

Representative 2.5Gb/s and 5Gb/s PHY Performance in Bundled Cat5e and Cat6 Configurations With and Without Mitigation

IEEE P802.3bz 2.5G/5GBASE-T Task Force

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- Jon Lewis, Dell
- Paul Wachtel, Panduit

Purpose & Summary

- Describe testing performed to investigate proposed P802.3bz Use Cases
 - 2.5Gb/s and 5Gb/s data rates over various Cat5e and Cat6 cabling/connector configurations
- Results show that 2.5Gb/s and 5Gb/s data rates can be reliably achieved over the “Use Cases Supported” as described in `diminico_3bz_01_0316.pdf`

Test Setup & Sweep Description

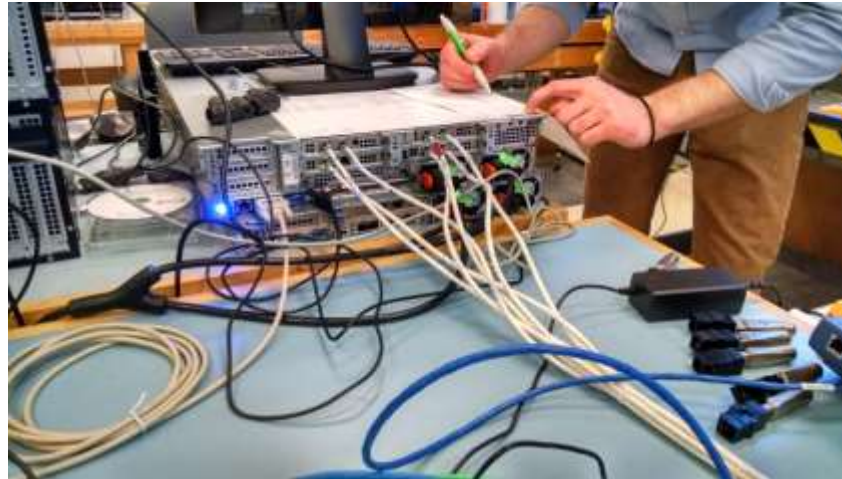
- Seven pairs of 2.5Gb/s- and 5Gb/s-capable devices (14 devices) are connected to various Cat5e and Cat6 cabling configurations
- Victim devices and 3 sets of aggressor devices (4 cables, 8 devices total) are controlled and monitored throughout the test
 - Link events are initiated on the near-end device of each pair by restarting autonegotiation after setting the desired rate
 - The near-end and far-end devices for these 4 cables are monitored with data collected on each device as noted below
 - *Note: The remaining 3 sets of aggressors are configured to transmit data at the desired rate but are not monitored*
- Data collected includes the number of link attempts to achieve link, the observed time-to-link, resolved rate and reported SNR operating margin (presented as normalized values)

Test Setup Examples

Unbundled cabling



Endpoints installed in server

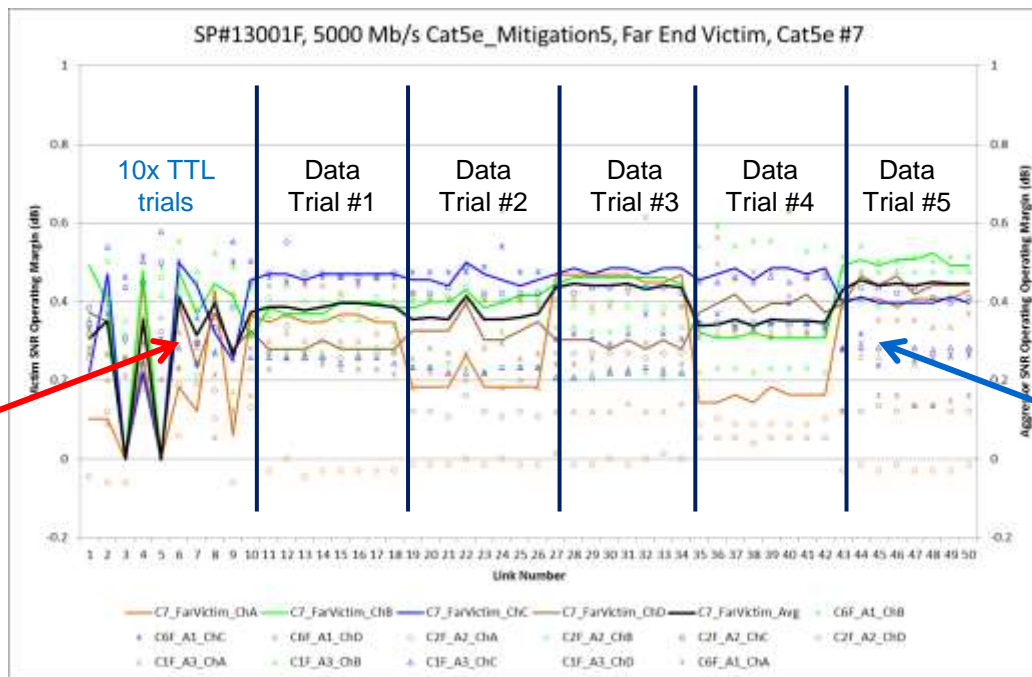


Bundled cabling



SNR Margin Plot Decoder Ring

- Each test case includes a total of 15 link trials
 - The first 10 trials are “link” only with one SNR operating margin measurement/trial
 - The last 5 trials include short data passes as a quick BER check (not statistically significant); SNR operating margins are checked at ~10s intervals.
- Operating margin is normalized on a per-pair basis to the maximum observed value for that pair across all trials



Victim per-pair (by color) and average operating margin (black) indicated by line plot

Aggressors A1, A2, A3 per-pair (by color) operating margin indicated by scatter plots

Test Data Decoder Ring

Cable configuration

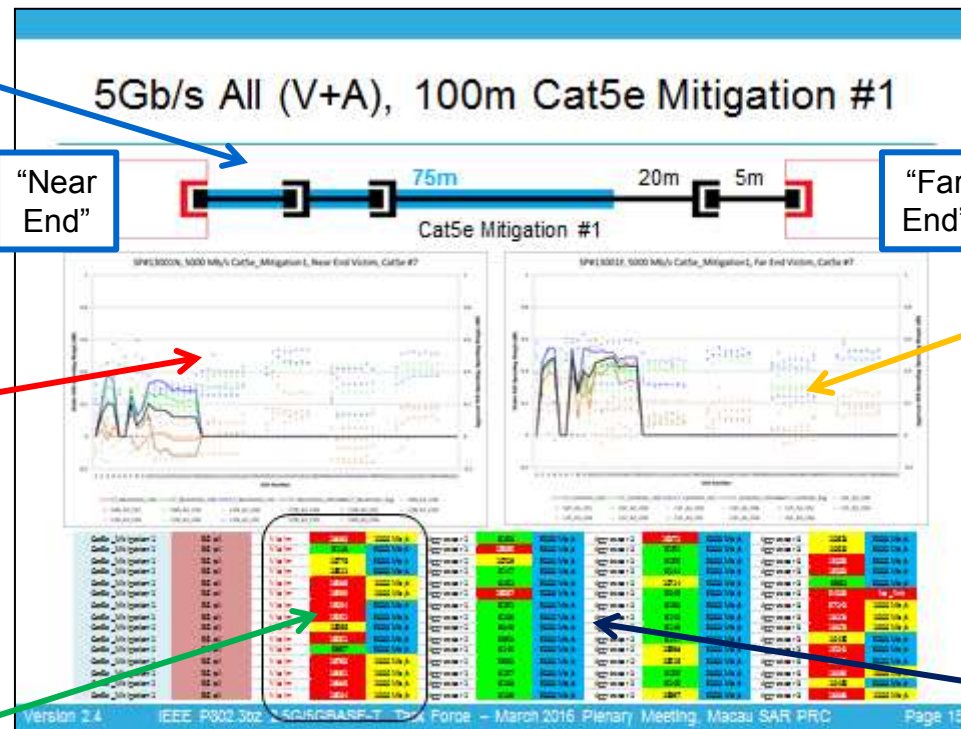
- Blue lines indicate bundling
- Blue “x m” text is the bundled length
- Black “x m” text is the unbundled length

Near end normalized SNR operating margin

- Solid lines = victim
- Scatter plots = aggressors

Victim DUT/LP pair TTL and resolved speed

Aggressor DUT/LP pairs TTL and resolved speed



Far end normalized SNR operating margin

- Solid lines = victim
- Scatter plots = aggressors

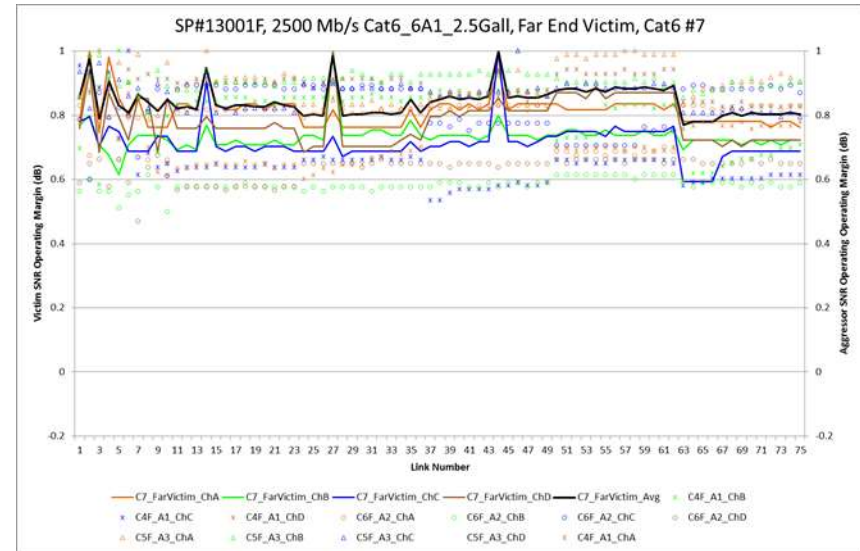
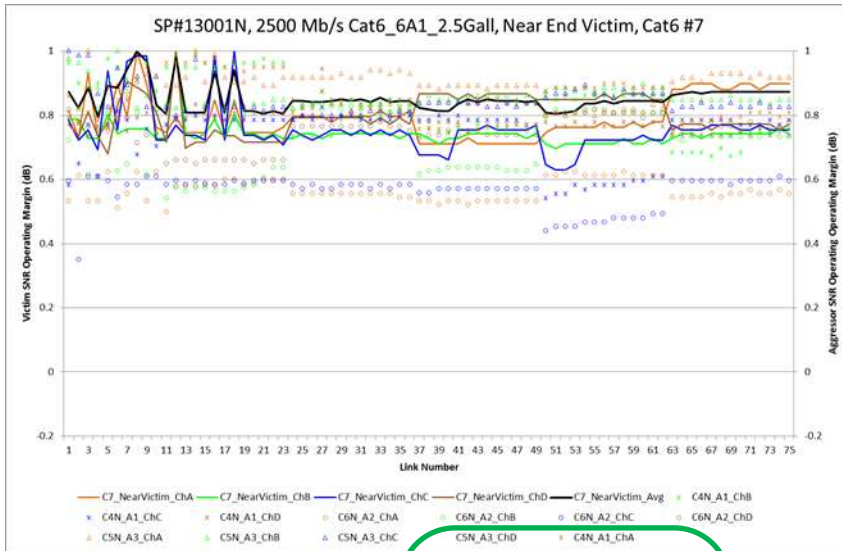
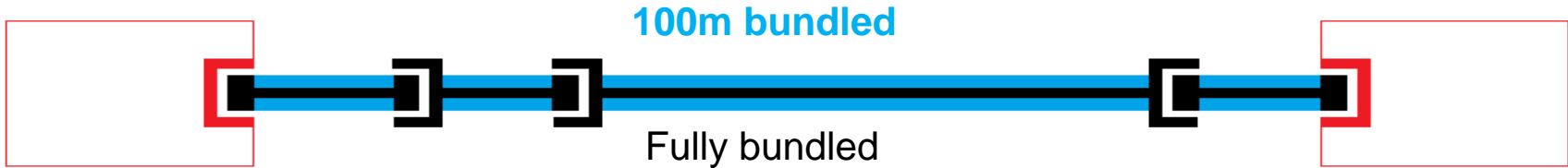
Results summary

- The 1st two columns identify the test case
- The next column groups identify the DUT/LP pair, measured time-to-link (TTL) and resolved link speed

Category 6 Test Cases

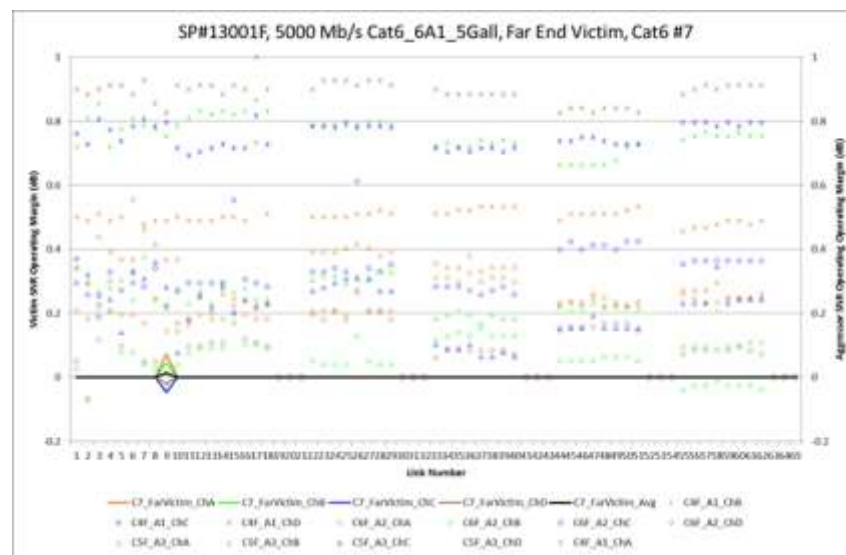
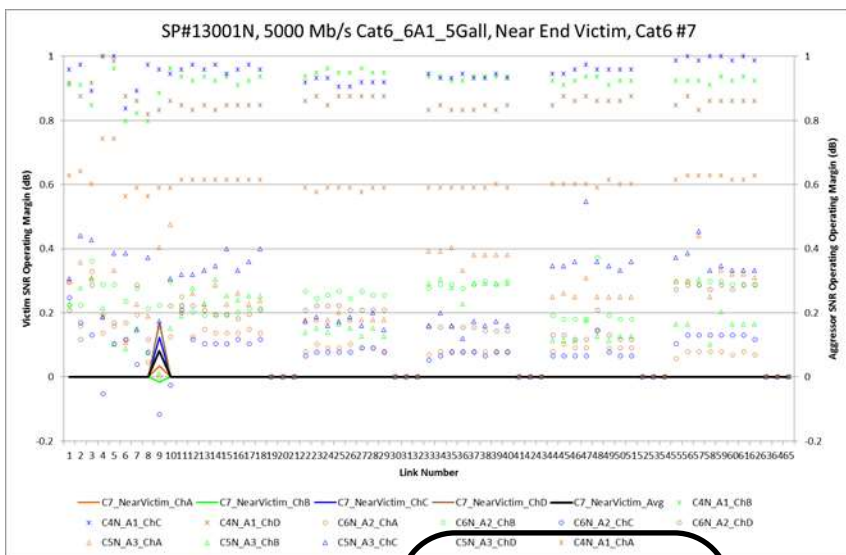
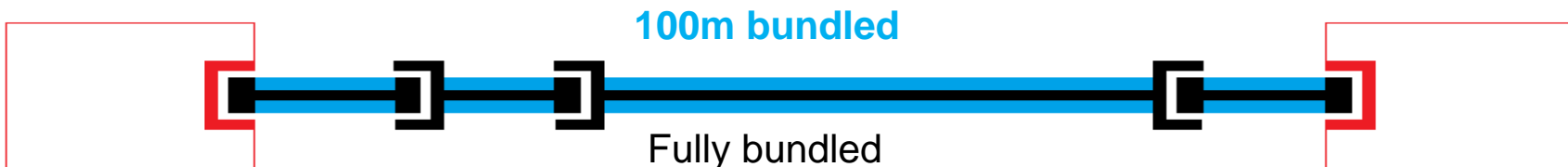
- Five test cases were evaluated
 - #1: 2.5Gb/s on all victim/aggressor cables, 100m fully bundled
 - #2: 5Gb/s on all victim/aggressor cables, 100m fully bundled
 - #3 through #5: 5Gb/s on all victim/aggressor cables with three unbundled configurations (described on each test case summary slide)

2.5Gb/s All (V+A), 100m Cat6



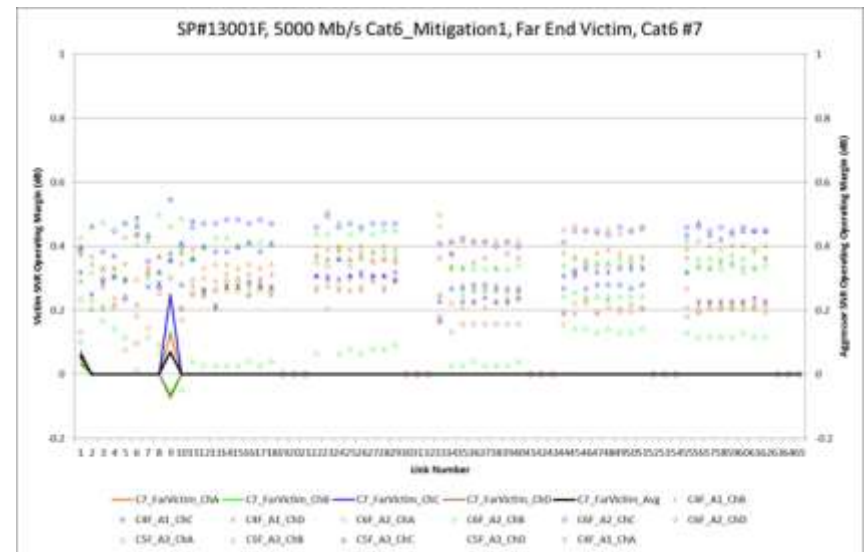
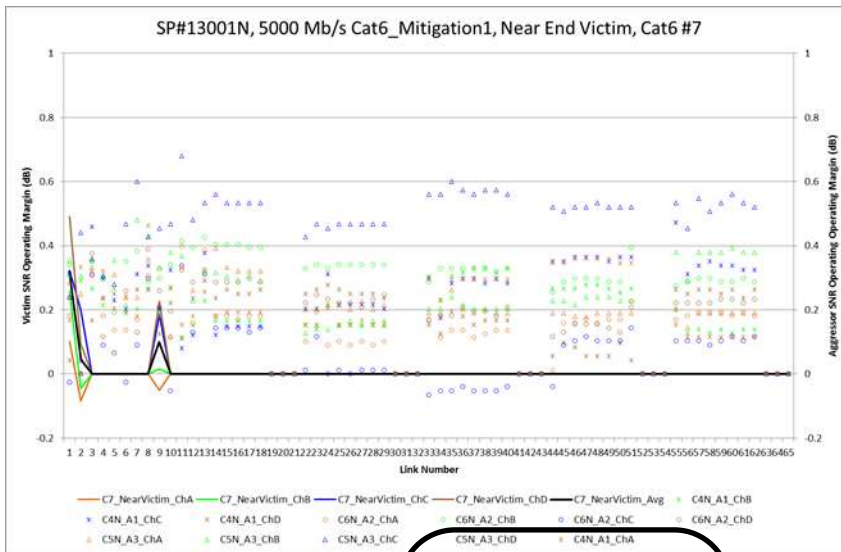
Cat6_6A1	2.5G all	Victim	5966	2500 Mb/s	Aggressor 1	5959	2500 Mb/s	Aggressor 2	5944	2500 Mb/s	Aggressor 3	5959	2500 Mb/s
Cat6_6A1	2.5G all	Victim	6148	2500 Mb/s	Aggressor 1	6162	2500 Mb/s	Aggressor 2	6139	2500 Mb/s	Aggressor 3	5944	2500 Mb/s
Cat6_6A1	2.5G all	Victim	5950	2500 Mb/s	Aggressor 1	6161	2500 Mb/s	Aggressor 2	6350	2500 Mb/s	Aggressor 3	6124	2500 Mb/s
Cat6_6A1	2.5G all	Victim	6130	2500 Mb/s	Aggressor 1	6144	2500 Mb/s	Aggressor 2	6154	2500 Mb/s	Aggressor 3	5946	2500 Mb/s
Cat6_6A1	2.5G all	Victim	6136	2500 Mb/s	Aggressor 1	6118	2500 Mb/s	Aggressor 2	6161	2500 Mb/s	Aggressor 3	5948	2500 Mb/s
Cat6_6A1	2.5G all	Victim	6151	2500 Mb/s	Aggressor 1	6131	2500 Mb/s	Aggressor 2	6153	2500 Mb/s	Aggressor 3	5950	2500 Mb/s
Cat6_6A1	2.5G all	Victim	6141	2500 Mb/s	Aggressor 1	6141	2500 Mb/s	Aggressor 2	6166	2500 Mb/s	Aggressor 3	5947	2500 Mb/s
Cat6_6A1	2.5G all	Victim	6136	2500 Mb/s	Aggressor 1	6148	2500 Mb/s	Aggressor 2	6168	2500 Mb/s	Aggressor 3	6126	2500 Mb/s
Cat6_6A1	2.5G all	Victim	6137	2500 Mb/s	Aggressor 1	6140	2500 Mb/s	Aggressor 2	6147	2500 Mb/s	Aggressor 3	6132	2500 Mb/s
Cat6_6A1	2.5G all	Victim	6127	2500 Mb/s	Aggressor 1	6137	2500 Mb/s	Aggressor 2	6149	2500 Mb/s	Aggressor 3	5959	2500 Mb/s
Cat6_6A1	2.5G all	Victim	6128	2500 Mb/s	Aggressor 1	6150	2500 Mb/s	Aggressor 2	6155	2500 Mb/s	Aggressor 3	5940	2500 Mb/s
Cat6_6A1	2.5G all	Victim	6146	2500 Mb/s	Aggressor 1	6161	2500 Mb/s	Aggressor 2	6160	2500 Mb/s	Aggressor 3	5936	2500 Mb/s
Cat6_6A1	2.5G all	Victim	6130	2500 Mb/s	Aggressor 1	6158	2500 Mb/s	Aggressor 2	6132	2500 Mb/s	Aggressor 3	5965	2500 Mb/s
Cat6_6A1	2.5G all	Victim	6132	2500 Mb/s	Aggressor 1	6143	2500 Mb/s	Aggressor 2	6141	2500 Mb/s	Aggressor 3	6137	2500 Mb/s
Cat6_6A1	2.5G all	Victim	6120	2500 Mb/s	Aggressor 1	6144	2500 Mb/s	Aggressor 2	6159	2500 Mb/s	Aggressor 3	6136	2500 Mb/s

5Gb/s All (V+A), 100m Cat6



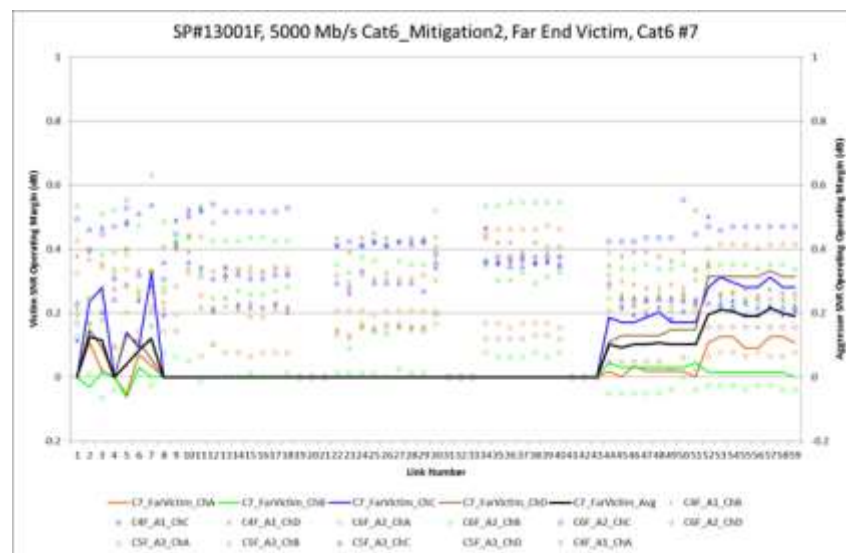
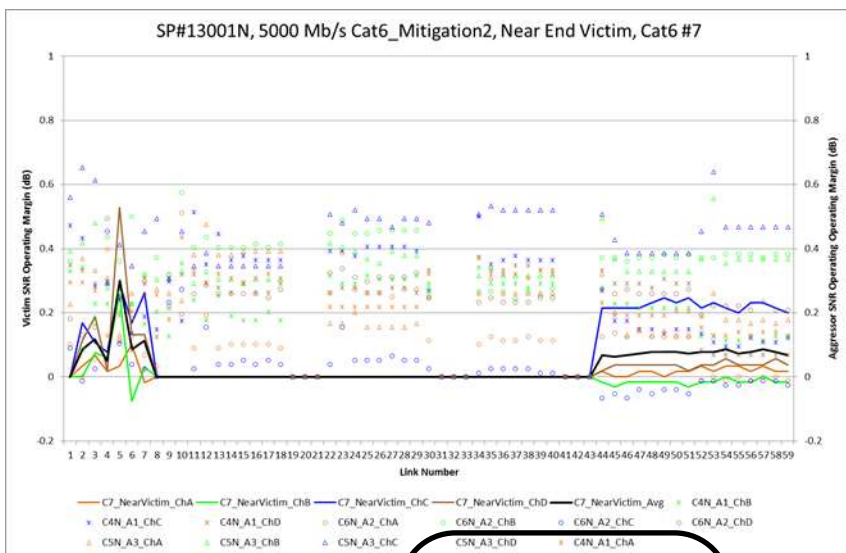
Cat6_6A1	5G all	Victim	18420	1000 Mb/s	Aggressor 1	6152	5000 Mb/s	Aggressor 2	6144	5000 Mb/s	Aggressor 3	5952	5000 Mb/s
Cat6_6A1	5G all	Victim	61542	1000 Mb/s	Aggressor 1	6144	5000 Mb/s	Aggressor 2	6138	5000 Mb/s	Aggressor 3	5974	5000 Mb/s
Cat6_6A1	5G all	Victim	18405	1000 Mb/s	Aggressor 1	5947	5000 Mb/s	Aggressor 2	6362	5000 Mb/s	Aggressor 3	5940	5000 Mb/s
Cat6_6A1	5G all	Victim	18391	1000 Mb/s	Aggressor 1	6156	5000 Mb/s	Aggressor 2	6146	5000 Mb/s	Aggressor 3	5953	5000 Mb/s
Cat6_6A1	5G all	Victim	18397	1000 Mb/s	Aggressor 1	5957	5000 Mb/s	Aggressor 2	6355	5000 Mb/s	Aggressor 3	6138	5000 Mb/s
Cat6_6A1	5G all	Victim	18577	1000 Mb/s	Aggressor 1	5948	5000 Mb/s	Aggressor 2	6148	5000 Mb/s	Aggressor 3	5941	5000 Mb/s
Cat6_6A1	5G all	Victim	18446	1000 Mb/s	Aggressor 1	6149	5000 Mb/s	Aggressor 2	6139	5000 Mb/s	Aggressor 3	6144	5000 Mb/s
Cat6_6A1	5G all	Victim	18388	1000 Mb/s	Aggressor 1	6137	5000 Mb/s	Aggressor 2	6351	5000 Mb/s	Aggressor 3	5946	5000 Mb/s
Cat6_6A1	5G all	Victim	51004	5000 Mb/s	Aggressor 1	6147	5000 Mb/s	Aggressor 2	6164	5000 Mb/s	Aggressor 3	5947	5000 Mb/s
Cat6_6A1	5G all	Victim	18778	1000 Mb/s	Aggressor 1	6168	5000 Mb/s	Aggressor 2	6148	5000 Mb/s	Aggressor 3	6133	5000 Mb/s
Cat6_6A1	5G all	Victim	18197	1000 Mb/s	Aggressor 1	6147	5000 Mb/s	Aggressor 2	6160	5000 Mb/s	Aggressor 3	6126	5000 Mb/s
Cat6_6A1	5G all	Victim	21753	1000 Mb/s	Aggressor 1	6138	5000 Mb/s	Aggressor 2	6143	5000 Mb/s	Aggressor 3	6113	5000 Mb/s
Cat6_6A1	5G all	Victim	56219	1000 Mb/s	Aggressor 1	5948	5000 Mb/s	Aggressor 2	6137	5000 Mb/s	Aggressor 3	5931	5000 Mb/s
Cat6_6A1	5G all	Victim	46412	1000 Mb/s	Aggressor 1	6145	5000 Mb/s	Aggressor 2	6163	5000 Mb/s	Aggressor 3	5934	5000 Mb/s
Cat6_6A1	5G all	Victim	44791	1000 Mb/s	Aggressor 1	6147	5000 Mb/s	Aggressor 2	6143	5000 Mb/s	Aggressor 3	5940	5000 Mb/s

5Gb/s All (V+A), 100m Cat6 Mitigation #1



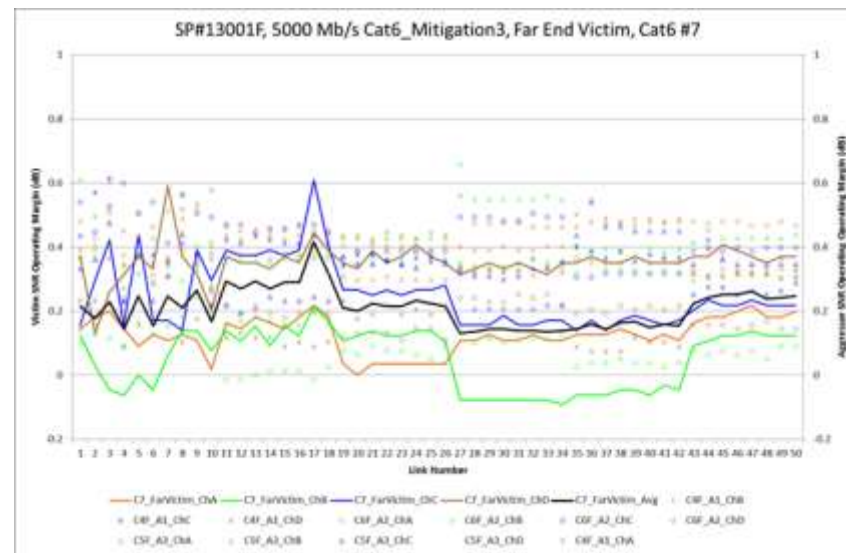
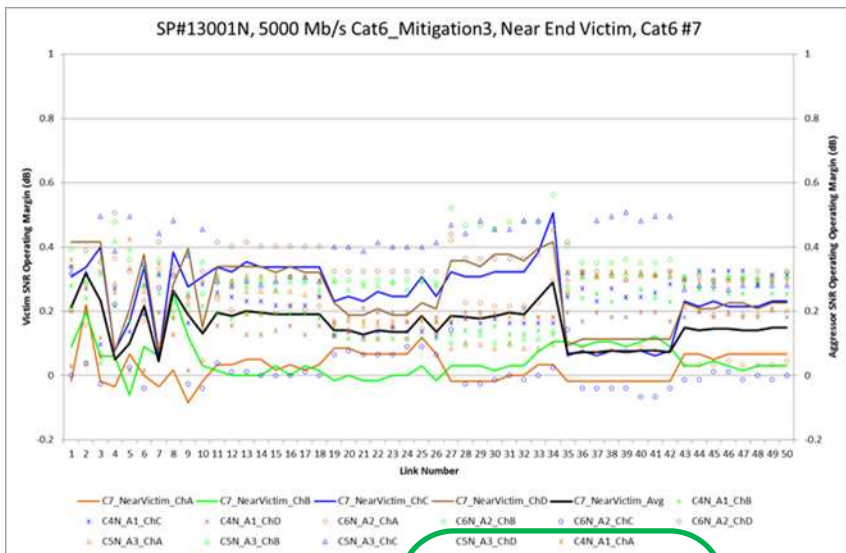
Cat6_Mitigation1	5G all	Victim	5993	5000 Mb/s	Aggressor 1	6161	5000 Mb/s	Aggressor 2	6167	5000 Mb/s	Aggressor 3	6136	5000 Mb/s
Cat6_Mitigation1	5G all	Victim	5950	5000 Mb/s	Aggressor 1	6148	5000 Mb/s	Aggressor 2	18437	1000 Mb/s	Aggressor 3	5941	5000 Mb/s
Cat6_Mitigation1	5G all	Victim	18421	1000 Mb/s	Aggressor 1	6151	5000 Mb/s	Aggressor 2	5962	5000 Mb/s	Aggressor 3	5931	5000 Mb/s
Cat6_Mitigation1	5G all	Victim	18229	1000 Mb/s	Aggressor 1	6155	5000 Mb/s	Aggressor 2	6144	5000 Mb/s	Aggressor 3	5941	5000 Mb/s
Cat6_Mitigation1	5G all	Victim	15049	5000 Mb/s	Aggressor 1	6127	5000 Mb/s	Aggressor 2	6150	5000 Mb/s	Aggressor 3	6134	5000 Mb/s
Cat6_Mitigation1	5G all	Victim	18586	1000 Mb/s	Aggressor 1	10518	5000 Mb/s	Aggressor 2	10703	5000 Mb/s	Aggressor 3	6140	5000 Mb/s
Cat6_Mitigation1	5G all	Victim	52217	1000 Mb/s	Aggressor 1	5947	5000 Mb/s	Aggressor 2	6142	5000 Mb/s	Aggressor 3	6126	5000 Mb/s
Cat6_Mitigation1	5G all	Victim	18769	1000 Mb/s	Aggressor 1	6128	5000 Mb/s	Aggressor 2	6165	5000 Mb/s	Aggressor 3	5943	5000 Mb/s
Cat6_Mitigation1	5G all	Victim	15030	5000 Mb/s	Aggressor 1	6140	5000 Mb/s	Aggressor 2	6140	5000 Mb/s	Aggressor 3	5957	5000 Mb/s
Cat6_Mitigation1	5G all	Victim	18569	1000 Mb/s	Aggressor 1	6137	5000 Mb/s	Aggressor 2	6160	5000 Mb/s	Aggressor 3	6134	5000 Mb/s
Cat6_Mitigation1	5G all	Victim	18424	1000 Mb/s	Aggressor 1	6155	5000 Mb/s	Aggressor 2	6162	5000 Mb/s	Aggressor 3	5944	5000 Mb/s
Cat6_Mitigation1	5G all	Victim	18395	1000 Mb/s	Aggressor 1	6140	5000 Mb/s	Aggressor 2	6146	5000 Mb/s	Aggressor 3	6324	5000 Mb/s
Cat6_Mitigation1	5G all	Victim	18579	1000 Mb/s	Aggressor 1	6152	5000 Mb/s	Aggressor 2	6150	5000 Mb/s	Aggressor 3	6118	5000 Mb/s
Cat6_Mitigation1	5G all	Victim	18219	1000 Mb/s	Aggressor 1	6157	5000 Mb/s	Aggressor 2	6154	5000 Mb/s	Aggressor 3	5946	5000 Mb/s
Cat6_Mitigation1	5G all	Victim	18596	1000 Mb/s	Aggressor 1	5960	5000 Mb/s	Aggressor 2	6155	5000 Mb/s	Aggressor 3	6105	5000 Mb/s

5Gb/s All (V+A), 100m Cat6 Mitigation #2



Cat6_Mitigation2	5G all	Victim	18527	1000 Mb/s	Aggressor 1	6134	5000 Mb/s	Aggressor 2	6155	5000 Mb/s	Aggressor 3	6119	5000 Mb/s
Cat6_Mitigation2	5G all	Victim	10423	5000 Mb/s	Aggressor 1	5959	5000 Mb/s	Aggressor 2	6141	5000 Mb/s	Aggressor 3	6124	5000 Mb/s
Cat6_Mitigation2	5G all	Victim	15241	5000 Mb/s	Aggressor 1	6139	5000 Mb/s	Aggressor 2	10690	5000 Mb/s	Aggressor 3	5955	5000 Mb/s
Cat6_Mitigation2	5G all	Victim	15054	5000 Mb/s	Aggressor 1	6152	5000 Mb/s	Aggressor 2	6150	5000 Mb/s	Aggressor 3	6319	5000 Mb/s
Cat6_Mitigation2	5G all	Victim	10584	5000 Mb/s	Aggressor 1	6145	5000 Mb/s	Aggressor 2	6135	5000 Mb/s	Aggressor 3	5959	5000 Mb/s
Cat6_Mitigation2	5G all	Victim	15238	5000 Mb/s	Aggressor 1	6159	5000 Mb/s	Aggressor 2	6160	5000 Mb/s	Aggressor 3	5944	5000 Mb/s
Cat6_Mitigation2	5G all	Victim	15052	5000 Mb/s	Aggressor 1	6144	5000 Mb/s	Aggressor 2	6142	5000 Mb/s	Aggressor 3	6133	5000 Mb/s
Cat6_Mitigation2	5G all	Victim	38611	1000 Mb/s	Aggressor 1	6146	5000 Mb/s	Aggressor 2	6147	5000 Mb/s	Aggressor 3	6126	5000 Mb/s
Cat6_Mitigation2	5G all	Victim	18395	1000 Mb/s	Aggressor 1	5953	5000 Mb/s	Aggressor 2	6161	5000 Mb/s	Aggressor 3	5945	5000 Mb/s
Cat6_Mitigation2	5G all	Victim	18397	1000 Mb/s	Aggressor 1	6150	5000 Mb/s	Aggressor 2	6147	5000 Mb/s	Aggressor 3	5953	5000 Mb/s
Cat6_Mitigation2	5G all	Victim	18580	1000 Mb/s	Aggressor 1	5961	5000 Mb/s	Aggressor 2	6153	5000 Mb/s	Aggressor 3	5918	5000 Mb/s
Cat6_Mitigation2	5G all	Victim	18569	1000 Mb/s	Aggressor 1	6151	5000 Mb/s	Aggressor 2	6327	5000 Mb/s	Aggressor 3	5931	5000 Mb/s
Cat6_Mitigation2	5G all	Victim	18563	1000 Mb/s	Aggressor 1	6145	5000 Mb/s	Aggressor 2	6146	5000 Mb/s	Aggressor 3	5927	5000 Mb/s
Cat6_Mitigation2	5G all	Victim	10401	5000 Mb/s	Aggressor 1	6145	5000 Mb/s	Aggressor 2	6153	5000 Mb/s	Aggressor 3	5936	5000 Mb/s
Cat6_Mitigation2	5G all	Victim	15033	5000 Mb/s	Aggressor 1	6147	5000 Mb/s	Aggressor 2	10703	5000 Mb/s	Aggressor 3	5948	5000 Mb/s

5Gb/s All (V+A), 100m Cat6 Mitigation #3

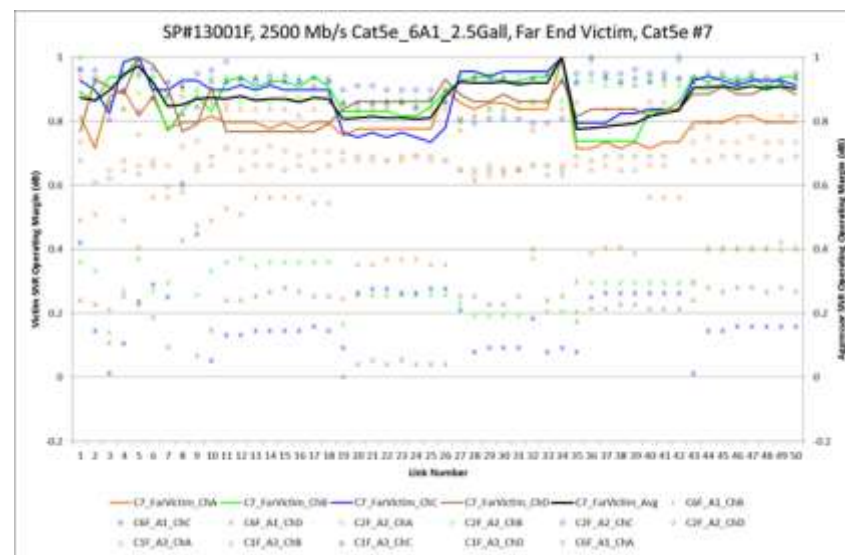
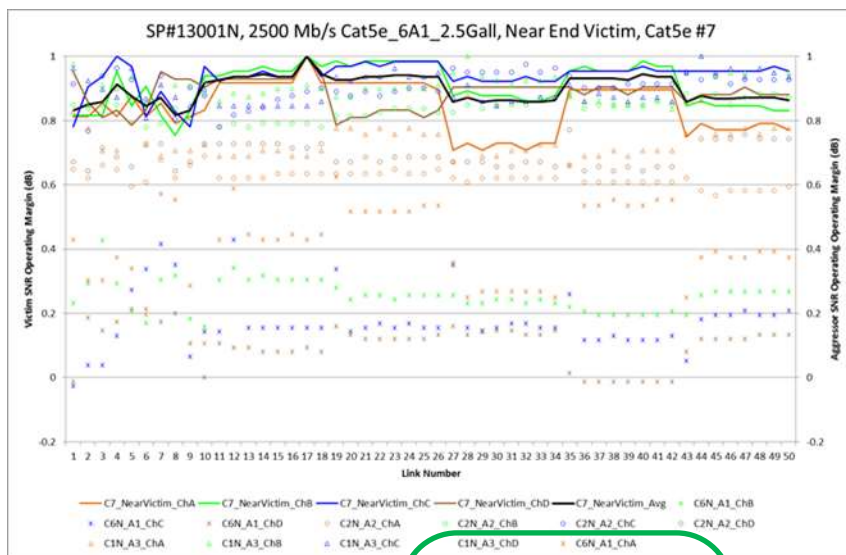
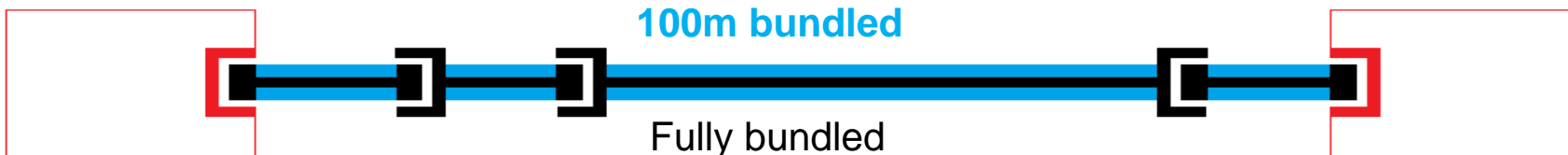


Cat6_Mitigation3	5G all	Victim	5949	5000 Mb/s	Aggressor 1	6147	5000 Mb/s	Aggressor 2	6176	5000 Mb/s	Aggressor 3	5944	5000 Mb/s
Cat6_Mitigation3	5G all	Victim	5948	5000 Mb/s	Aggressor 1	6142	5000 Mb/s	Aggressor 2	6166	5000 Mb/s	Aggressor 3	5954	5000 Mb/s
Cat6_Mitigation3	5G all	Victim	10606	5000 Mb/s	Aggressor 1	6153	5000 Mb/s	Aggressor 2	6136	5000 Mb/s	Aggressor 3	5952	5000 Mb/s
Cat6_Mitigation3	5G all	Victim	15023	5000 Mb/s	Aggressor 1	6148	5000 Mb/s	Aggressor 2	6143	5000 Mb/s	Aggressor 3	6125	5000 Mb/s
Cat6_Mitigation3	5G all	Victim	5943	5000 Mb/s	Aggressor 1	6152	5000 Mb/s	Aggressor 2	6134	5000 Mb/s	Aggressor 3	6145	5000 Mb/s
Cat6_Mitigation3	5G all	Victim	5951	5000 Mb/s	Aggressor 1	6152	5000 Mb/s	Aggressor 2	6155	5000 Mb/s	Aggressor 3	6123	5000 Mb/s
Cat6_Mitigation3	5G all	Victim	6138	5000 Mb/s	Aggressor 1	6159	5000 Mb/s	Aggressor 2	6150	5000 Mb/s	Aggressor 3	6134	5000 Mb/s
Cat6_Mitigation3	5G all	Victim	15254	5000 Mb/s	Aggressor 1	6154	5000 Mb/s	Aggressor 2	6135	5000 Mb/s	Aggressor 3	6149	5000 Mb/s
Cat6_Mitigation3	5G all	Victim	5934	5000 Mb/s	Aggressor 1	6361	5000 Mb/s	Aggressor 2	6340	5000 Mb/s	Aggressor 3	6122	5000 Mb/s
Cat6_Mitigation3	5G all	Victim	10576	5000 Mb/s	Aggressor 1	5948	5000 Mb/s	Aggressor 2	6166	5000 Mb/s	Aggressor 3	5956	5000 Mb/s
Cat6_Mitigation3	5G all	Victim	5920	5000 Mb/s	Aggressor 1	6145	5000 Mb/s	Aggressor 2	6114	5000 Mb/s	Aggressor 3	6132	5000 Mb/s
Cat6_Mitigation3	5G all	Victim	6114	5000 Mb/s	Aggressor 1	6163	5000 Mb/s	Aggressor 2	6324	5000 Mb/s	Aggressor 3	6138	5000 Mb/s
Cat6_Mitigation3	5G all	Victim	6136	5000 Mb/s	Aggressor 1	6141	5000 Mb/s	Aggressor 2	6111	5000 Mb/s	Aggressor 3	6121	5000 Mb/s
Cat6_Mitigation3	5G all	Victim	10589	5000 Mb/s	Aggressor 1	6140	5000 Mb/s	Aggressor 2	6128	5000 Mb/s	Aggressor 3	6121	5000 Mb/s
Cat6_Mitigation3	5G all	Victim	5949	5000 Mb/s	Aggressor 1	6139	5000 Mb/s	Aggressor 2	6140	5000 Mb/s	Aggressor 3	6291	5000 Mb/s

Category 5e Test Cases

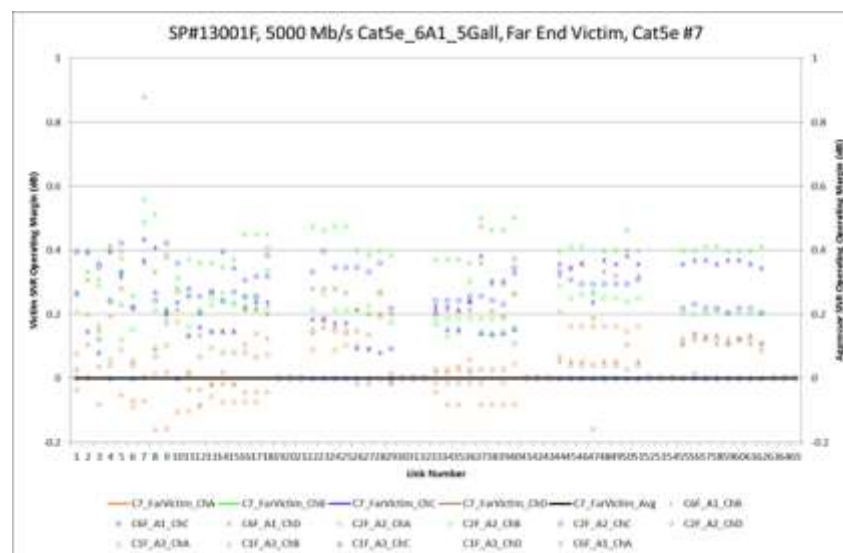
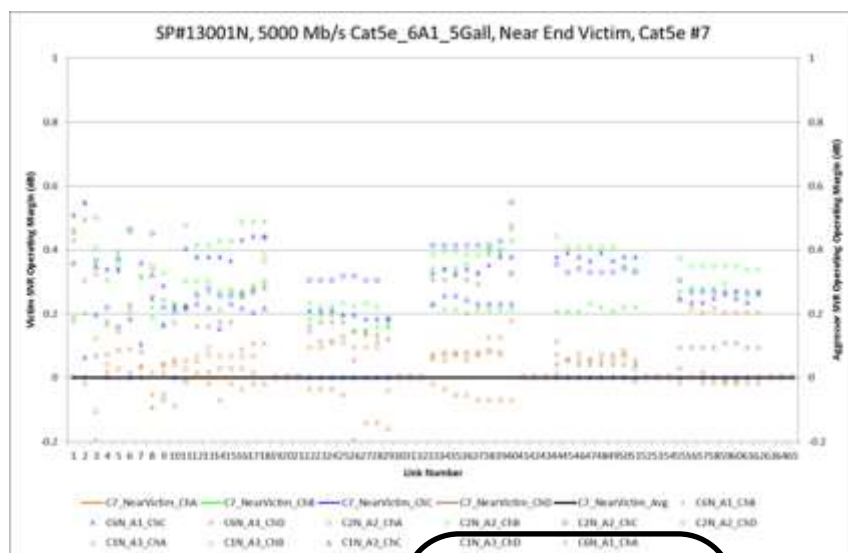
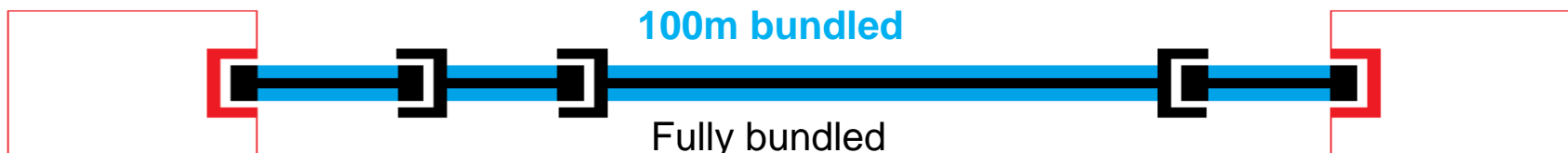
- Seven test cases were evaluated
 - #1: 2.5Gb/s on all victim/aggressor cables, 100m fully bundled
 - #2: 5Gb/s on all victim/aggressor cables, 100m fully bundled
 - #3 through #5: 5Gb/s on all victim/aggressor cables using the 3-connector configuration with three unbundled configurations (described on each test case summary slide)
 - #6 through #7: 5Gb/s on all victim/aggressor cables using the 2-connector configuration with two unbundled configurations (described on each test case summary slide)

2.5Gb/s All (V+A), 100m Cat5e



CatSe_6A1	2.5G all	Victim	5957	2500 Mb/s	Aggressor 1	6164	2500 Mb/s	Aggressor 2	6166	2500 Mb/s	Aggressor 3	6326	2500 Mb/s
CatSe_6A1	2.5G all	Victim	5940	2500 Mb/s	Aggressor 1	6232	2500 Mb/s	Aggressor 2	6158	2500 Mb/s	Aggressor 3	6130	2500 Mb/s
CatSe_6A1	2.5G all	Victim	5959	2500 Mb/s	Aggressor 1	6142	2500 Mb/s	Aggressor 2	6149	2500 Mb/s	Aggressor 3	5974	2500 Mb/s
CatSe_6A1	2.5G all	Victim	6127	2500 Mb/s	Aggressor 1	6149	2500 Mb/s	Aggressor 2	6152	2500 Mb/s	Aggressor 3	5946	2500 Mb/s
CatSe_6A1	2.5G all	Victim	5948	2500 Mb/s	Aggressor 1	6138	2500 Mb/s	Aggressor 2	6151	2500 Mb/s	Aggressor 3	5953	2500 Mb/s
CatSe_6A1	2.5G all	Victim	6135	2500 Mb/s	Aggressor 1	6164	2500 Mb/s	Aggressor 2	6151	2500 Mb/s	Aggressor 3	5951	2500 Mb/s
CatSe_6A1	2.5G all	Victim	5957	2500 Mb/s	Aggressor 1	6149	2500 Mb/s	Aggressor 2	6135	2500 Mb/s	Aggressor 3	5945	2500 Mb/s
CatSe_6A1	2.5G all	Victim	6125	2500 Mb/s	Aggressor 1	6144	2500 Mb/s	Aggressor 2	6158	2500 Mb/s	Aggressor 3	5940	2500 Mb/s
CatSe_6A1	2.5G all	Victim	6138	2500 Mb/s	Aggressor 1	6145	2500 Mb/s	Aggressor 2	6149	2500 Mb/s	Aggressor 3	5945	2500 Mb/s
CatSe_6A1	2.5G all	Victim	6120	2500 Mb/s	Aggressor 1	6128	2500 Mb/s	Aggressor 2	6145	2500 Mb/s	Aggressor 3	6322	2500 Mb/s
CatSe_6A1	2.5G all	Victim	6120	2500 Mb/s	Aggressor 1	6135	2500 Mb/s	Aggressor 2	6149	2500 Mb/s	Aggressor 3	5940	2500 Mb/s
CatSe_6A1	2.5G all	Victim	5937	2500 Mb/s	Aggressor 1	6148	2500 Mb/s	Aggressor 2	6105	2500 Mb/s	Aggressor 3	6117	2500 Mb/s
CatSe_6A1	2.5G all	Victim	6124	2500 Mb/s	Aggressor 1	6345	2500 Mb/s	Aggressor 2	6135	2500 Mb/s	Aggressor 3	6138	2500 Mb/s
CatSe_6A1	2.5G all	Victim	6120	2500 Mb/s	Aggressor 1	6151	2500 Mb/s	Aggressor 2	6125	2500 Mb/s	Aggressor 3	6134	2500 Mb/s
CatSe_6A1	2.5G all	Victim	5960	2500 Mb/s	Aggressor 1	6126	2500 Mb/s	Aggressor 2	6122	2500 Mb/s	Aggressor 3	5936	2500 Mb/s

5Gb/s All (V+A), 100m Cat5e

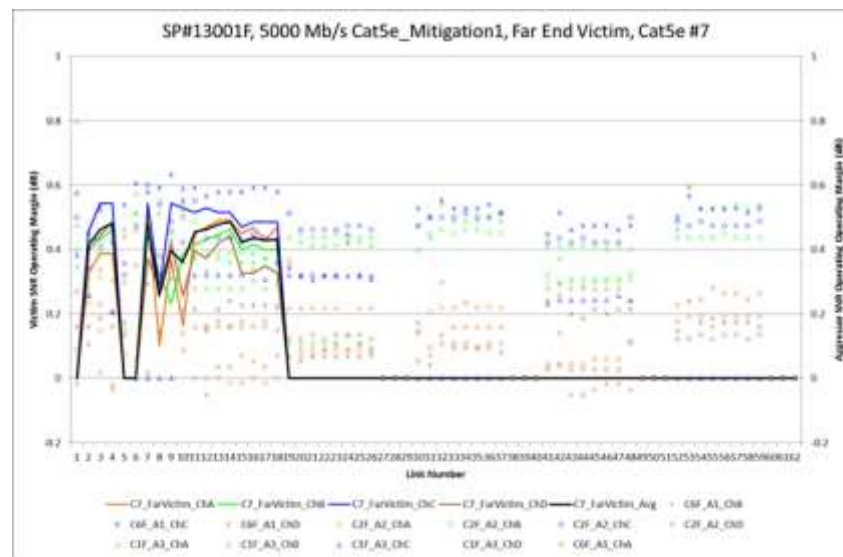
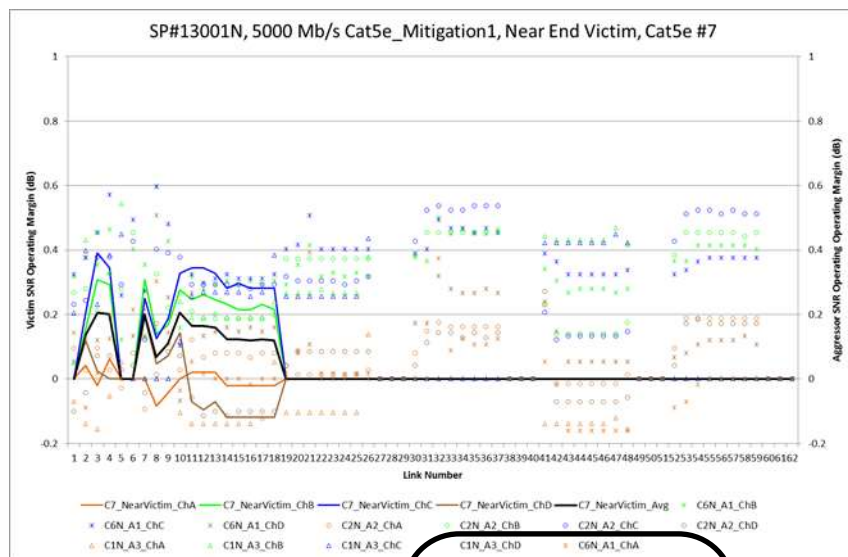


Cat5e_6A1	5G all	Victim	18198	1000 Mb/s	Aggressor 1	6146	5000 Mb/s	Aggressor 2	18639	1000 Mb/s	Aggressor 3	5939	5000 Mb/s
Cat5e_6A1	5G all	Victim	18033	1000 Mb/s	Aggressor 1	5957	5000 Mb/s	Aggressor 2	18462	1000 Mb/s	Aggressor 3	5960	5000 Mb/s
Cat5e_6A1	5G all	Victim	18041	1000 Mb/s	Aggressor 1	6140	5000 Mb/s	Aggressor 2	15082	5000 Mb/s	Aggressor 3	5949	5000 Mb/s
Cat5e_6A1	5G all	Victim	18399	1000 Mb/s	Aggressor 1	6138	5000 Mb/s	Aggressor 2	6149	5000 Mb/s	Aggressor 3	5210	1000 Mb/s
Cat5e_6A1	5G all	Victim	18024	1000 Mb/s	Aggressor 1	6148	5000 Mb/s	Aggressor 2	10527	5000 Mb/s	Aggressor 3	10608	5000 Mb/s
Cat5e_6A1	5G all	Victim	18401	1000 Mb/s	Aggressor 1	10518	5000 Mb/s	Aggressor 2	6155	5000 Mb/s	Aggressor 3	18781	1000 Mb/s
Cat5e_6A1	5G all	Victim	18403	1000 Mb/s	Aggressor 1	10701	5000 Mb/s	Aggressor 2	10316	1000 Mb/s	Aggressor 3	10395	5000 Mb/s
Cat5e_6A1	5G all	Victim	18027	1000 Mb/s	Aggressor 1	6132	5000 Mb/s	Aggressor 2	5961	5000 Mb/s	Aggressor 3	6153	5000 Mb/s
Cat5e_6A1	5G all	Victim	18184	1000 Mb/s	Aggressor 1	6146	5000 Mb/s	Aggressor 2	6159	5000 Mb/s	Aggressor 3	5962	5000 Mb/s
Cat5e_6A1	5G all	Victim	18210	1000 Mb/s	Aggressor 1	15446	5000 Mb/s	Aggressor 2	6151	5000 Mb/s	Aggressor 3	18778	1000 Mb/s
Cat5e_6A1	5G all	Victim	18205	1000 Mb/s	Aggressor 1	6145	5000 Mb/s	Aggressor 2	15043	5000 Mb/s	Aggressor 3	10420	5000 Mb/s
Cat5e_6A1	5G all	Victim	18017	1000 Mb/s	Aggressor 1	6354	5000 Mb/s	Aggressor 2	6150	5000 Mb/s	Aggressor 3	18346	1000 Mb/s
Cat5e_6A1	5G all	Victim	18225	1000 Mb/s	Aggressor 1	11089	5000 Mb/s	Aggressor 2	6157	5000 Mb/s	Aggressor 3	10385	5000 Mb/s
Cat5e_6A1	5G all	Victim	18215	1000 Mb/s	Aggressor 1	5957	5000 Mb/s	Aggressor 2	6143	5000 Mb/s	Aggressor 3	18412	1000 Mb/s
Cat5e_6A1	5G all	Victim	18218	1000 Mb/s	Aggressor 1	6133	5000 Mb/s	Aggressor 2	6132	5000 Mb/s	Aggressor 3	18200	1000 Mb/s

5Gb/s All (V+A), 100m Cat5e Mitigation #1

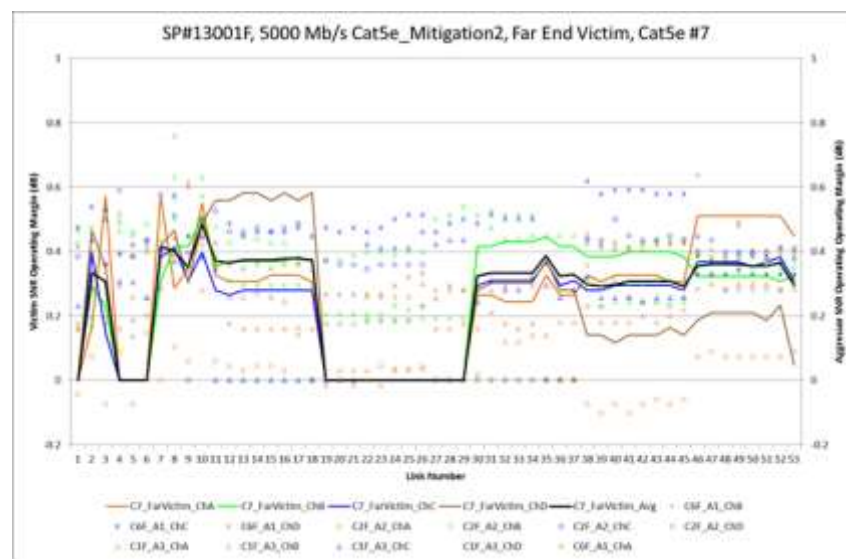
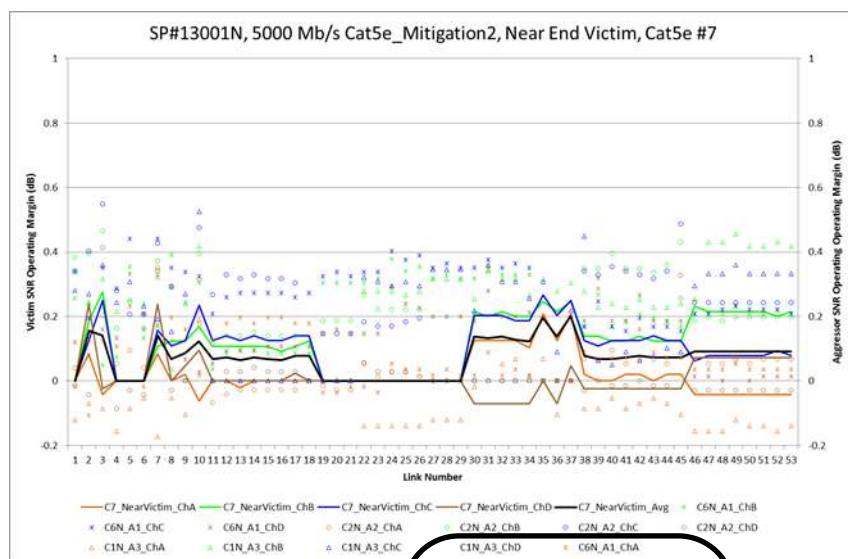


Cat5e Mitigation #1



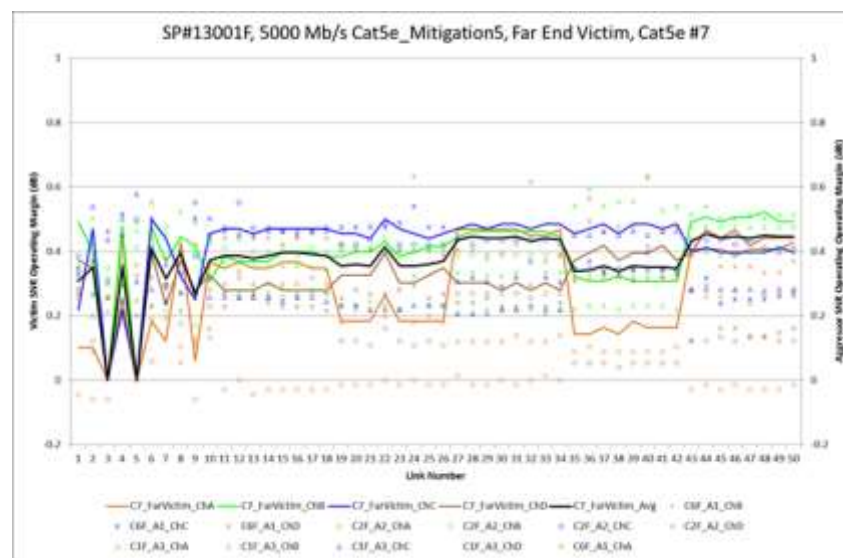
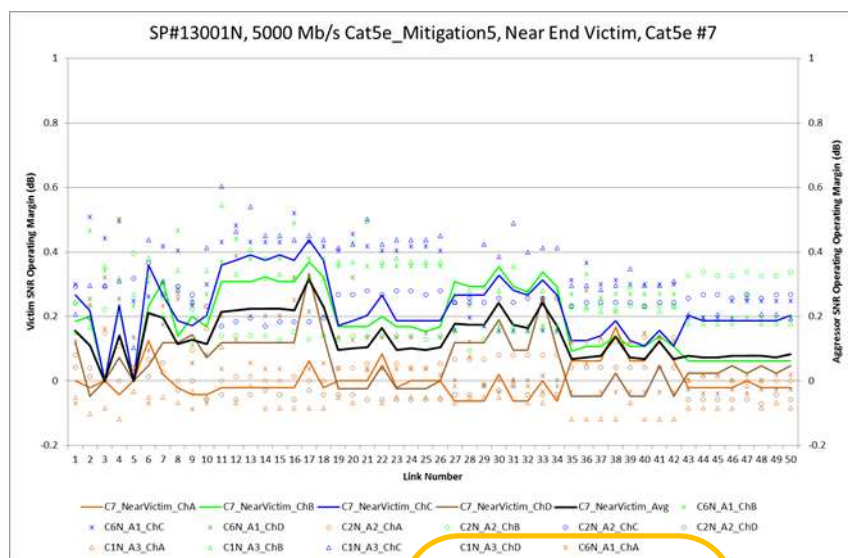
Cat5e_Mitigation1	5G all	Victim	18483	1000 Mb/s	Aggressor 1	6153	5000 Mb/s	Aggressor 2	15271	5000 Mb/s	Aggressor 3	10613	5000 Mb/s
Cat5e_Mitigation1	5G all	Victim	6128	5000 Mb/s	Aggressor 1	15065	5000 Mb/s	Aggressor 2	6151	5000 Mb/s	Aggressor 3	10622	5000 Mb/s
Cat5e_Mitigation1	5G all	Victim	10776	5000 Mb/s	Aggressor 1	10709	5000 Mb/s	Aggressor 2	6155	5000 Mb/s	Aggressor 3	15053	5000 Mb/s
Cat5e_Mitigation1	5G all	Victim	10612	5000 Mb/s	Aggressor 1	6147	5000 Mb/s	Aggressor 2	6144	5000 Mb/s	Aggressor 3	15032	5000 Mb/s
Cat5e_Mitigation1	5G all	Victim	18586	1000 Mb/s	Aggressor 1	6152	5000 Mb/s	Aggressor 2	10714	5000 Mb/s	Aggressor 3	5962	5000 Mb/s
Cat5e_Mitigation1	5G all	Victim	18599	1000 Mb/s	Aggressor 1	15067	5000 Mb/s	Aggressor 2	6346	5000 Mb/s	Aggressor 3	54008	No_link
Cat5e_Mitigation1	5G all	Victim	15064	5000 Mb/s	Aggressor 1	6151	5000 Mb/s	Aggressor 2	6163	5000 Mb/s	Aggressor 3	57242	1000 Mb/s
Cat5e_Mitigation1	5G all	Victim	15052	5000 Mb/s	Aggressor 1	6139	5000 Mb/s	Aggressor 2	6143	5000 Mb/s	Aggressor 3	18218	1000 Mb/s
Cat5e_Mitigation1	5G all	Victim	10566	5000 Mb/s	Aggressor 1	6349	5000 Mb/s	Aggressor 2	6148	5000 Mb/s	Aggressor 3	18373	1000 Mb/s
Cat5e_Mitigation1	5G all	Victim	15051	5000 Mb/s	Aggressor 1	5953	5000 Mb/s	Aggressor 2	6147	5000 Mb/s	Aggressor 3	10425	5000 Mb/s
Cat5e_Mitigation1	5G all	Victim	5957	5000 Mb/s	Aggressor 1	6145	5000 Mb/s	Aggressor 2	10698	5000 Mb/s	Aggressor 3	15041	5000 Mb/s
Cat5e_Mitigation1	5G all	Victim	18760	1000 Mb/s	Aggressor 1	5960	5000 Mb/s	Aggressor 2	10516	5000 Mb/s	Aggressor 3	15043	5000 Mb/s
Cat5e_Mitigation1	5G all	Victim	18391	1000 Mb/s	Aggressor 1	6157	5000 Mb/s	Aggressor 2	6155	5000 Mb/s	Aggressor 3	18394	1000 Mb/s
Cat5e_Mitigation1	5G all	Victim	18386	1000 Mb/s	Aggressor 1	6138	5000 Mb/s	Aggressor 2	6145	5000 Mb/s	Aggressor 3	10406	5000 Mb/s
Cat5e_Mitigation1	5G all	Victim	18534	1000 Mb/s	Aggressor 1	6139	5000 Mb/s	Aggressor 2	10697	5000 Mb/s	Aggressor 3	18383	1000 Mb/s

5Gb/s All (V+A), 100m Cat5e Mitigation #2



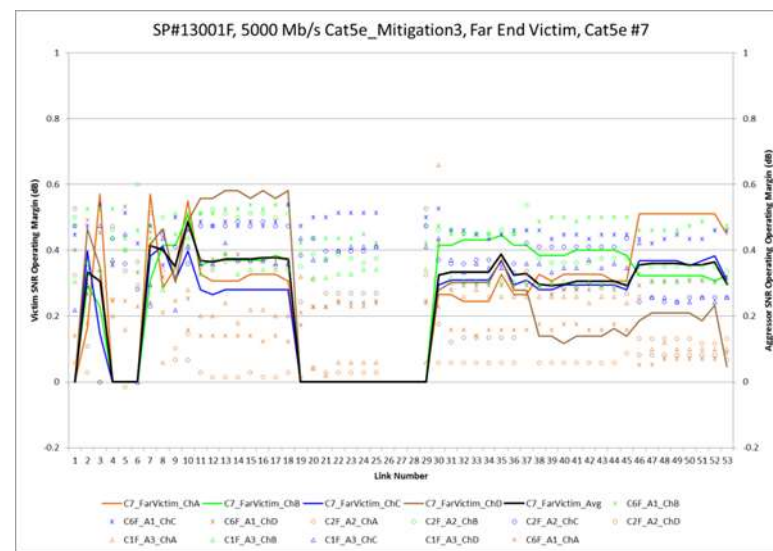
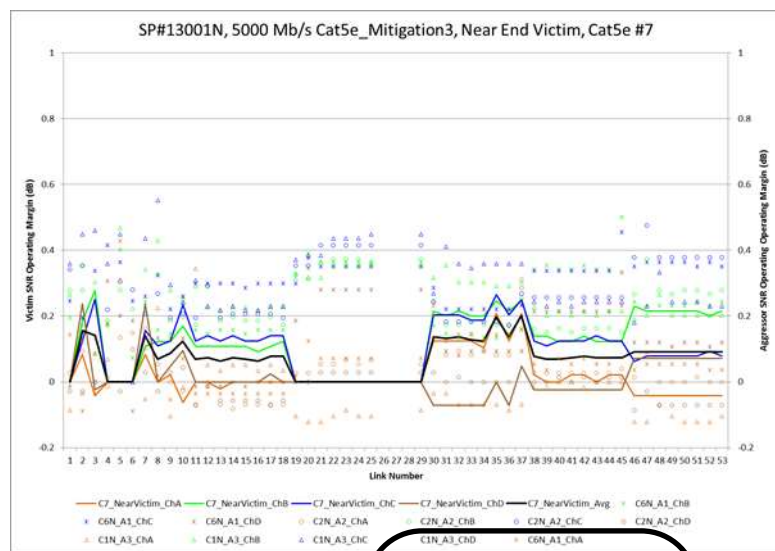
Cat5e_Mitigation2	5G all	Victim	18398	1000 Mb/s	Aggressor 1	6154	5000 Mb/s	Aggressor 2	6345	5000 Mb/s	Aggressor 3	5935	5000 Mb/s
Cat5e_Mitigation2	5G all	Victim	5949	5000 Mb/s	Aggressor 1	5953	5000 Mb/s	Aggressor 2	10715	5000 Mb/s	Aggressor 3	6133	5000 Mb/s
Cat5e_Mitigation2	5G all	Victim	10598	5000 Mb/s	Aggressor 1	5959	5000 Mb/s	Aggressor 2	6140	5000 Mb/s	Aggressor 3	10585	5000 Mb/s
Cat5e_Mitigation2	5G all	Victim	18584	1000 Mb/s	Aggressor 1	6144	5000 Mb/s	Aggressor 2	10697	5000 Mb/s	Aggressor 3	10605	5000 Mb/s
Cat5e_Mitigation2	5G all	Victim	18405	1000 Mb/s	Aggressor 1	6144	5000 Mb/s	Aggressor 2	15256	5000 Mb/s	Aggressor 3	10588	5000 Mb/s
Cat5e_Mitigation2	5G all	Victim	18403	1000 Mb/s	Aggressor 1	6160	5000 Mb/s	Aggressor 2	10710	5000 Mb/s	Aggressor 3	10602	5000 Mb/s
Cat5e_Mitigation2	5G all	Victim	15055	5000 Mb/s	Aggressor 1	10517	5000 Mb/s	Aggressor 2	6151	5000 Mb/s	Aggressor 3	15068	5000 Mb/s
Cat5e_Mitigation2	5G all	Victim	15067	5000 Mb/s	Aggressor 1	6154	5000 Mb/s	Aggressor 2	10701	5000 Mb/s	Aggressor 3	10425	5000 Mb/s
Cat5e_Mitigation2	5G all	Victim	6123	5000 Mb/s	Aggressor 1	6348	5000 Mb/s	Aggressor 2	18427	1000 Mb/s	Aggressor 3	15062	5000 Mb/s
Cat5e_Mitigation2	5G all	Victim	10617	5000 Mb/s	Aggressor 1	6145	5000 Mb/s	Aggressor 2	6160	5000 Mb/s	Aggressor 3	6130	5000 Mb/s
Cat5e_Mitigation2	5G all	Victim	10404	5000 Mb/s	Aggressor 1	6126	5000 Mb/s	Aggressor 2	6156	5000 Mb/s	Aggressor 3	18366	1000 Mb/s
Cat5e_Mitigation2	5G all	Victim	16333	1000 Mb/s	Aggressor 1	6158	5000 Mb/s	Aggressor 2	6141	5000 Mb/s	Aggressor 3	5955	5000 Mb/s
Cat5e_Mitigation2	5G all	Victim	15042	5000 Mb/s	Aggressor 1	6144	5000 Mb/s	Aggressor 2	18833	1000 Mb/s	Aggressor 3	6124	5000 Mb/s
Cat5e_Mitigation2	5G all	Victim	10574	5000 Mb/s	Aggressor 1	6166	5000 Mb/s	Aggressor 2	5944	5000 Mb/s	Aggressor 3	5936	5000 Mb/s
Cat5e_Mitigation2	5G all	Victim	15088	5000 Mb/s	Aggressor 1	6148	5000 Mb/s	Aggressor 2	6140	5000 Mb/s	Aggressor 3	15060	5000 Mb/s

5Gb/s All (V+A), 100m Cat5e Mitigation #5



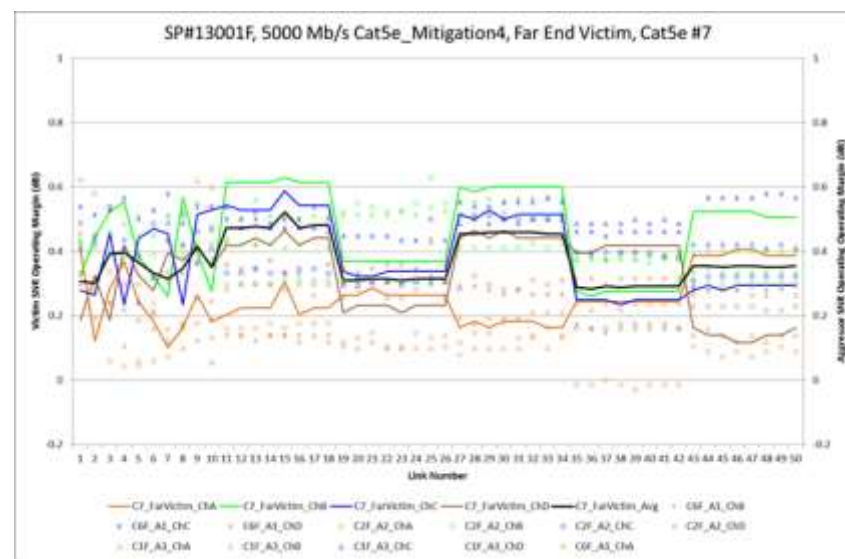
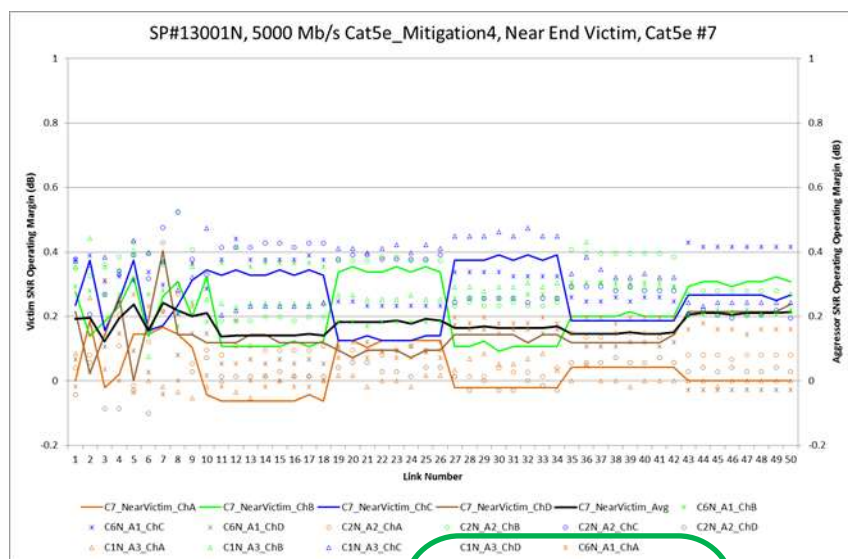
Cat5e_Mitigation5	5G all	Victim	6137	5000 Mb/s	Aggressor 1	6143	5000 Mb/s	Aggressor 2	6147	5000 Mb/s	Aggressor 3	6134	5000 Mb/s
Cat5e_Mitigation5	5G all	Victim	6135	5000 Mb/s	Aggressor 1	5966	5000 Mb/s	Aggressor 2	6151	5000 Mb/s	Aggressor 3	10597	5000 Mb/s
Cat5e_Mitigation5	5G all	Victim	18600	1000 Mb/s	Aggressor 1	5949	5000 Mb/s	Aggressor 2	6160	5000 Mb/s	Aggressor 3	6319	5000 Mb/s
Cat5e_Mitigation5	5G all	Victim	10420	5000 Mb/s	Aggressor 1	6158	5000 Mb/s	Aggressor 2	6139	5000 Mb/s	Aggressor 3	10578	5000 Mb/s
Cat5e_Mitigation5	5G all	Victim	18594	1000 Mb/s	Aggressor 1	6136	5000 Mb/s	Aggressor 2	6159	5000 Mb/s	Aggressor 3	6135	5000 Mb/s
Cat5e_Mitigation5	5G all	Victim	5952	5000 Mb/s	Aggressor 1	6148	5000 Mb/s	Aggressor 2	6160	5000 Mb/s	Aggressor 3	6132	5000 Mb/s
Cat5e_Mitigation5	5G all	Victim	5952	5000 Mb/s	Aggressor 1	5954	5000 Mb/s	Aggressor 2	6149	5000 Mb/s	Aggressor 3	5956	5000 Mb/s
Cat5e_Mitigation5	5G all	Victim	5926	5000 Mb/s	Aggressor 1	6137	5000 Mb/s	Aggressor 2	6162	5000 Mb/s	Aggressor 3	6133	5000 Mb/s
Cat5e_Mitigation5	5G all	Victim	5944	5000 Mb/s	Aggressor 1	6120	5000 Mb/s	Aggressor 2	6146	5000 Mb/s	Aggressor 3	10779	5000 Mb/s
Cat5e_Mitigation5	5G all	Victim	15212	5000 Mb/s	Aggressor 1	5956	5000 Mb/s	Aggressor 2	6369	5000 Mb/s	Aggressor 3	5941	5000 Mb/s
Cat5e_Mitigation5	5G all	Victim	5943	5000 Mb/s	Aggressor 1	6335	5000 Mb/s	Aggressor 2	10679	5000 Mb/s	Aggressor 3	6125	5000 Mb/s
Cat5e_Mitigation5	5G all	Victim	10383	5000 Mb/s	Aggressor 1	5963	5000 Mb/s	Aggressor 2	6153	5000 Mb/s	Aggressor 3	6320	5000 Mb/s
Cat5e_Mitigation5	5G all	Victim	10749	5000 Mb/s	Aggressor 1	6145	5000 Mb/s	Aggressor 2	6139	5000 Mb/s	Aggressor 3	10581	5000 Mb/s
Cat5e_Mitigation5	5G all	Victim	10590	5000 Mb/s	Aggressor 1	6140	5000 Mb/s	Aggressor 2	6145	5000 Mb/s	Aggressor 3	10580	5000 Mb/s
Cat5e_Mitigation5	5G all	Victim	10591	5000 Mb/s	Aggressor 1	6141	5000 Mb/s	Aggressor 2	6143	5000 Mb/s	Aggressor 3	10401	5000 Mb/s

5Gb/s All (V+A), 100m Cat5e Mitigation #3



Cat5e_Mitigation3	5G all	Victim	15136	1000 Mb/s	Aggressor 1	6159	5000 Mb/s	Aggressor 2	6336	5000 Mb/s	Aggressor 3	6148	5000 Mb/s
Cat5e_Mitigation3	5G all	Victim	5963	5000 Mb/s	Aggressor 1	5959	5000 Mb/s	Aggressor 2	6139	5000 Mb/s	Aggressor 3	10393	5000 Mb/s
Cat5e_Mitigation3	5G all	Victim	10800	5000 Mb/s	Aggressor 1	5955	5000 Mb/s	Aggressor 2	18453	1000 Mb/s	Aggressor 3	6131	5000 Mb/s
Cat5e_Mitigation3	5G all	Victim	5961	1000 Mb/s	Aggressor 1	6150	5000 Mb/s	Aggressor 2	5948	5000 Mb/s	Aggressor 3	6131	5000 Mb/s
Cat5e_Mitigation3	5G all	Victim	5948	1000 Mb/s	Aggressor 1	6144	5000 Mb/s	Aggressor 2	6158	5000 Mb/s	Aggressor 3	5940	5000 Mb/s
Cat5e_Mitigation3	5G all	Victim	5941	1000 Mb/s	Aggressor 1	6157	5000 Mb/s	Aggressor 2	6150	5000 Mb/s	Aggressor 3	18409	1000 Mb/s
Cat5e_Mitigation3	5G all	Victim	5939	5000 Mb/s	Aggressor 1	5954	5000 Mb/s	Aggressor 2	6146	5000 Mb/s	Aggressor 3	5939	5000 Mb/s
Cat5e_Mitigation3	5G all	Victim	5963	5000 Mb/s	Aggressor 1	5960	5000 Mb/s	Aggressor 2	6155	5000 Mb/s	Aggressor 3	5955	5000 Mb/s
Cat5e_Mitigation3	5G all	Victim	5950	5000 Mb/s	Aggressor 1	6172	5000 Mb/s	Aggressor 2	10714	5000 Mb/s	Aggressor 3	15025	5000 Mb/s
Cat5e_Mitigation3	5G all	Victim	5949	5000 Mb/s	Aggressor 1	6125	5000 Mb/s	Aggressor 2	6138	5000 Mb/s	Aggressor 3	6141	5000 Mb/s
Cat5e_Mitigation3	5G all	Victim	5952	5000 Mb/s	Aggressor 1	6138	5000 Mb/s	Aggressor 2	15039	5000 Mb/s	Aggressor 3	5948	5000 Mb/s
Cat5e_Mitigation3	5G all	Victim	5950	1000 Mb/s	Aggressor 1	10721	5000 Mb/s	Aggressor 2	6153	5000 Mb/s	Aggressor 3	5931	5000 Mb/s
Cat5e_Mitigation3	5G all	Victim	5944	5000 Mb/s	Aggressor 1	6148	5000 Mb/s	Aggressor 2	10707	5000 Mb/s	Aggressor 3	10399	5000 Mb/s
Cat5e_Mitigation3	5G all	Victim	6129	5000 Mb/s	Aggressor 1	6143	5000 Mb/s	Aggressor 2	6148	5000 Mb/s	Aggressor 3	15008	5000 Mb/s
Cat5e_Mitigation3	5G all	Victim	10759	5000 Mb/s	Aggressor 1	6140	5000 Mb/s	Aggressor 2	6350	5000 Mb/s	Aggressor 3	10761	5000 Mb/s

5Gb/s All (V+A), 100m Cat5e Mitigation #4



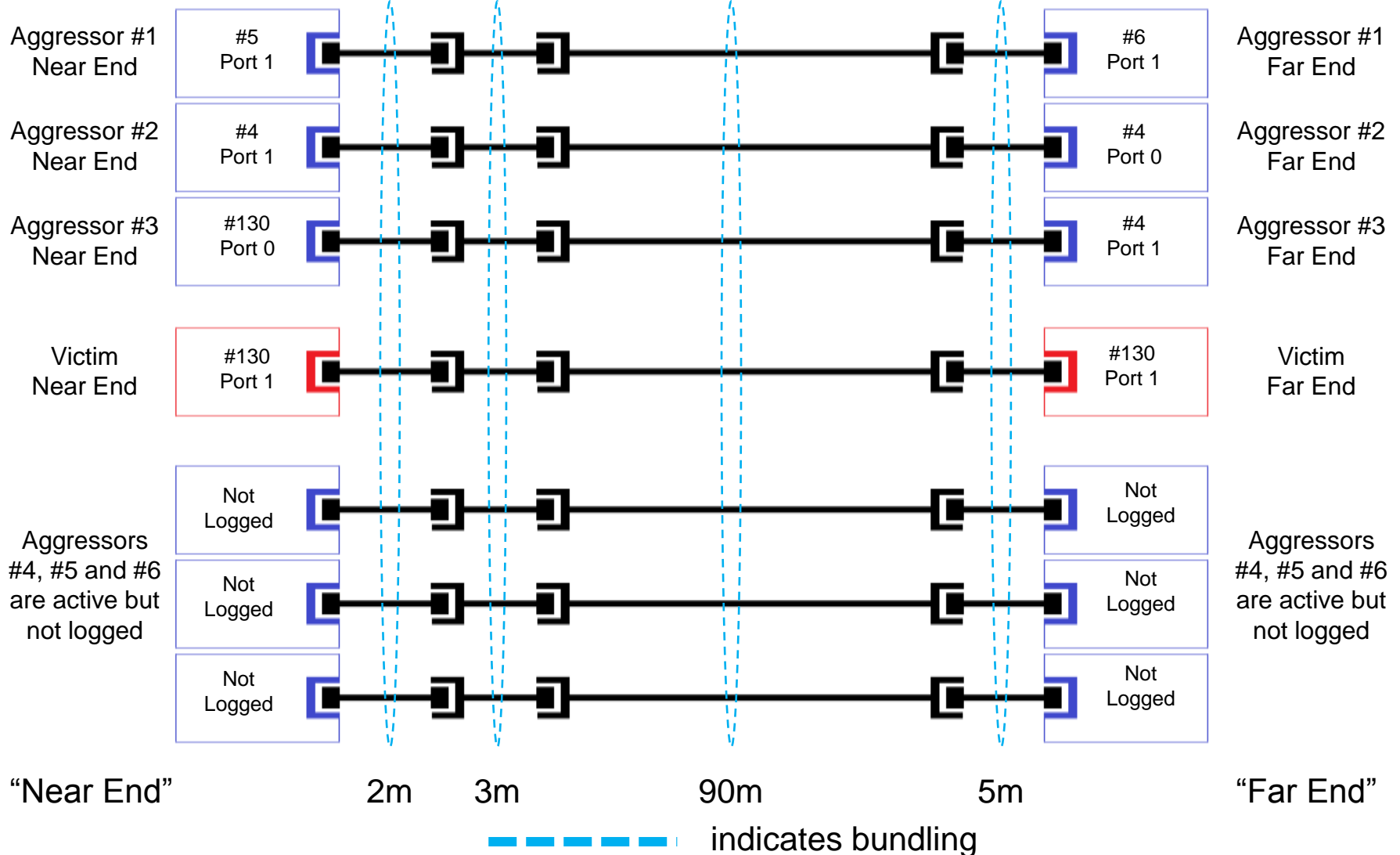
Cat5e_Mitigation4	5G all	Victim	15136	5000 Mb/s	Aggressor 1	6345	5000 Mb/s	Aggressor 2	6161	5000 Mb/s	Aggressor 3	5962	5000 Mb/s
Cat5e_Mitigation4	5G all	Victim	5963	5000 Mb/s	Aggressor 1	6146	5000 Mb/s	Aggressor 2	6154	5000 Mb/s	Aggressor 3	5952	5000 Mb/s
Cat5e_Mitigation4	5G all	Victim	10800	5000 Mb/s	Aggressor 1	6151	5000 Mb/s	Aggressor 2	6144	5000 Mb/s	Aggressor 3	5957	5000 Mb/s
Cat5e_Mitigation4	5G all	Victim	5961	5000 Mb/s	Aggressor 1	5958	5000 Mb/s	Aggressor 2	6331	5000 Mb/s	Aggressor 3	5944	5000 Mb/s
Cat5e_Mitigation4	5G all	Victim	5948	5000 Mb/s	Aggressor 1	5957	5000 Mb/s	Aggressor 2	6171	5000 Mb/s	Aggressor 3	6135	5000 Mb/s
Cat5e_Mitigation4	5G all	Victim	5941	5000 Mb/s	Aggressor 1	6147	5000 Mb/s	Aggressor 2	6173	5000 Mb/s	Aggressor 3	6127	5000 Mb/s
Cat5e_Mitigation4	5G all	Victim	5939	5000 Mb/s	Aggressor 1	6140	5000 Mb/s	Aggressor 2	6157	5000 Mb/s	Aggressor 3	6119	5000 Mb/s
Cat5e_Mitigation4	5G all	Victim	5963	5000 Mb/s	Aggressor 1	6157	5000 Mb/s	Aggressor 2	6149	5000 Mb/s	Aggressor 3	5949	5000 Mb/s
Cat5e_Mitigation4	5G all	Victim	5950	5000 Mb/s	Aggressor 1	5951	5000 Mb/s	Aggressor 2	15089	5000 Mb/s	Aggressor 3	6132	5000 Mb/s
Cat5e_Mitigation4	5G all	Victim	5949	5000 Mb/s	Aggressor 1	5947	5000 Mb/s	Aggressor 2	6151	5000 Mb/s	Aggressor 3	6127	5000 Mb/s
Cat5e_Mitigation4	5G all	Victim	5952	5000 Mb/s	Aggressor 1	5959	5000 Mb/s	Aggressor 2	6314	5000 Mb/s	Aggressor 3	5945	5000 Mb/s
Cat5e_Mitigation4	5G all	Victim	5950	5000 Mb/s	Aggressor 1	6155	5000 Mb/s	Aggressor 2	6154	5000 Mb/s	Aggressor 3	5933	5000 Mb/s
Cat5e_Mitigation4	5G all	Victim	5944	5000 Mb/s	Aggressor 1	6347	5000 Mb/s	Aggressor 2	6156	5000 Mb/s	Aggressor 3	6151	5000 Mb/s
Cat5e_Mitigation4	5G all	Victim	6129	5000 Mb/s	Aggressor 1	6146	5000 Mb/s	Aggressor 2	6153	5000 Mb/s	Aggressor 3	5950	5000 Mb/s
Cat5e_Mitigation4	5G all	Victim	10759	5000 Mb/s	Aggressor 1	5950	5000 Mb/s	Aggressor 2	6352	5000 Mb/s	Aggressor 3	6137	5000 Mb/s

Summary

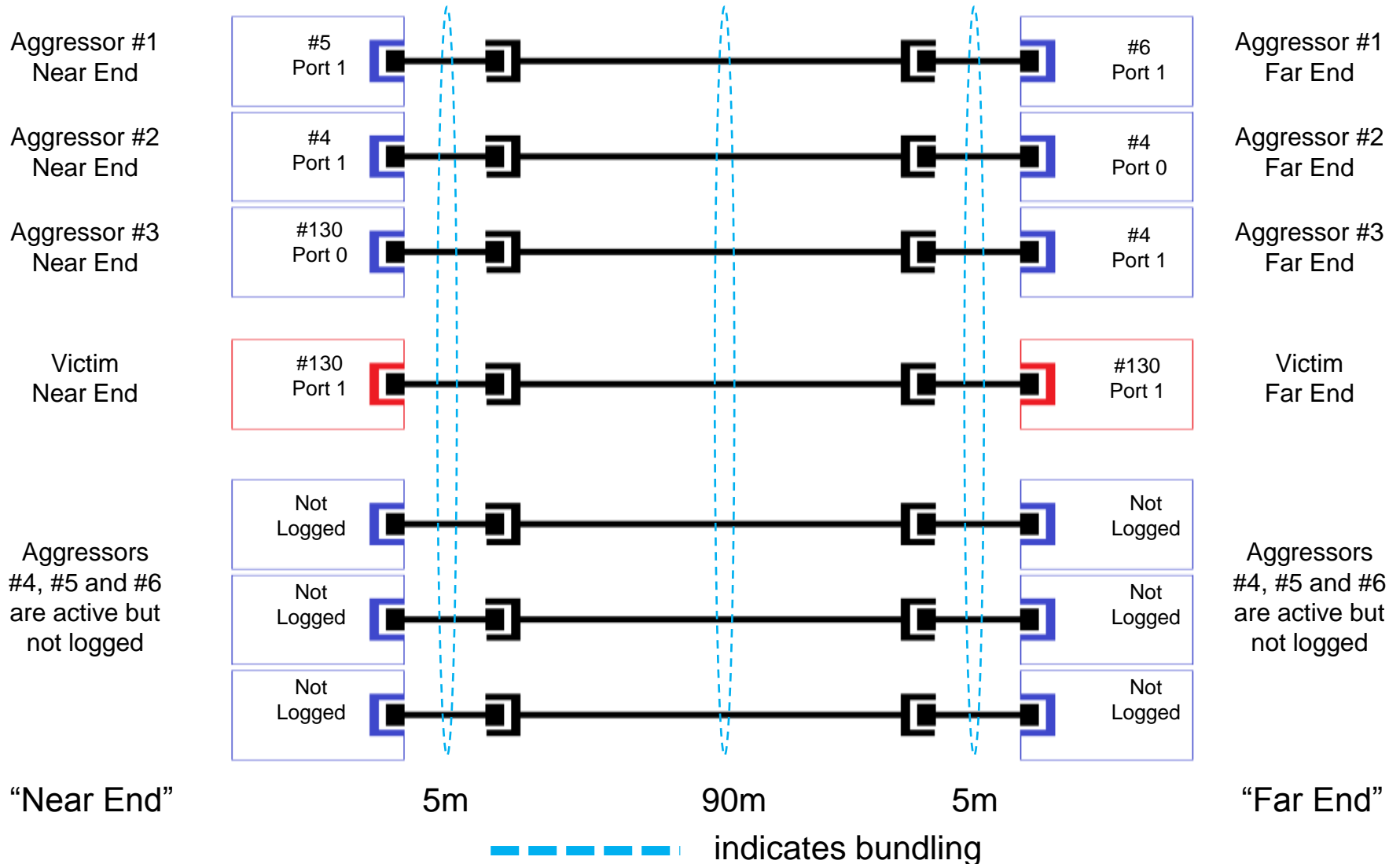
- 2.5Gb/s and 5Gb/s rates can be reliably achieved over the “Use Cases Supported” as described in [diminico_3bz_01_0316.pdf](#).
- Mitigation (“unbundling”) at both endpoints is the “big lever”; additional mitigation in the horizontal link segment provides performance benefits as measured by TTL, resolved link data rate and reported SNR operating margin.
- Deployment configurations/supported Use Cases should follow proposed link segment ALSNR recommendations.

Thank You!

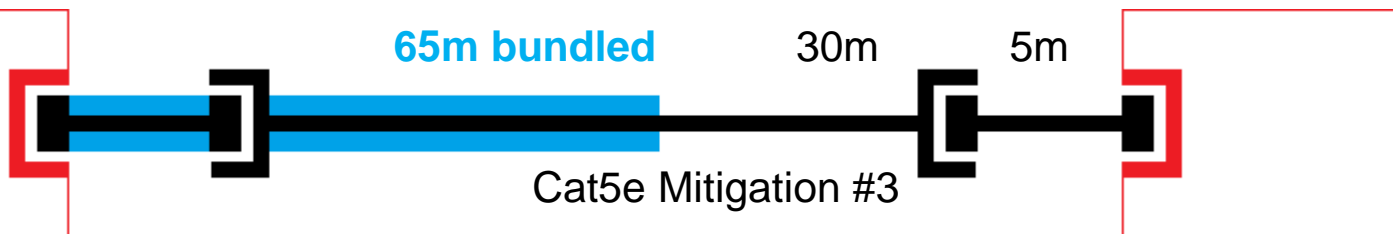
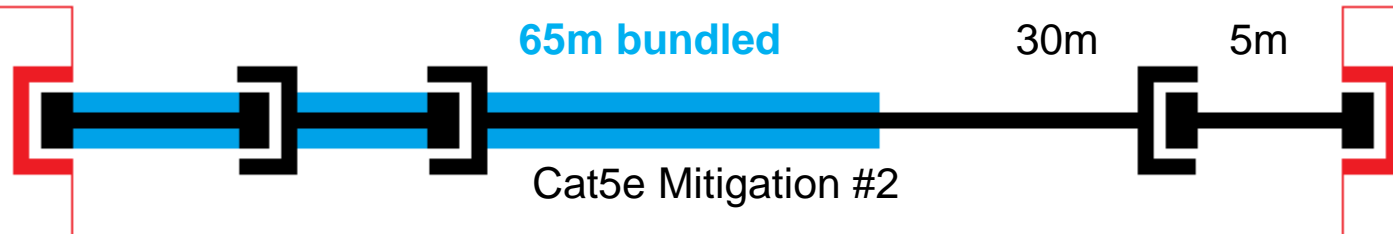
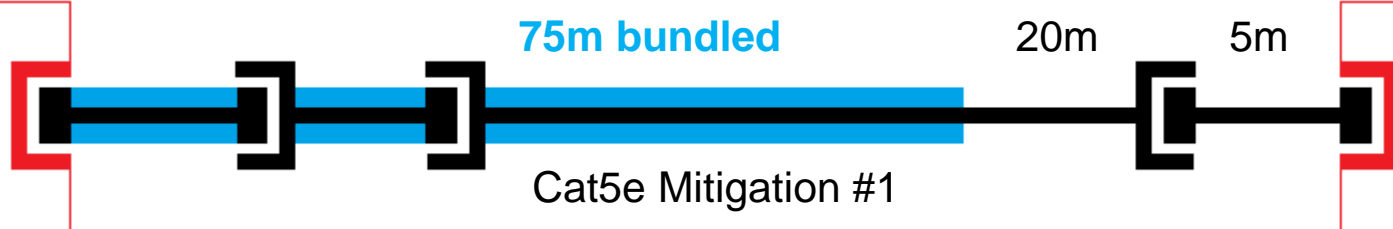
Basic 3-Connector Configuration




Basic 2-Connector Configuration

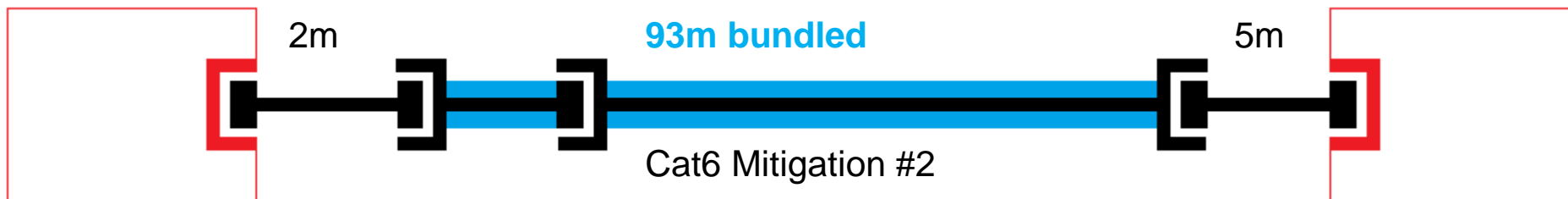
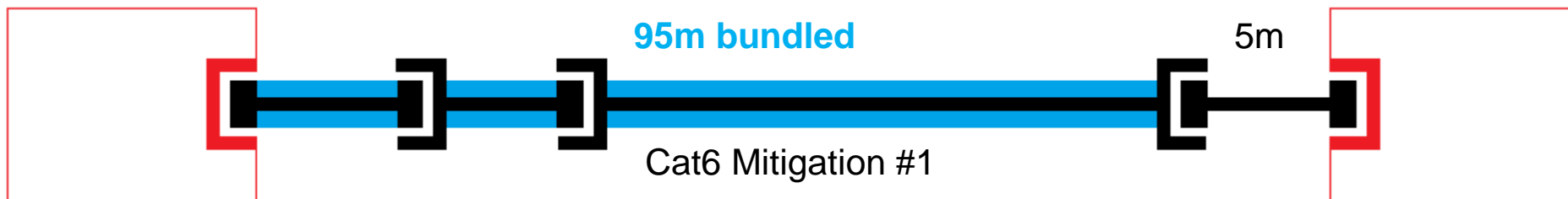
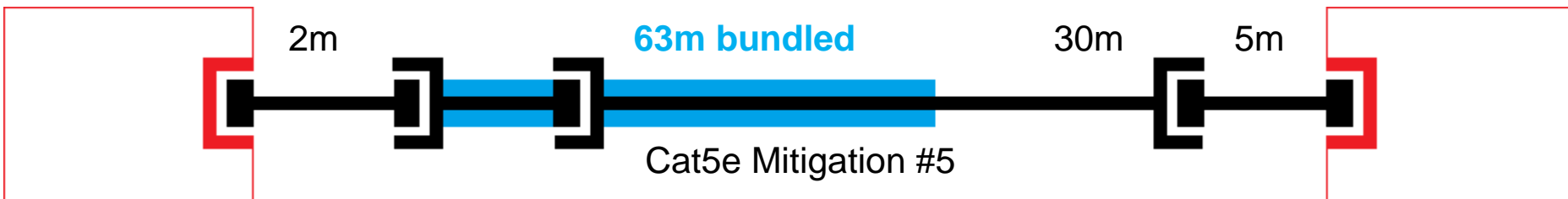
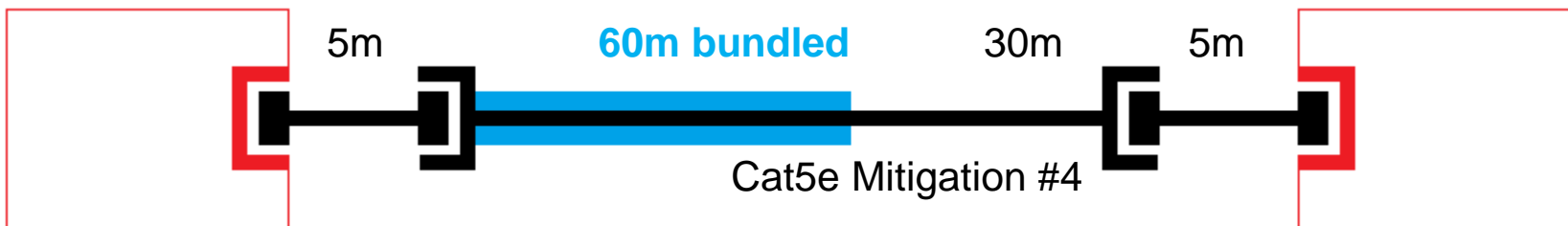



Cable Configurations (1/3)



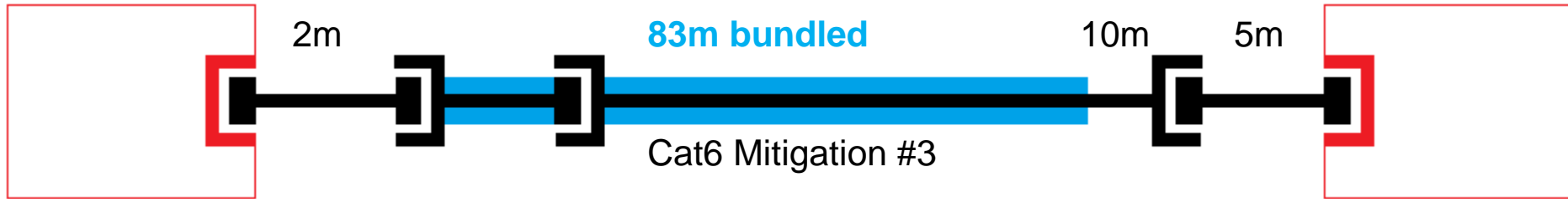
 indicates bundling. Blue "x m" = bundled length, Black "y m" = unbundled length


Cable Configurations (2/3)



 indicates bundling. Blue "x m" = bundled length, Black "y m" = unbundle length

Cable Configurations (3/3)



 indicates bundling. Blue "x m" = bundled length, Black "y m" = unbundled length