Channels for Consideration by the Signaling Ad Hoc

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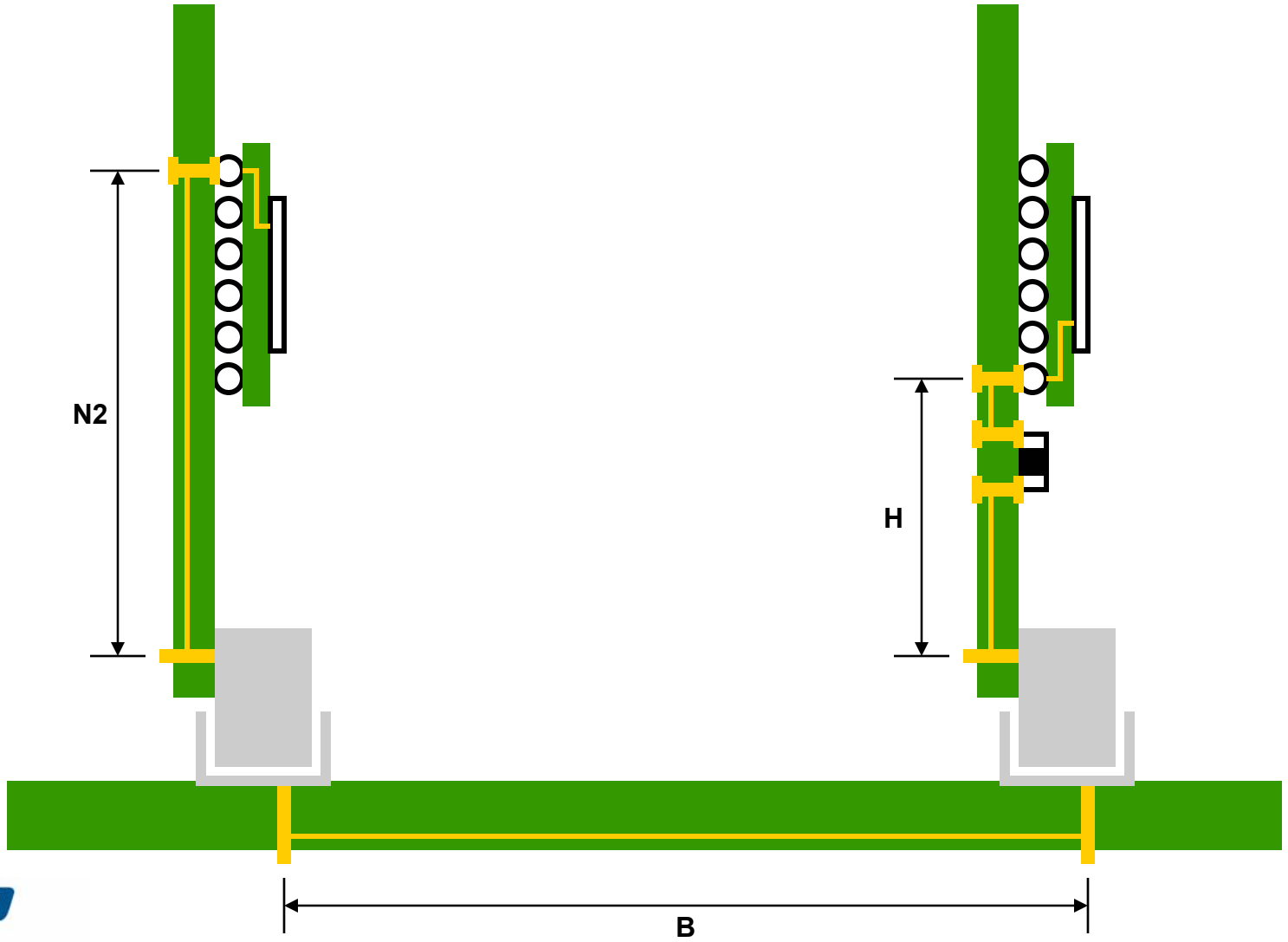
tyco Electronics

Two-Connector Topology



Topology Data

Description	N1 (mm)	N2 (mm)	B (mm)	H (mm)	Total (mm)	No. Connectors	AC / DC Coupling	Source
Blade Server								
Proposed Worst-Case	76	102	533	127	838	3	AC	*koenen_01_0504.pdf*
ATCA								
Full Mesh (max)	0	127	533	127	787	2	AC	*(note 1)*
Switch / Router								
2 to 3 chassis/rack (min)	0	152	51	305	508	2	AC	*goergen_01_0304.pdf (note 2)*
2 to 3 chassis/rack (max)	0	152	559	305	1016			
5 to 8 chassis/rack (min)	0	127	51	229	406			
5 to 8 chassis/rack (max)	0	127	432	229	787			
					700	2	AC or DC	*mandich_01_0704.pdf*
					1000		AC	
ATCA Example (Star)								
min(B)	0	102	28	102	231	2	AC	*peters_01_0504.pdf*
max(B)	0	102	244	102	447			

Note 1: From PICMG 3.0 R1.0 AdvancedTCA Specification, December 30, 2002 (8.4.2.1 and 8.2.4.3).

Note 2: Based on LC-2/SF-2. For minimum values, fabric position is assumed to be in the middle of the line cards. For maximum values, fabric position is assumed to be at the top of the line cards.

Topology Observations

- Worst-case backplane trace length (B) is about 21” (533mm).
  - Applies to full-mesh and star applications where the hub cards are positioned at the top or bottom of the node cards.
  - This distance may be reduced by centering the hub cards.
    - Example: Tyco Electronics Dual-Star ATCA Backplane, B(max) = 9.8” (248mm).
- Wide range of variability in the expected trace length on node and hub cards.
  - N2 = 3” (76mm) to 6” (152mm)
  - H = 3” to 12” (305mm)
  - Median trace length is 6” (152mm).
  - Additional mezzanine connector and N1 = 3” for blade servers.
- AC-coupling is required by multiple applications.

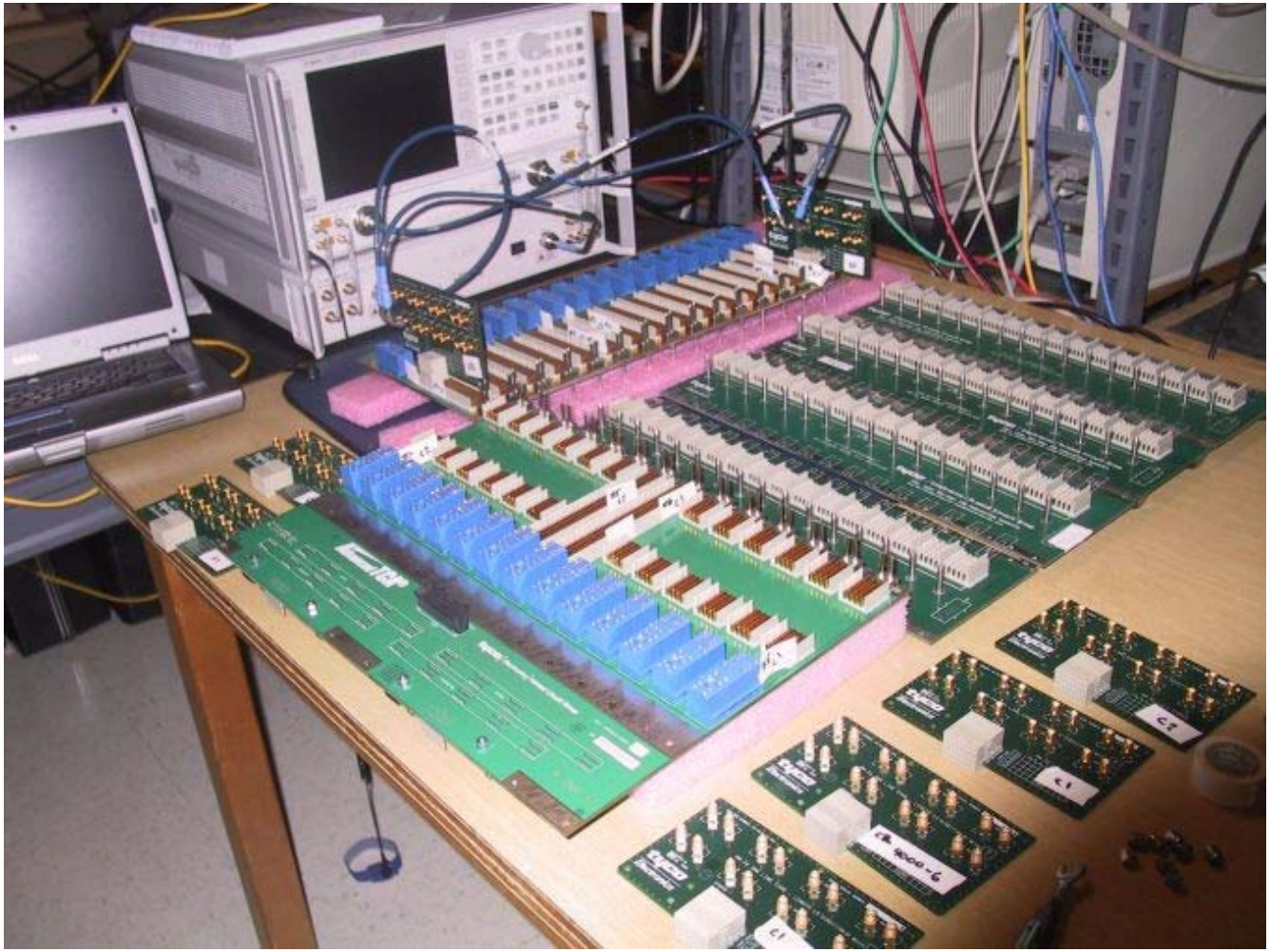
Recommended Channels of Interest

- Objective: 1m of “improved FR-4”
  - 10” Line Card > 20” Backplane > 10” Line Card
- ATCA Full Mesh
  - 6” Line Card > 20” Backplane > 6” Line Card
- ATCA Dual-Star
  - 6” Line Card > 10” Backplane (with and without stub) > 6” Line Card
- Adjacent Slots
  - 6” Line Card > 1” Backplane (with stub) > 6” Line Card
- Variations of above scenarios based on different grades of “improved FR-4”

Summary of Proposed Test Cases

Test Case	Line Card		Backplane			Total Length	Comments
	Length	Material	Length	Material	Stub		
1	10" (254mm)	Nelco 4000-13SI	20" (508mm)	Nelco 4000-13SI	Bottom (or counter-boring)	40" (1016mm)	Channel Model *Tyco - Data to be available within 2 to 3 weeks*
2	10" (254mm)	Nelco 4000-13	20" (508mm)	Nelco 4000-13SI	Bottom (or counter-boring)	40" (1016mm)	Margin Test Case *Tyco - Data is available.*
3	10" (254mm)	Nelco 4000-6	20" (508mm)	Nelco 4000-13SI	Bottom (or counter-boring)	40" (1016mm)	Margin Test Case *Tyco - Data is available.*
4	6" (152mm)	Nelco 4000-13	20" (508mm)	Nelco 4000-13SI	Bottom (or counter-boring)	32" (812mm)	ATCA Full Mesh *Tyco - Data is available.*
5	6" (152mm)	Nelco 4000-13	10" (254mm)	Nelco 4000-13	Bottom (or counter-boring)	22" (558mm)	ATCA Dual Star *Tyco - Data is available.*
6	6" (152mm)	Nelco 4000-13	10" (254mm)	Nelco 4000-13	Top Layer (with stub)	22" (558mm)	ATCA Dual Star *Tyco - Data is available.*
7	6" (152mm)	Nelco 4000-13SI	1" (25mm)	Nelco 4000-13SI	Near Top-Layer (with stub)	13" (330mm)	Adjacent Slot *Tyco - Data is available.*
NOTE: Data for all test cases includes dominant, adjacent NEXT and FEXT aggressors.							

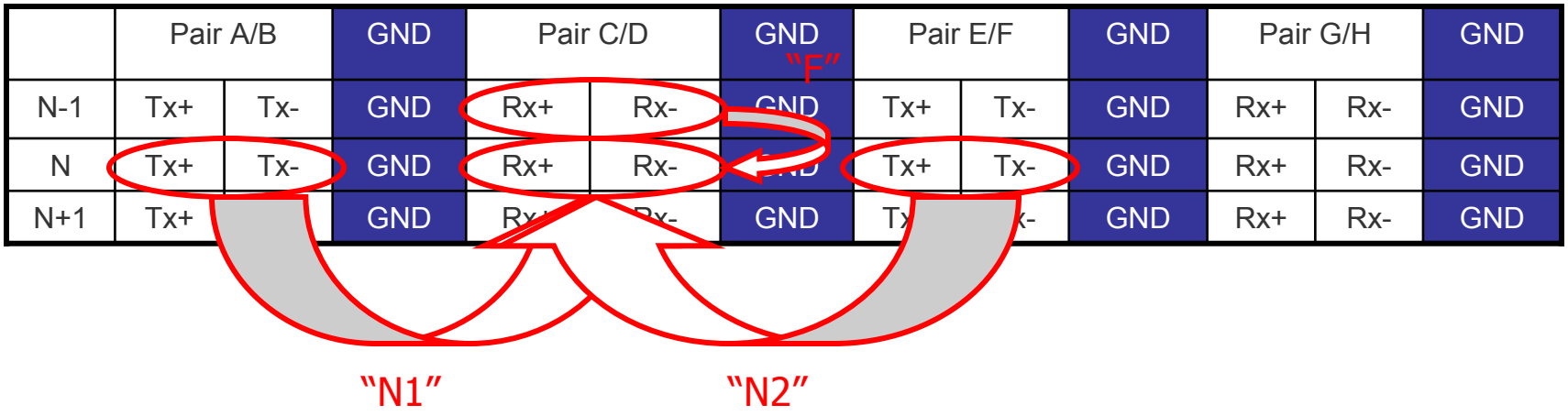
Test Setup @ UNH-IOL



Z-PACK HM-Zd Test Platforms

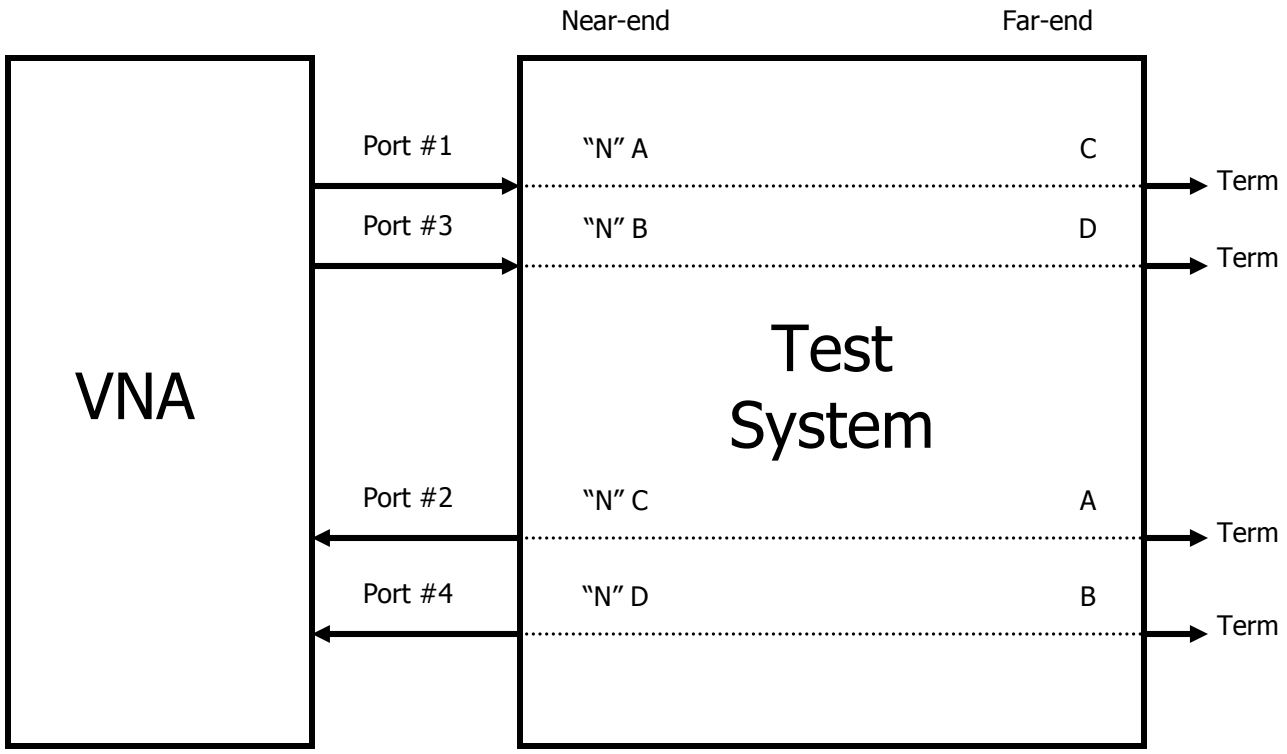
- ***Platform #1 – Kaparel ATCA Full Mesh Backplane***
  - Nelco 4000-13SI
  - 1” to 20” traces
  - Uses QuadRoute Technique
  - 0.125” thickness, 100 Ω Differential
  - 8 Signal layers throughout board
  - Validating use of “Improved FR-4”
- ***Platform #2 – Tyco ATCA Dual Star Backplane***
  - Nelco 4000-13
  - 1” to 10” traces
  - Uses QuadRoute Technique
  - 0.125” thickness, 100 Ω Differential
  - 4 Signal Layer throughout board
  - Validating use of “Improved FR-4”
- ***SMA Line Cards – All Platforms***
  - Nelco 4000-13, 4000-13SI
  - 6”, and 10” trace
  - 6 mil trace width, 100 Ω Differential
  - 0.092” thickness
  - 4 Signal layers throughout board
  - All boards for each material from same panel
  - “Improved FR-4” used

ATCA Pinout

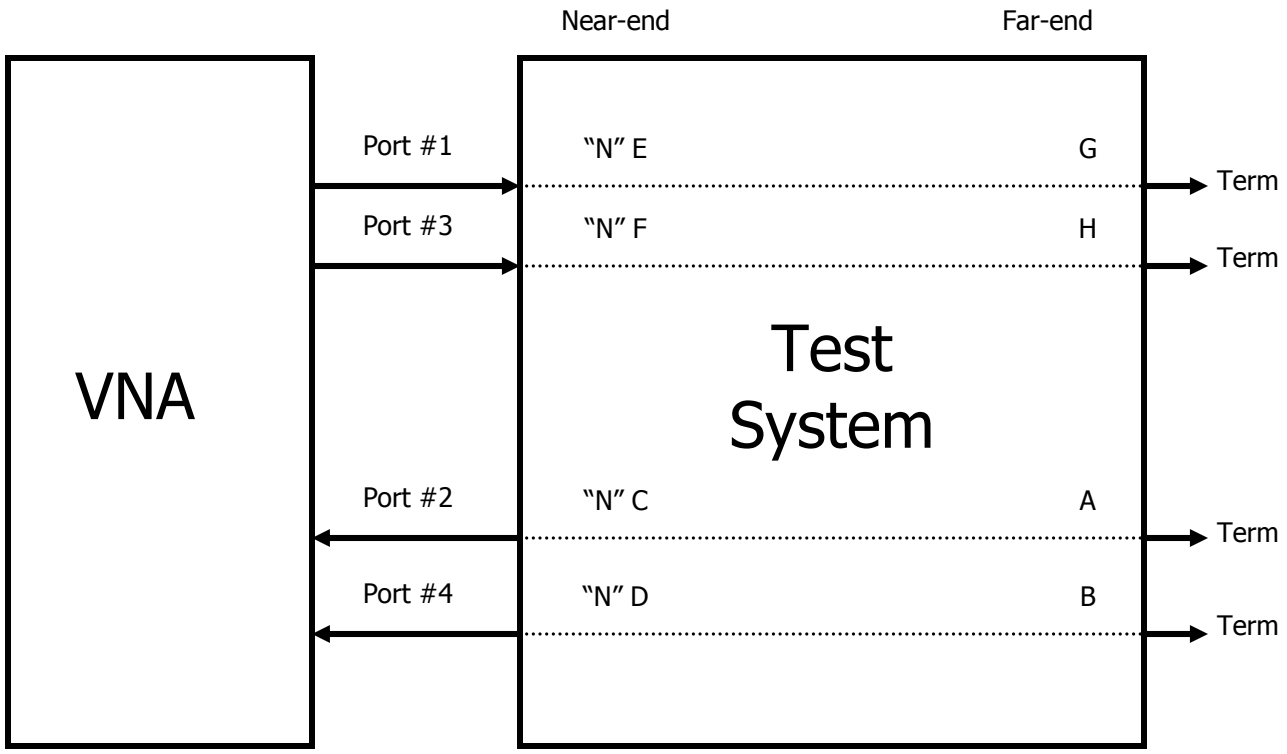


- Pair C/D chosen due to number of surrounding aggressors
- Direct adjacent aggressors are dominant
- Aggressors similar system length to victim
- NEXT Aggressors
  - Can not assume similar performance between
    - Pair A/B > Pair C/D ("N1")
    - Pair E/F > Pair C/D ("N2")
- FEXT Aggressors
  - Can assume similar performance between
    - "N-1" Pair C/D > "N" Pair C/D ("F")
    - "N+1" Pair C/D > "N" Pair C/D ("F")
- Line cards designed for different backplane pinout. Total system skew within pair not optimized between line cards / backplane. Investigating impact.

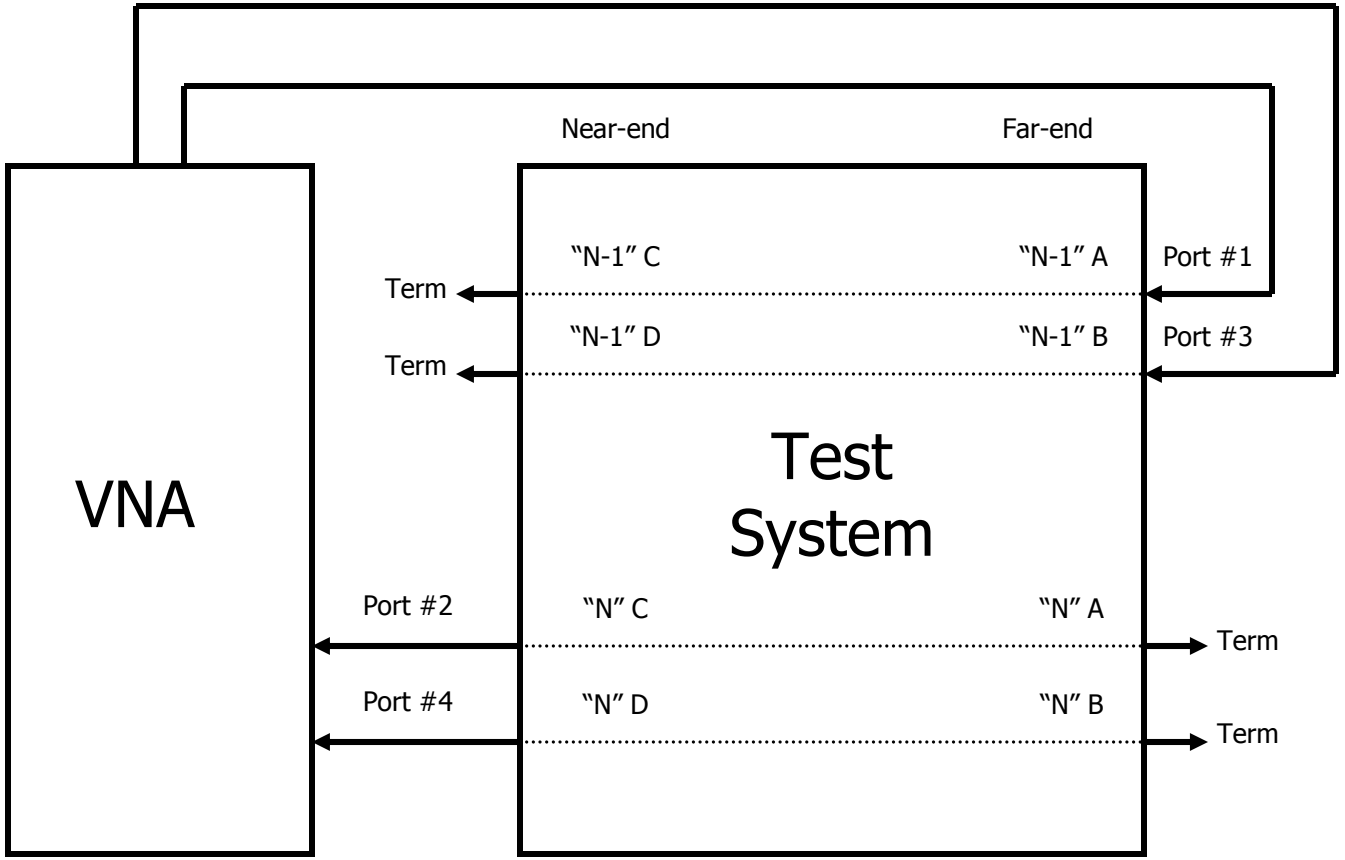
Crosstalk NEXT Aggressor "N1"



Crosstalk NEXT Aggressor "N2"

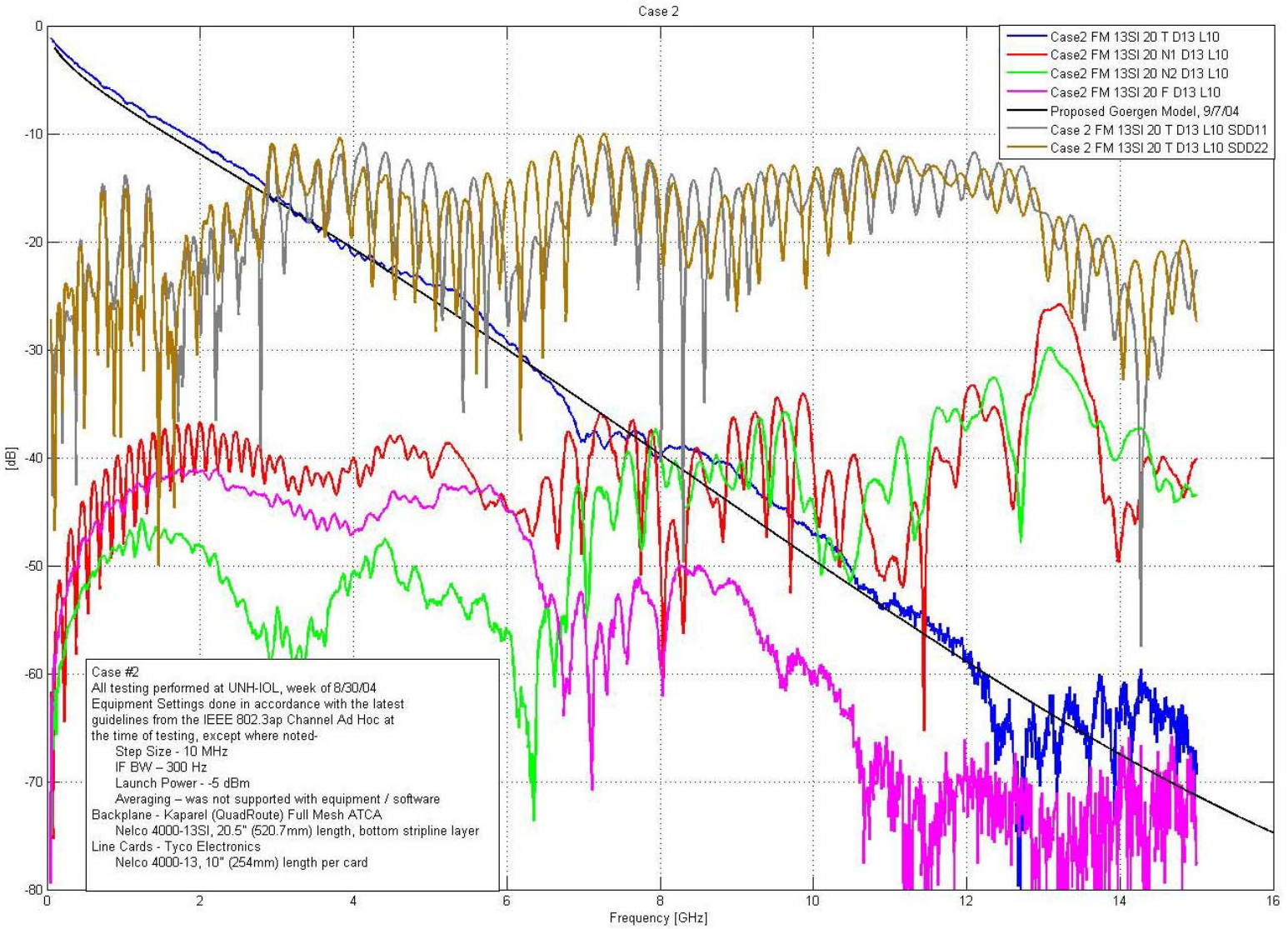


Crosstalk FEXT Aggressor

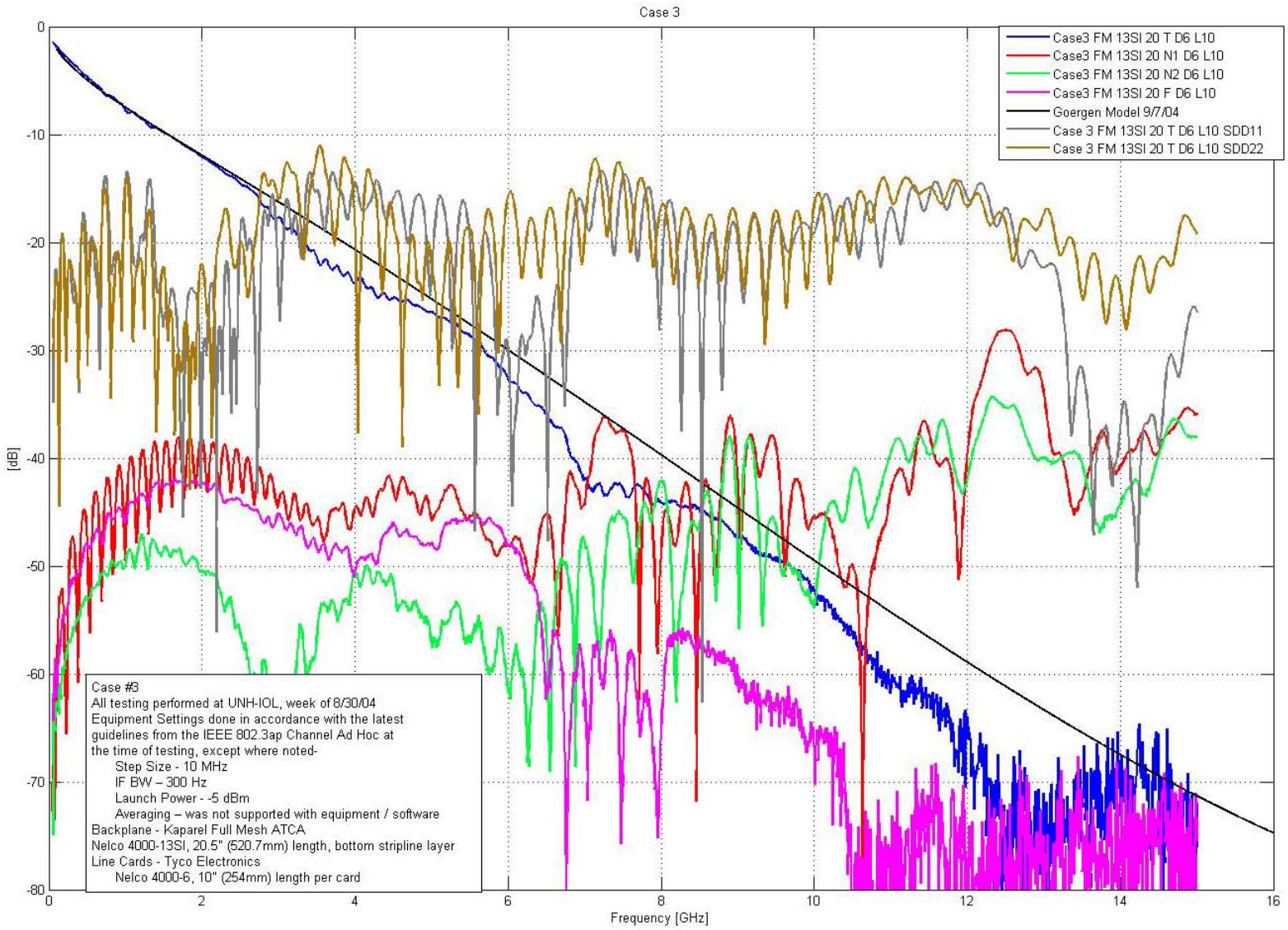


Case #1

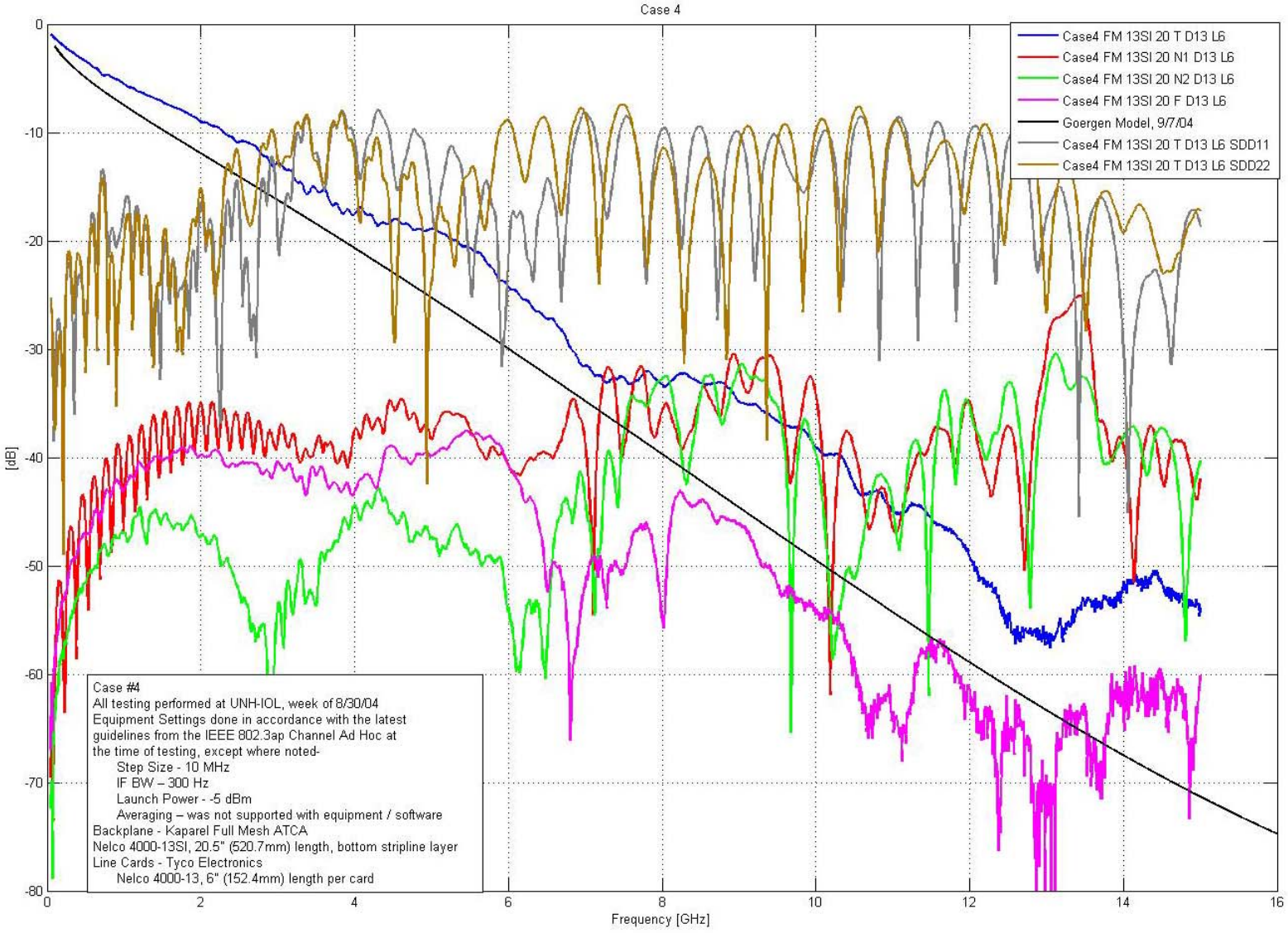
Case #2


Case 2
Case2 FM 13SI 20 T D13 L10
Case2 FM 13SI 20 N1 D13 L10
Case2 FM 13SI 20 N2 D13 L10
Case2 FM 13SI 20 F D13 L10
Proposed Goergen Model, 9/7/04
Case 2 FM 13SI 20 T D13 L10 SDD11
Case 2 FM 13SI 20 T D13 L10 SDD22
[dB]
Frequency [GHz]
Case #2
All testing performed at UNH-IOL, week of 8/30/04
Equipment Settings done in accordance with the latest
guidelines from the IEEE 802.3ap Channel Ad Hoc at
the time of testing, except where noted-
Step Size - 10 MHz
IF BW – 300 Hz
Launch Power - -5 dBm
Averaging – was not supported with equipment / software
Backplane - Kaparel (QuadRoute) Full Mesh ATCA
Nelco 4000-13SI, 20.5" (520.7mm) length, bottom stripline layer
Line Cards - Tyco Electronics
Nelco 4000-13, 10" (254mm) length per card

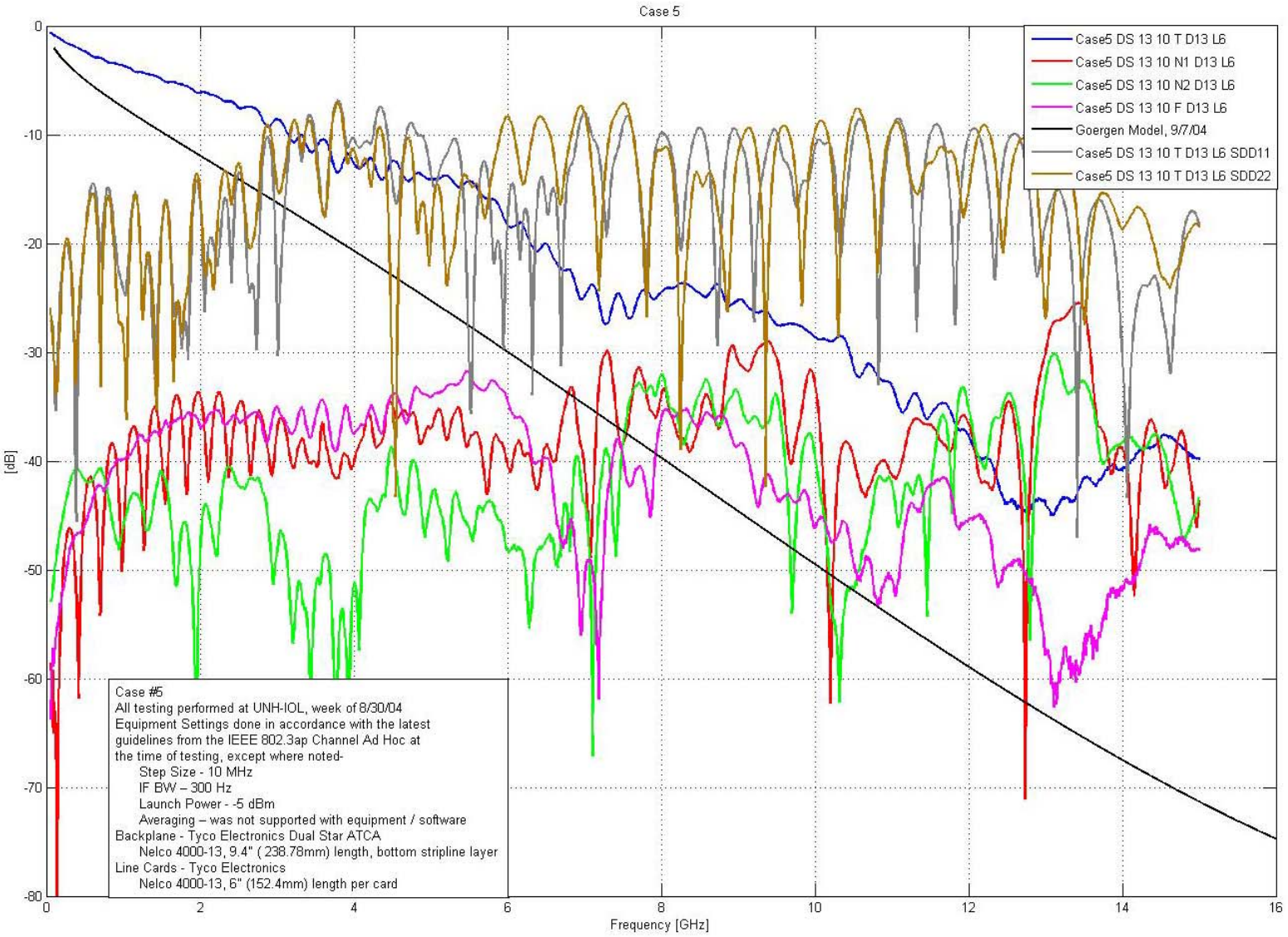
Case #3


Case 3
Case3 FM 13SI 20 T D6 L10
Case3 FM 13SI 20 N1 D6 L10
Case3 FM 13SI 20 N2 D6 L10
Case3 FM 13SI 20 F D6 L10
Goergen Model 9/7/04
Case 3 FM 13SI 20 T D6 L10 SDD11
Case 3 FM 13SI 20 T D6 L10 SDD22
[dB]
Frequency [GHz]
0
-10
-20
-30
-40
-50
-60
-70
-80
0
2
4
6
8
10
12
14
16
Case #3
All testing performed at UNH-IOL, week of 8/30/04
Equipment Settings done in accordance with the latest guidelines from the IEEE 802.3ap Channel Ad Hoc at the time of testing, except where noted-
Step Size - 10 MHz
IF BW – 300 Hz
Launch Power - -5 dBm
Averaging – was not supported with equipment / software
Backplane - Kaparel Full Mesh ATCA
Nelco 4000-13SI, 20.5" (520.7mm) length, bottom stripline layer
Line Cards - Tyco Electronics
Nelco 4000-6, 10" (254mm) length per card

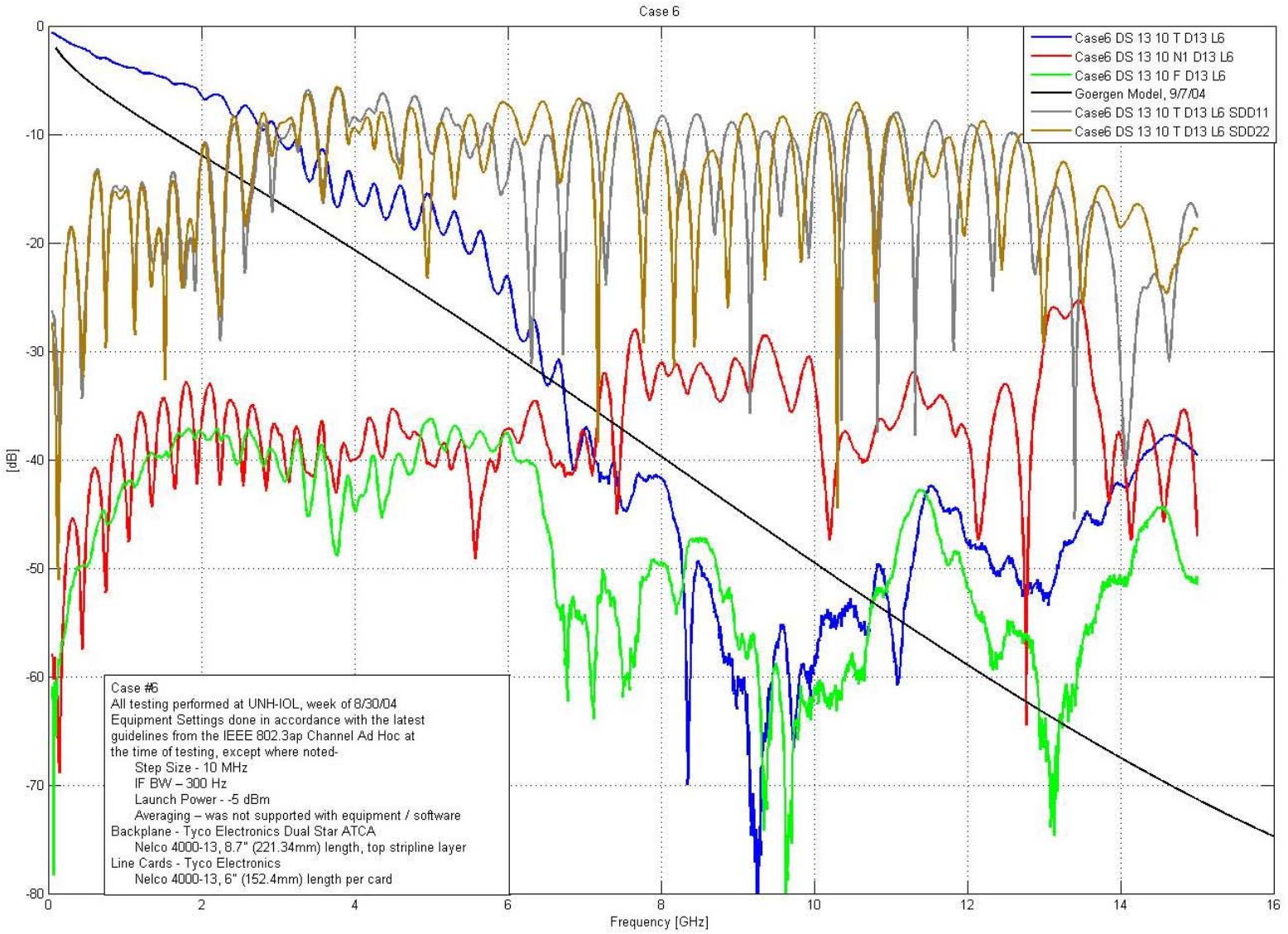
Case #4


Case 4
Case4 FM 13SI 20 T D13 L6
Case4 FM 13SI 20 N1 D13 L6
Case4 FM 13SI 20 N2 D13 L6
Case4 FM 13SI 20 F D13 L6
Goergen Model, 9/7/04
Case4 FM 13SI 20 T D13 L6 SDD11
Case4 FM 13SI 20 T D13 L6 SDD22
[dB]
Frequency [GHz]
0
-10
-20
-30
-40
-50
-60
-70
-80
0
2
4
6
8
10
12
14
16
Case #4
All testing performed at UNH-IOL, week of 8/30/04
Equipment Settings done in accordance with the latest guidelines from the IEEE 802.3ap Channel Ad Hoc at the time of testing, except where noted-
Step Size - 10 MHz
IF BW – 300 Hz
Launch Power - -5 dBm
Averaging – was not supported with equipment / software
Backplane - Kaparel Full Mesh ATCA
Nelco 4000-13SI, 20.5" (520.7mm) length, bottom stripline layer
Line Cards - Tyco Electronics
Nelco 4000-13, 6" (152.4mm) length per card

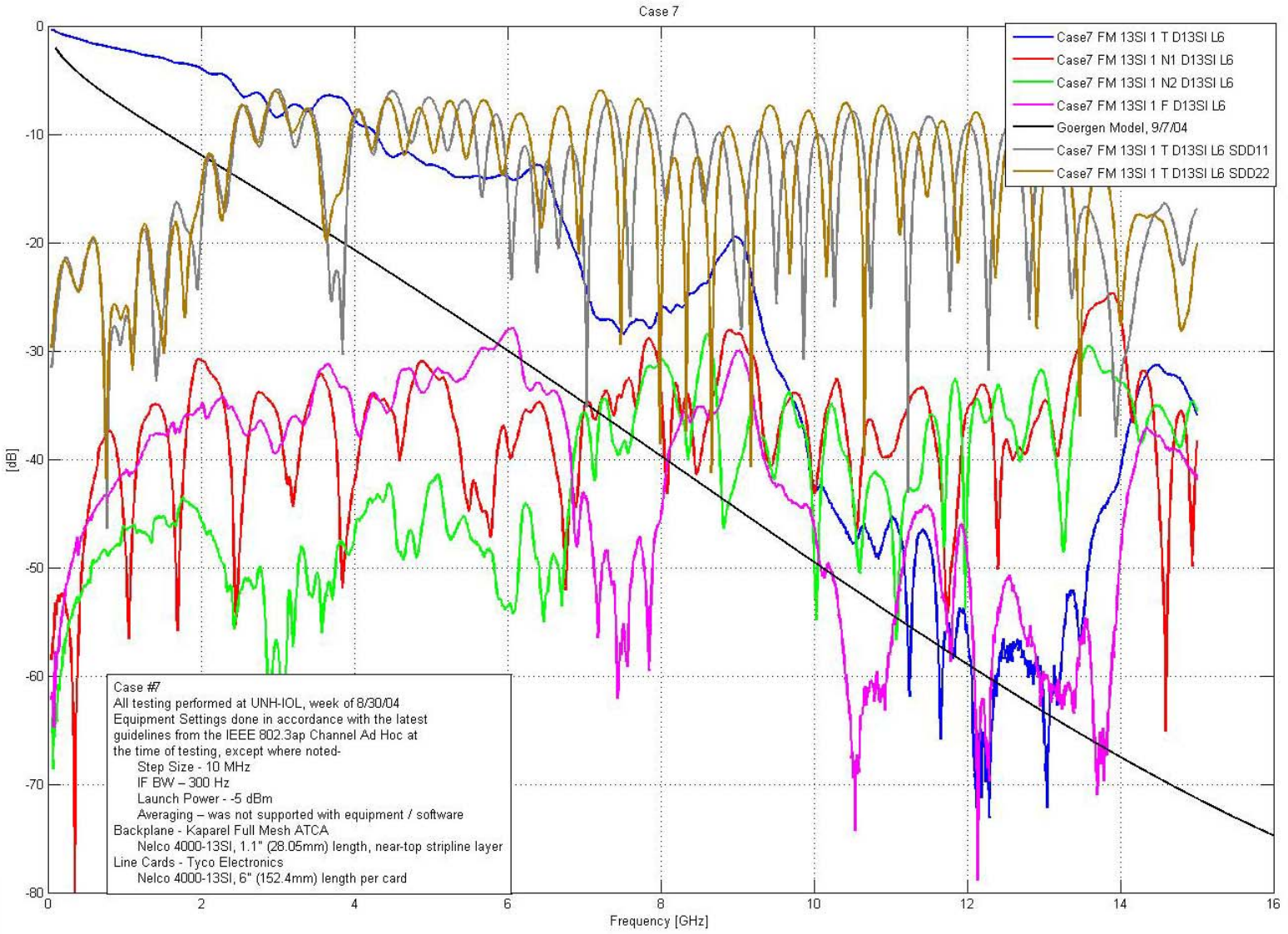
Case #5


Case 5
Case5 DS 13 10 T D13 L6
Case5 DS 13 10 N1 D13 L6
Case5 DS 13 10 N2 D13 L6
Case5 DS 13 10 F D13 L6
Goergen Model, 9/7/04
Case5 DS 13 10 T D13 L6 SDD11
Case5 DS 13 10 T D13 L6 SDD22
[dB]
Frequency [GHz]
0
-10
-20
-30
-40
-50
-60
-70
-80
0
2
4
6
8
10
12
14
16
Case #5
All testing performed at UNH-IOL, week of 8/30/04
Equipment Settings done in accordance with the latest guidelines from the IEEE 802.3ap Channel Ad Hoc at the time of testing, except where noted-
Step Size - 10 MHz
IF BW – 300 Hz
Launch Power - -5 dBm
Averaging – was not supported with equipment / software
Backplane - Tyco Electronics Dual Star ATCA
Nelco 4000-13, 9.4" (238.78mm) length, bottom stripline layer
Line Cards - Tyco Electronics
Nelco 4000-13, 6" (152.4mm) length per card

Case #6


Case 6
Case6 DS 13 10 T D13 L6
Case6 DS 13 10 N1 D13 L6
Case6 DS 13 10 F D13 L6
Goergen Model, 9/7/04
Case6 DS 13 10 T D13 L6 SDD11
Case6 DS 13 10 T D13 L6 SDD22
[dB]
Frequency [GHz]
0
-10
-20
-30
-40
-50
-60
-70
-80
0
2
4
6
8
10
12
14
16
Case #6
All testing performed at UNH-IOL, week of 8/30/04
Equipment Settings done in accordance with the latest
guidelines from the IEEE 802.3ap Channel Ad Hoc at
the time of testing, except where noted-
Step Size - 10 MHz
IF BW – 300 Hz
Launch Power - -5 dBm
Averaging – was not supported with equipment / software
Backplane - Tyco Electronics Dual Star ATCA
Nelco 4000-13, 8.7" (221.34mm) length, top stripline layer
Line Cards - Tyco Electronics
Nelco 4000-13, 6" (152.4mm) length per card

Case #7


Case 7
Case7 FM 13SI 1 T D13SI L6
Case7 FM 13SI 1 N1 D13SI L6
Case7 FM 13SI 1 N2 D13SI L6
Case7 FM 13SI 1 F D13SI L6
Goergen Model, 9/7/04
Case7 FM 13SI 1 T D13SI L6 SDD11
Case7 FM 13SI 1 T D13SI L6 SDD22
[dB]
Frequency [GHz]
0
-10
-20
-30
-40
-50
-60
-70
-80
0
2
4
6
8
10
12
14
16
Case #7
All testing performed at UNH-IOL, week of 8/30/04
Equipment Settings done in accordance with the latest guidelines from the IEEE 802.3ap Channel Ad Hoc at the time of testing, except where noted-
Step Size - 10 MHz
IF BW – 300 Hz
Launch Power - -5 dBm
Averaging – was not supported with equipment / software
Backplane - Kaparel Full Mesh ATCA
Nelco 4000-13SI, 1.1" (28.05mm) length, near-top stripline layer
Line Cards - Tyco Electronics
Nelco 4000-13SI, 6" (152.4mm) length per card

Additional Considerations

- Performance is implementation specific -
  - Forward channel
  - Return Loss
  - Crosstalk
- Stub Effects
  - Include even if they violate the channel model?
- Crosstalk
  - Different pin-outs.
- Return Loss
  - Good launch required to see difference.
  - Driven by line card layer connection with further peaking caused by backplane layer connection.
- Manufacturing and environmental variance