Alien Crosstalk Measurements and Performance with Screened Cat 5e Cable

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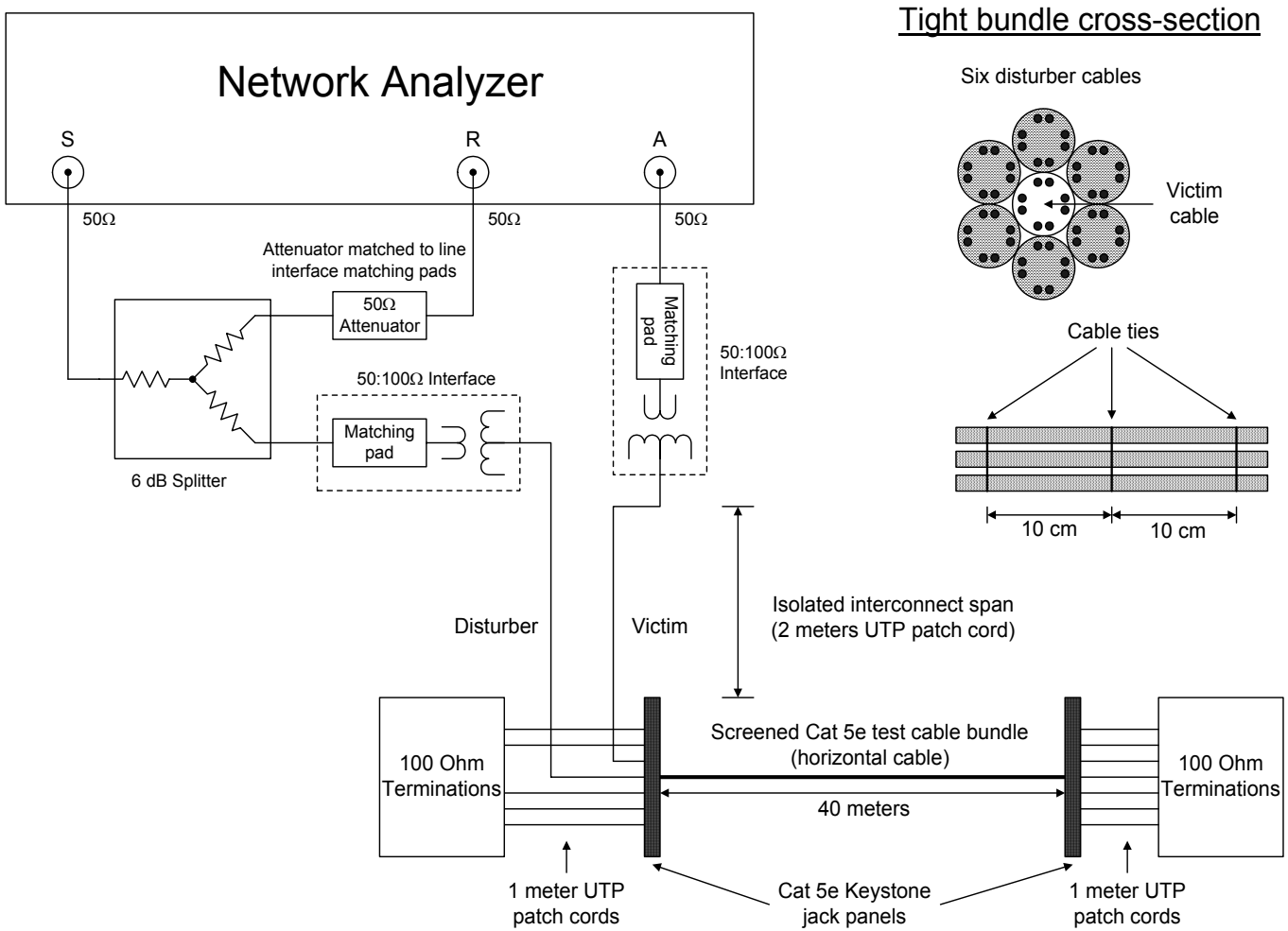
Overview

- Purpose:
  - Determine if screened Cat 5e cable provides a viable means of alien crosstalk mitigation to support 10GBase-T operation
- Measurement method and test setup
- Measurement results
- Channel capacity results
- Summary

Why Screened Cable (FTP)?

- Relatively inexpensive
  - Cost is <1.5X of same class UTP
  - Significantly less expensive than Cat 7/Class F.
- Compatible with UTP RJ45 connectors
- Not necessary to use screened RJ45 connectors
- Screened patch cords are readily available

Alien NEXT Measurement Setup

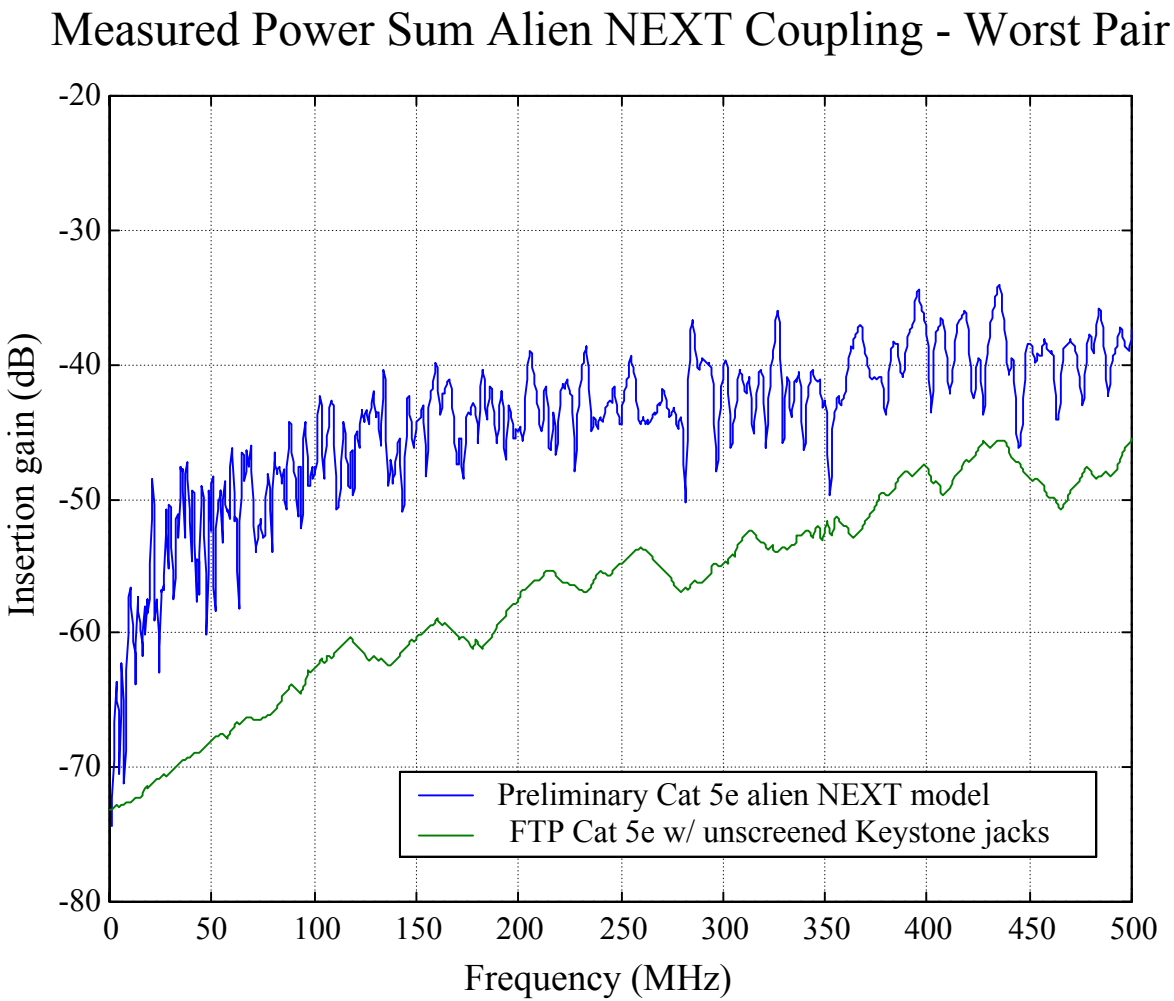


Alien Crosstalk Cable Test Bed

Procedure

- Measure pair-to-pair coupling between all wire pairs of victim and six surrounding disturber cables (96 total measurements)
- Calculate channel capacity of victim cable using power sum coupling into each victim pair from the six surrounding disturber cables
- Test with screened Cat 5e cable and standard Cat 5e UTP Keystone jack panel; shield is left floating

Measurement Results



- FTP provides effective mitigation even with unscreened connectors (foil shield is floating)

Measurement Summary

- Screened cable provides substantial reduction of alien crosstalk
- Cable foil screen may be left floating
  - Eliminates potential ground loop problems
  - Simplifies installation; compatible with installed base of UTP patch panels, connectors, and Keystone jacks

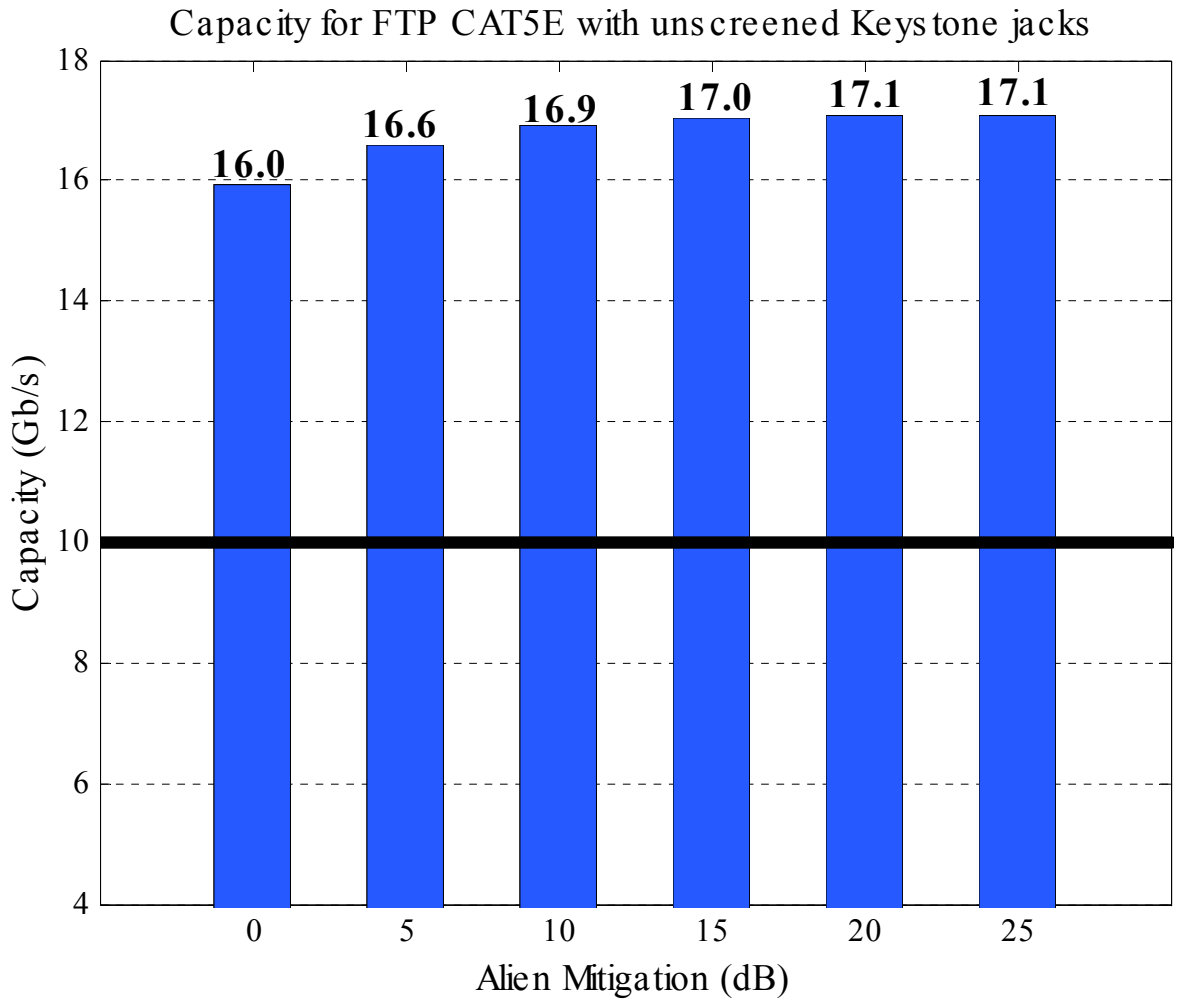
Capacity Calculations

- 10GBase-T Cabling Ad Hoc Channel Models:
  - Established models for Category 5e Insertion Loss, Return Loss, self NEXT and self FEXT (April 17, 2003).
- Alien crosstalk model for Cat 5e based on coupling measurements on tightly bundled screened Cat 5e cable
- Background Noise
  - Upper bound noise level of -150 dBm/Hz appears consistent with actual data center noise.[2,3]
- Launch power of 10 dBm.

Capacity Calculations

- Self-Impairment Cancellation:
  - 55 dB Return Loss Cancellation (15 dB Hybrid, 40 dB PHY)
  - 40 dB NEXT Cancellation
  - 25 dB FEXT Cancellation
- No Established Level for Alien NEXT Mitigation. Mitigation of 0 dB to 25 dB Realized through Combination of One or More Alternatives:
  - PHY (0 dB to 10 dB)[4]
  - Improved Installation Practices (0 dB to 10 dB)[1]
  - Enhanced Cable Design/Specification (0 dB to 25 dB)[5]

Channel Capacity Results



Summary

- Capacity greater than 10 Gbps can be achieved with:
  - Ad hoc Cat 5e models and alien crosstalk measurement models from screened cable
  - Reasonable levels of impairment cancellation
  - No alien crosstalk PHY mitigation
- Established the existence of low alien crosstalk cable that is low cost and compatible with the installed base UTP connectors

References

[1]Cohen, L., “Alien Crosstalk Measurements,” IEEE802.3 Contribution, Jan. 2003.

[2]Pagnanelli, C., “Data Center Background Noise Measurements,” IEEE802.3 10GBASE-T Contribution, May 2003.

[3]Cobb, T., “Background Noise,” IEEE802.3 10GBASE-T Contribution, May 2003.

[4]Solarflare Communications, “10GBASE-T Tutorial,” IEEE802.3 Contribution, Nov. 2002.

[5]Cobb, T., “Experimental Cat6 Cable Developed with Improved Alien NEXT,” IEEE802.3 Contribution, March 2003.