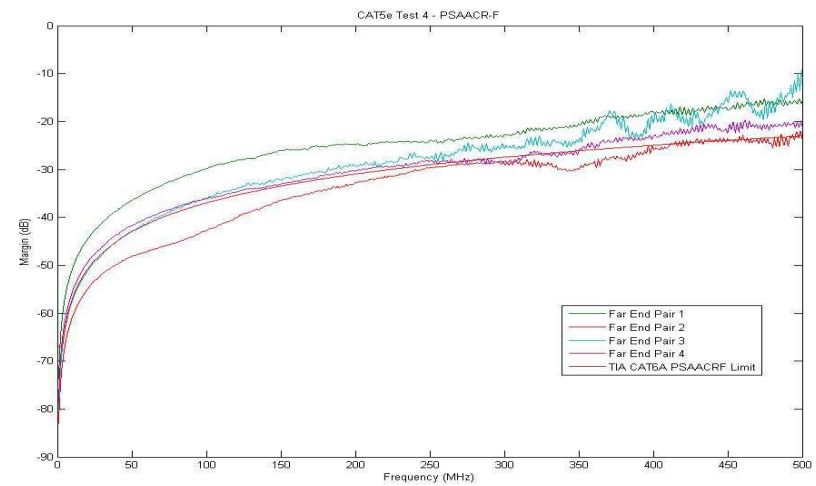
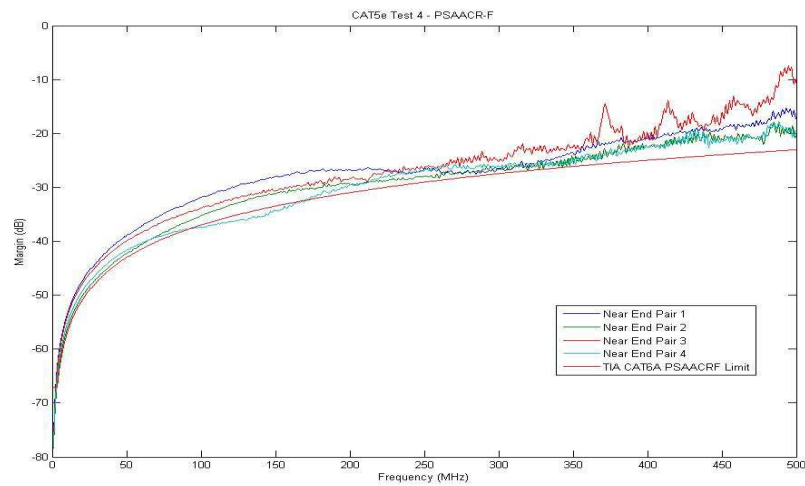
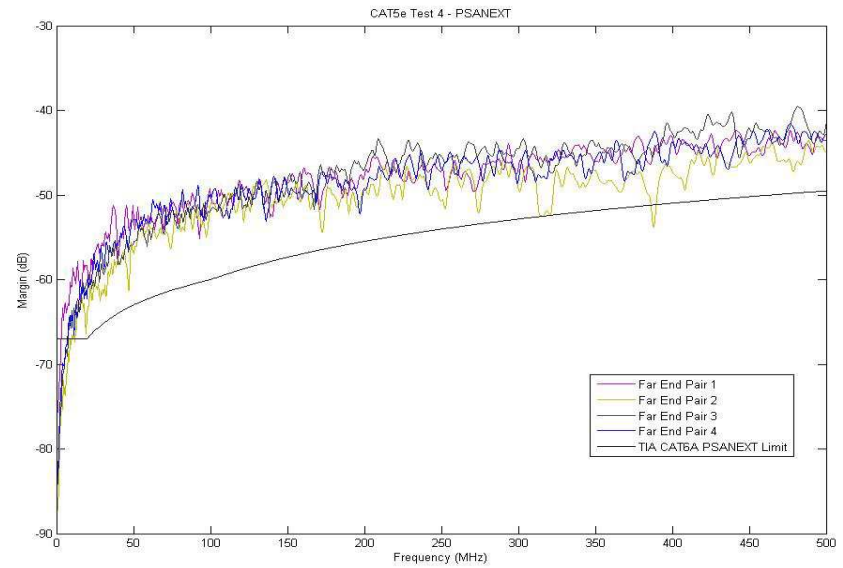
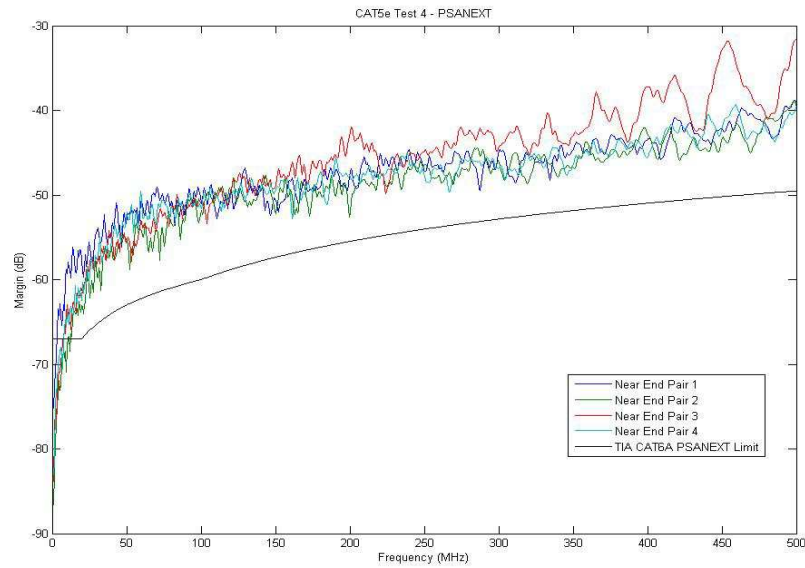
CAT5e - Test 2 (50m bundled from closet)



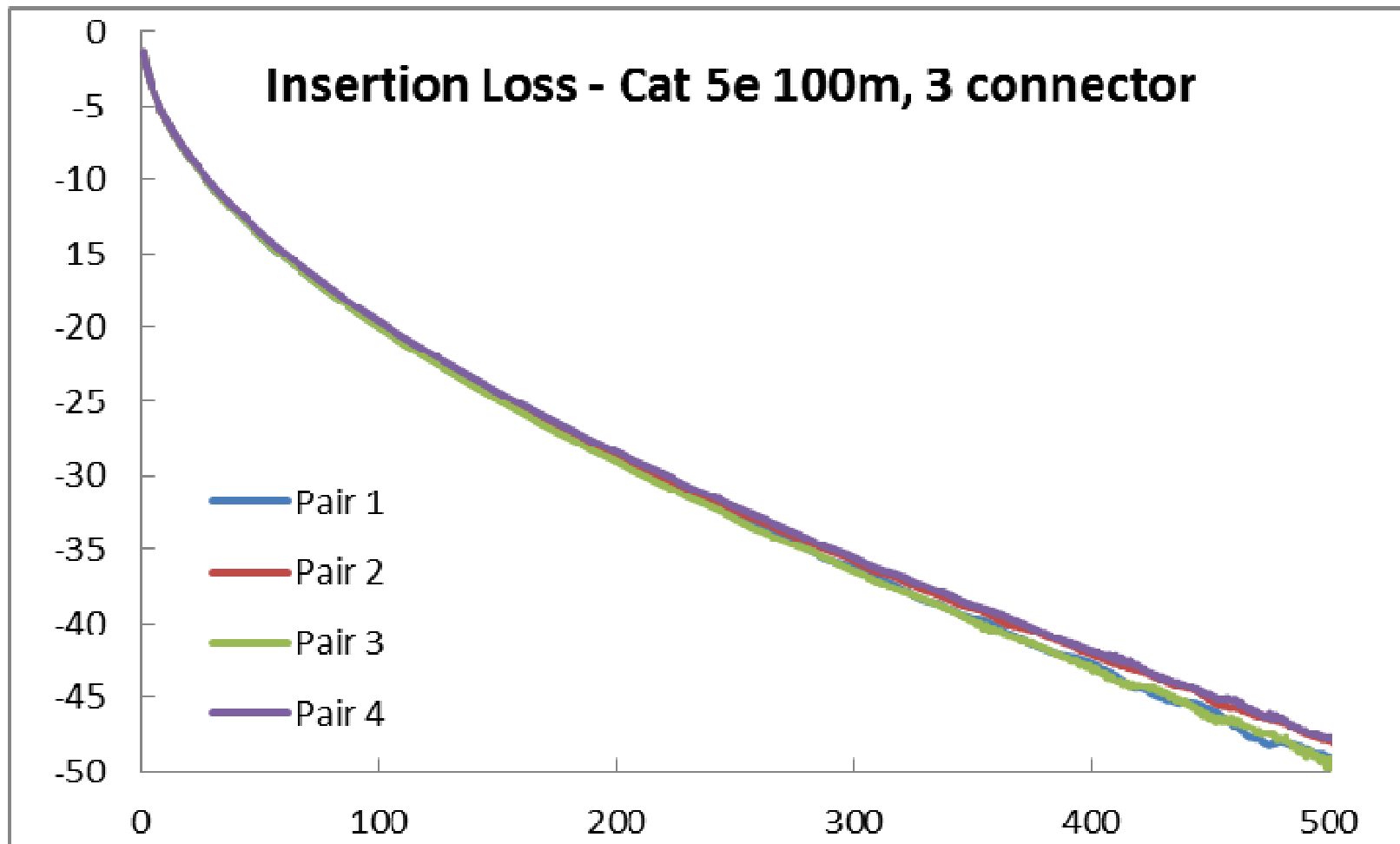
CAT5e - Test 3 (10m bundled from closet)



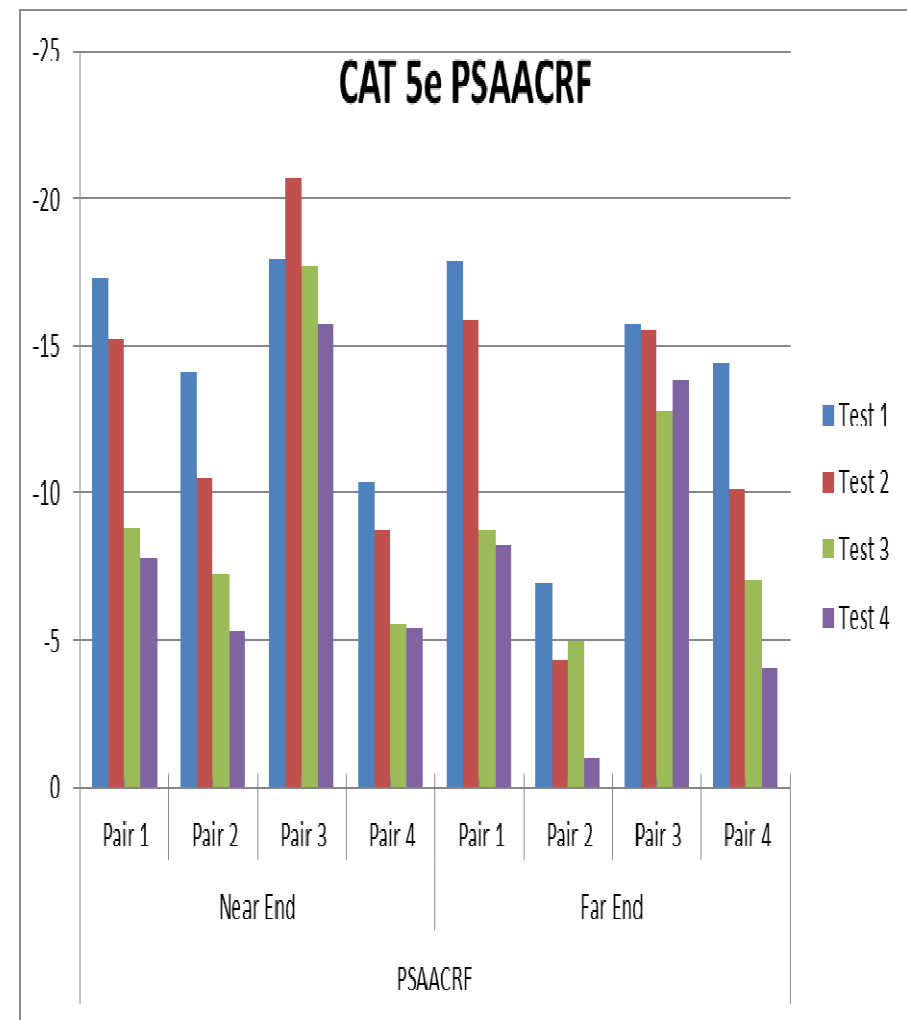
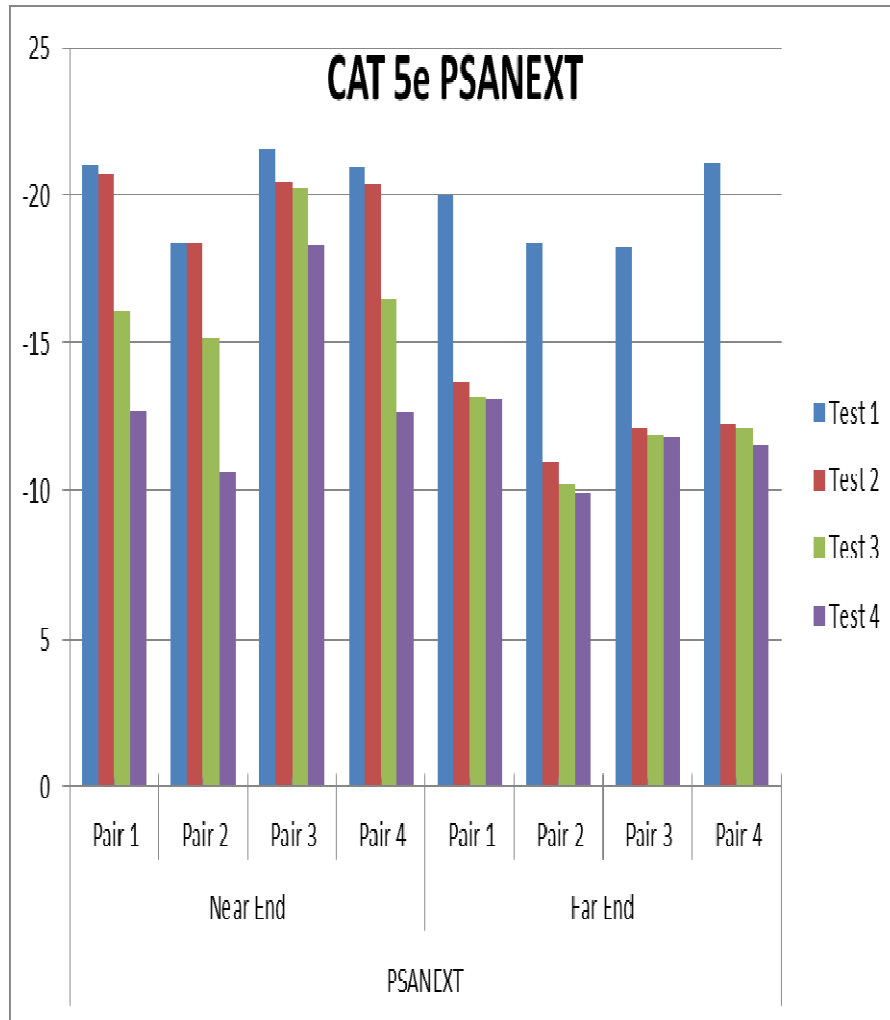
CAT5e - Test 4 (fully unbundled)



Cat 5e – Insertion Loss



CAT5e Channels Worst Case Margins

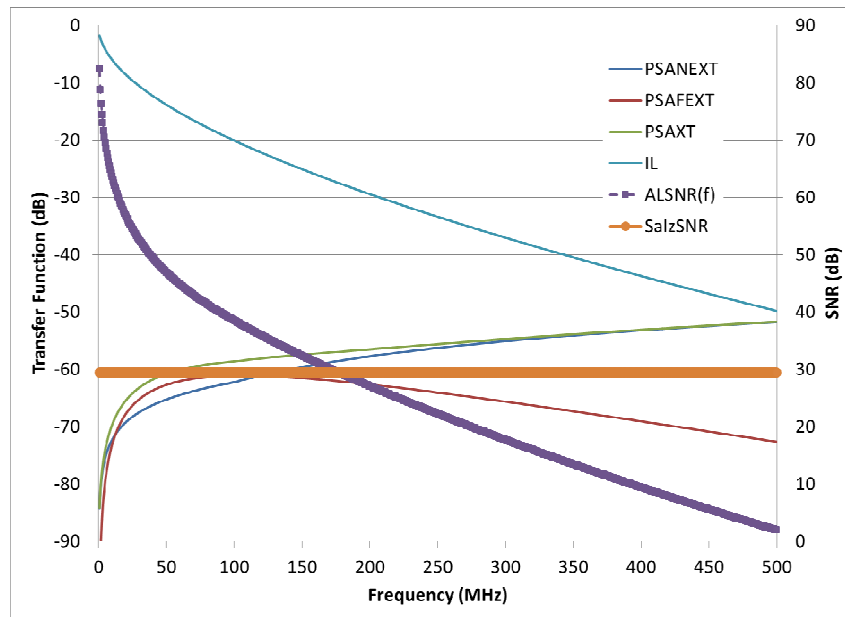


Salz SNR analysis

- Salz SNR analysis can be used as a starting point for feasibility
 - Assumes characteristics of PHY proposals (PAM signaling, symbol rates, performance targets)
 - Alien Crosstalk limited performance limits can be computed from cabling measurements
 - Does not DISPROVE feasibility - negative results require more detailed investigation
- Assume 10GBASE-T based technology
 - 23.8 dB target SNR (feasibility threshold)
 - 200 Mbaud PAM for 2.5 Gbps
 - 400 Mbaud PAM for 5 Gbps
- Compare with similar calculation for 800 Mbaud PAM using Clause 55 (10GBASE-T) limits for Cat 5e

Alien-Limited SNRs

10GBASE-T reference case:
28.9 dB alien-limited Salz SNR when
used with Clause 55 limits



Case 1, Cat5e (100m, fully bundled)	Alien-Limited Salz SNR (dB)
2.5G (200 MBd PAM)	31 dB (OK)
5G (400 MBd PAM)	25 dB (marginal)

Case 3, Cat5e (100m, 10m bundled)	Alien-Limited Salz SNR (dB)
2.5G (200 MBd PAM)	37 dB (OK)
5G (400 MBd PAM)	28 dB (like 10G)

Preliminary results show:

- 2.5G on Cat 5e appears feasible
- 5G on Cat 5e may be feasible
 - Variation in installation, e.g., bundling is a significant factor for 5G operation on Cat 5e

Next Steps

- Collect alien crosstalk data on Cat-6 channels based on the same configuration set – In progress
- If resource/time permits, collect alien crosstalk data of Cat-5e/Cat-6 channels from multiple vendors – Collaboration is highly encouraged
- Determine the worst-case channel configuration from various user cases for WAP application (number of connections, cable bundled size/distance, etc) – Need more inputs