Channel Characterization

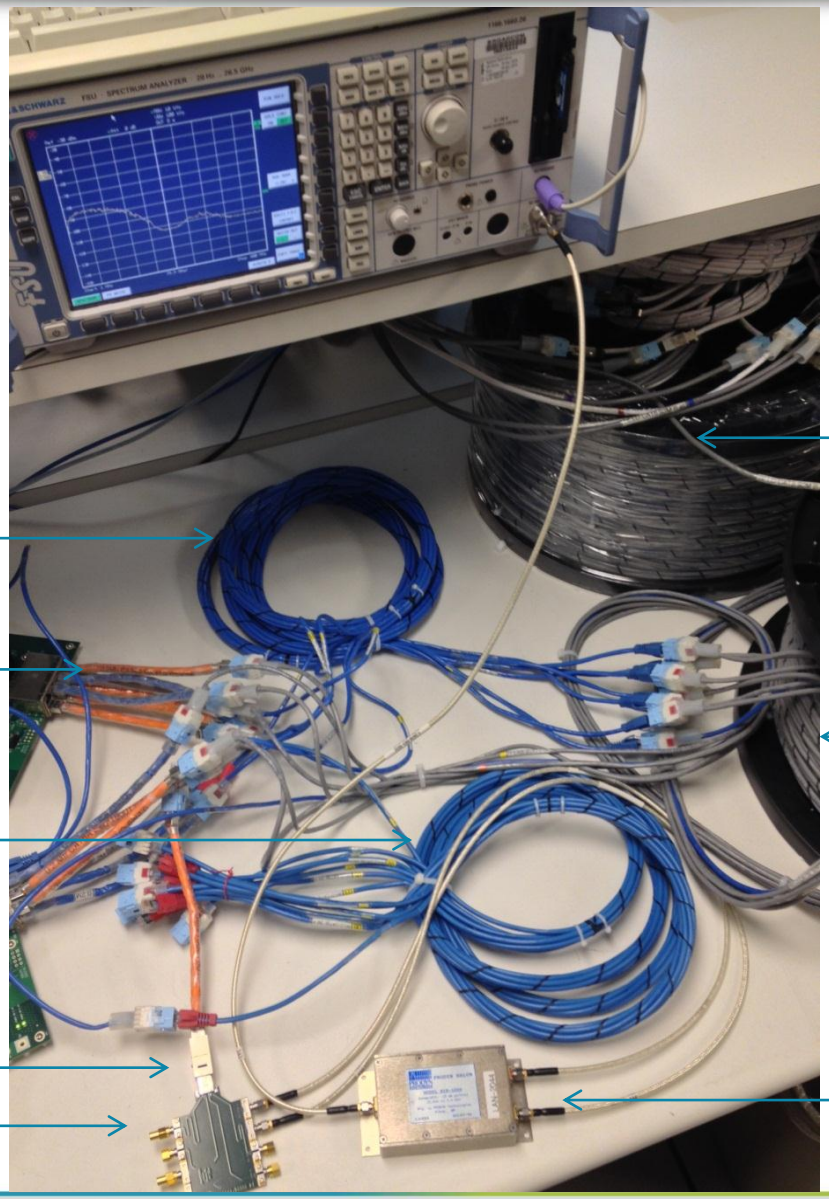
German Feyh

Jan 6th, 2015

Test setup

- Cable type: CAT5E and CAT6
- Cable
  - Victim: cable segments: 20cm + 5m + 92m + 3m + 20cm
    - 3m to reach the wireless access point from cable run
  - Interferer: cable segments: 20cm + 5m + 92m + 20cm
  - 6 around 1 bundled cable segments: 5m, 92m
  - Victim has 4 Connectors: male to female
- 10G derivatives as transmitters
  - 2.5G: baud rate scaled by 0.25 compared to 10G
  - 5G: baud rate scaled by 0.5 compared to 10G
  - Same time domain peak to peak signal as 10G
- 1G in test mode 4 for PSD measurement
- Measurement
  - Additional connector to RJ45 to SMA test fixture
  - Balun, FSU

Test setup

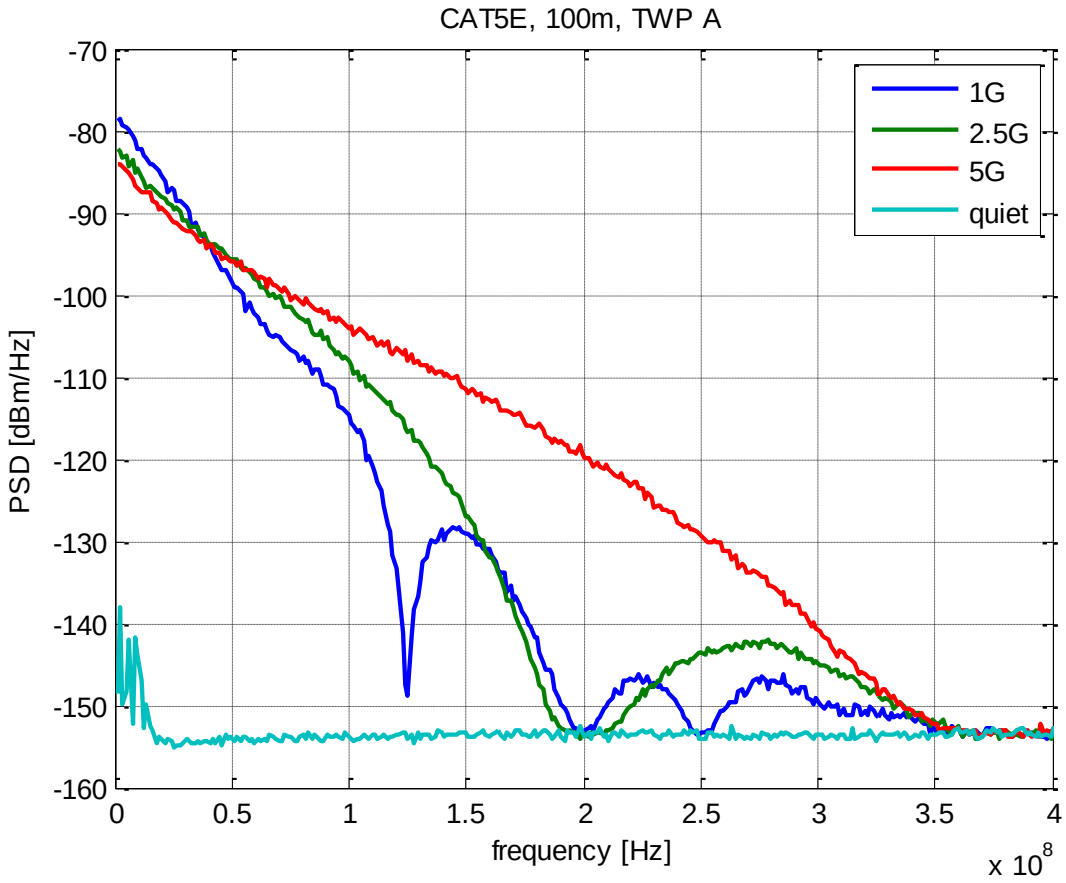

FSU
5m CAT5E
20cm CAT6A
3m CAT5E
Signal Sources
Connector
RJ45 to SMA
92m CAT6
6 around 1,
spooled
92m CAT5E
6 around 1,
spooled
Balun

Measurement strategy

- Measure relative signal and noise levels on same setup
  - RJ45 to SMA connector
  - Balun
- Presentation does not claim to measure absolute signal levels on the cable.
- Salz SNR computed as the difference between
  - Signal
  - Noise

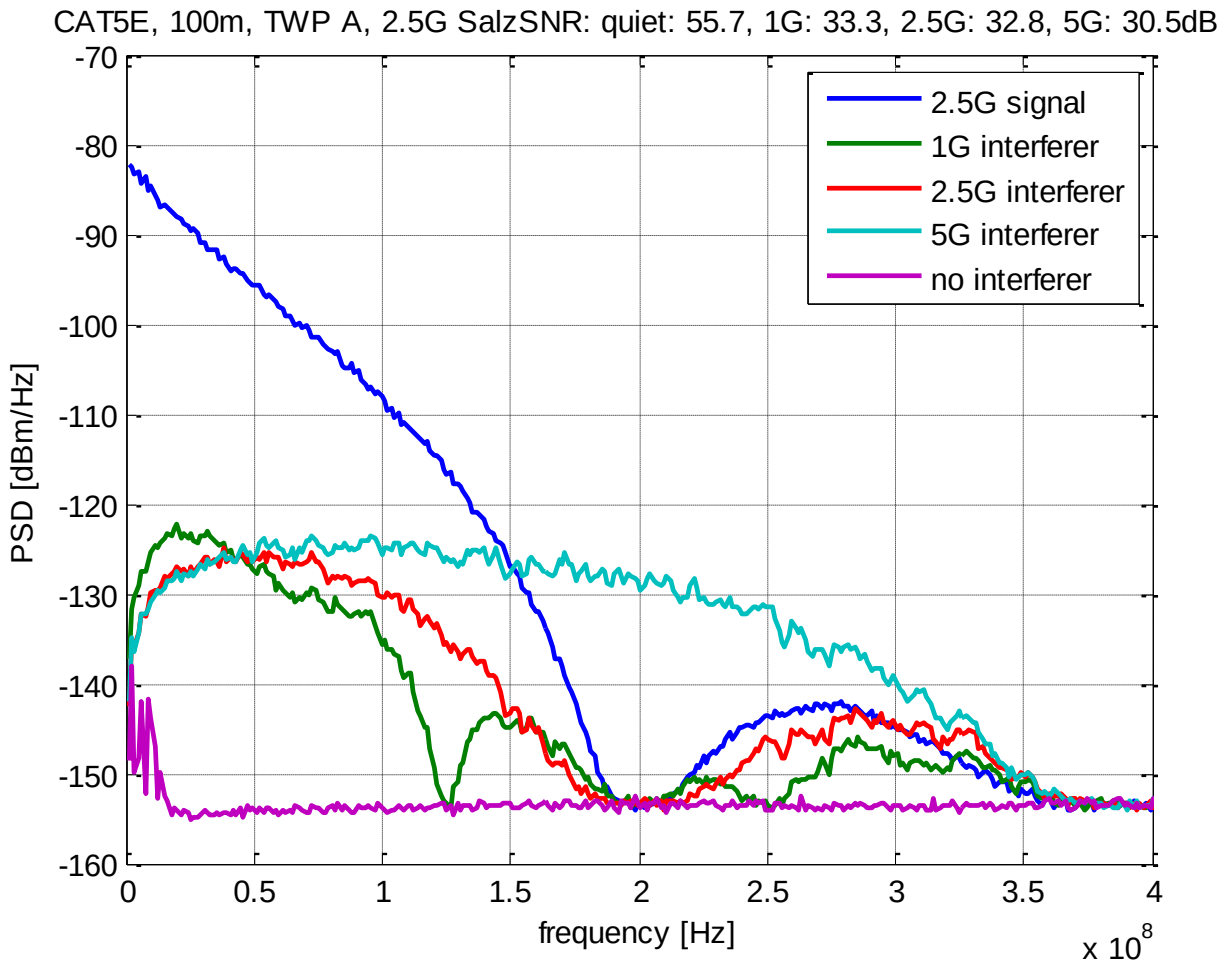
Comparison of signal PSD at MDI of receiver

- 100m CAT5E
- At DC: 1G Power > 2.5G power > 5G power
- Minima
  - 1G: 125MHz
  - 2.5G: 200MHz



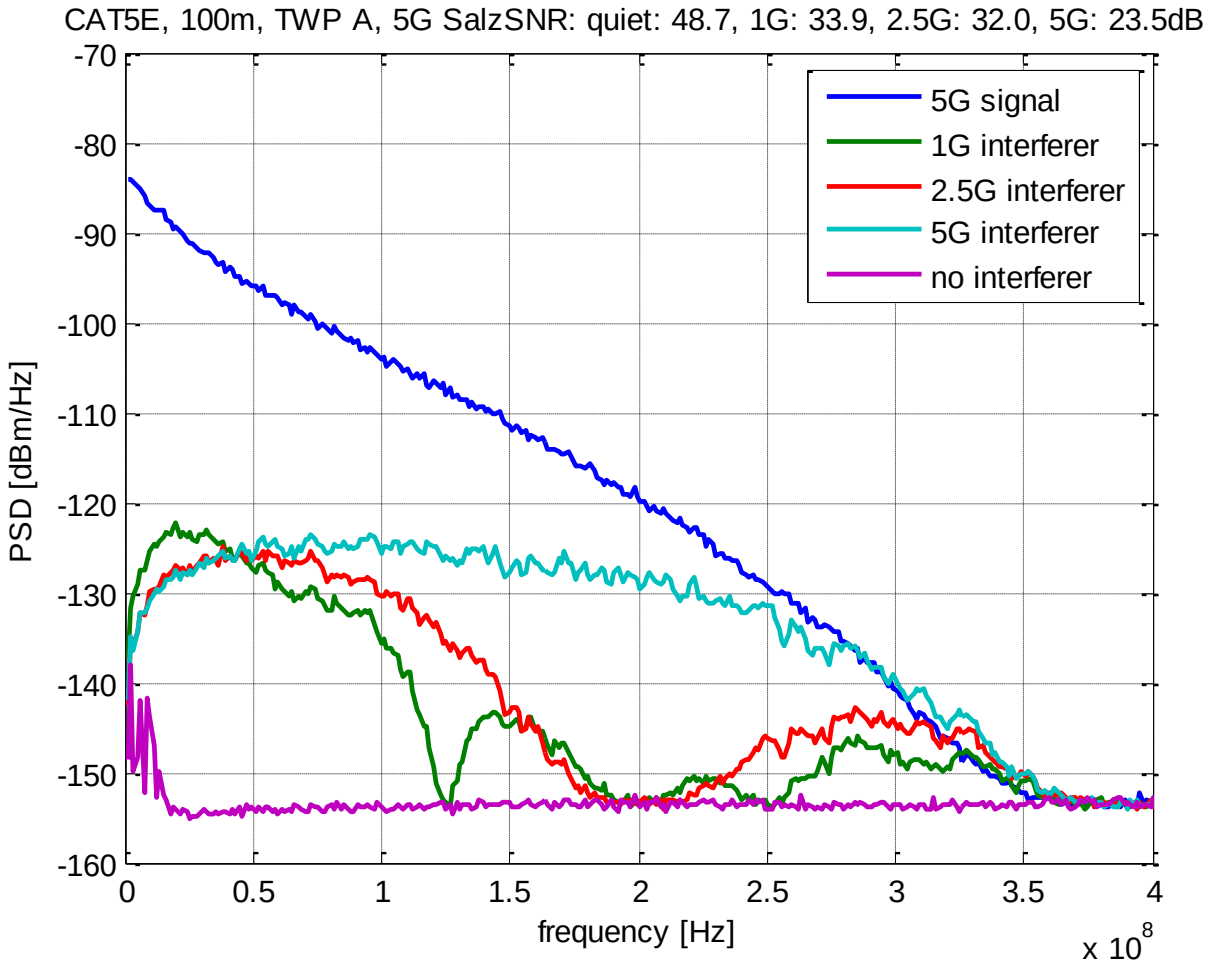
100m, 6 around 1 CAT5E
Signal and noise for 2.5G signal

- 2.5G transmission has more than 30dB Salz SNR



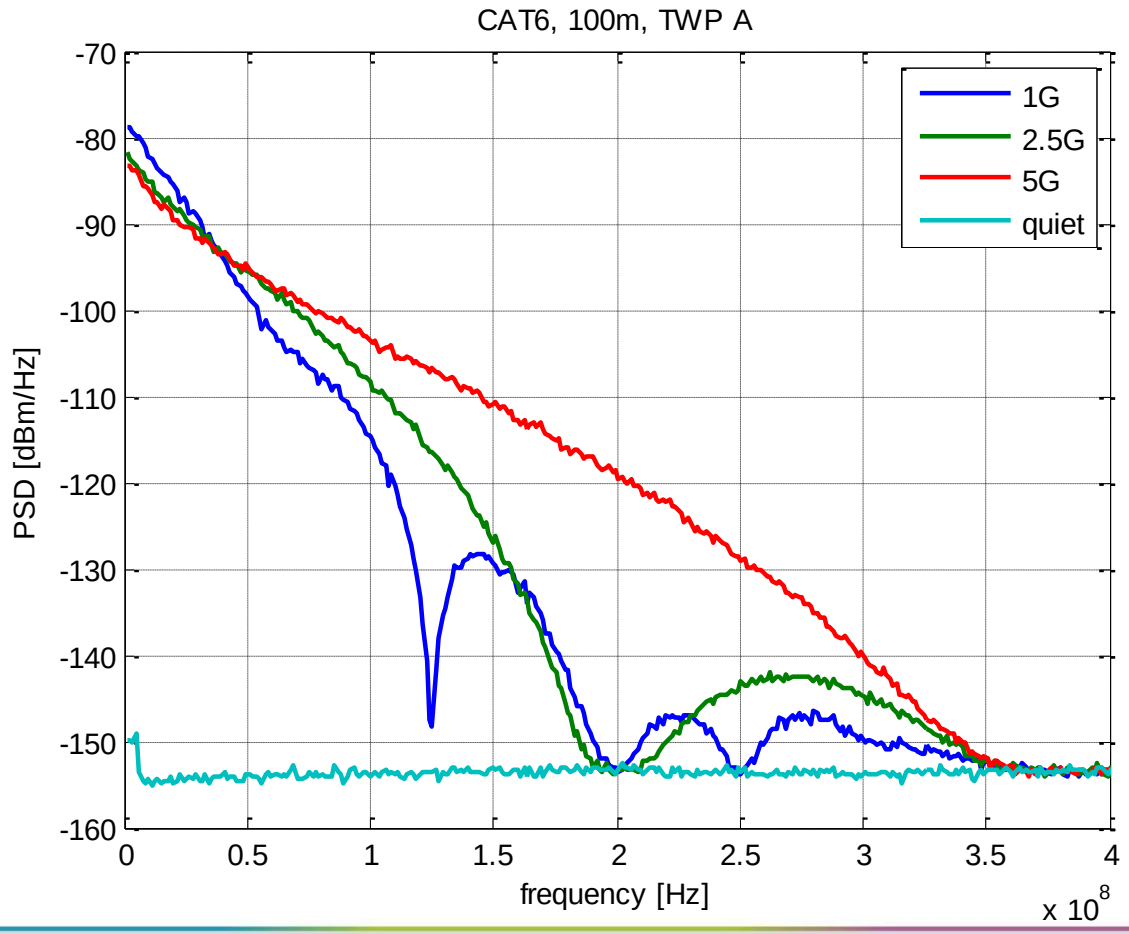
100m, 6 around 1 CAT5E
Signal and noise for 5G signal

- 5G signal and 5G interferers: 23.5dB



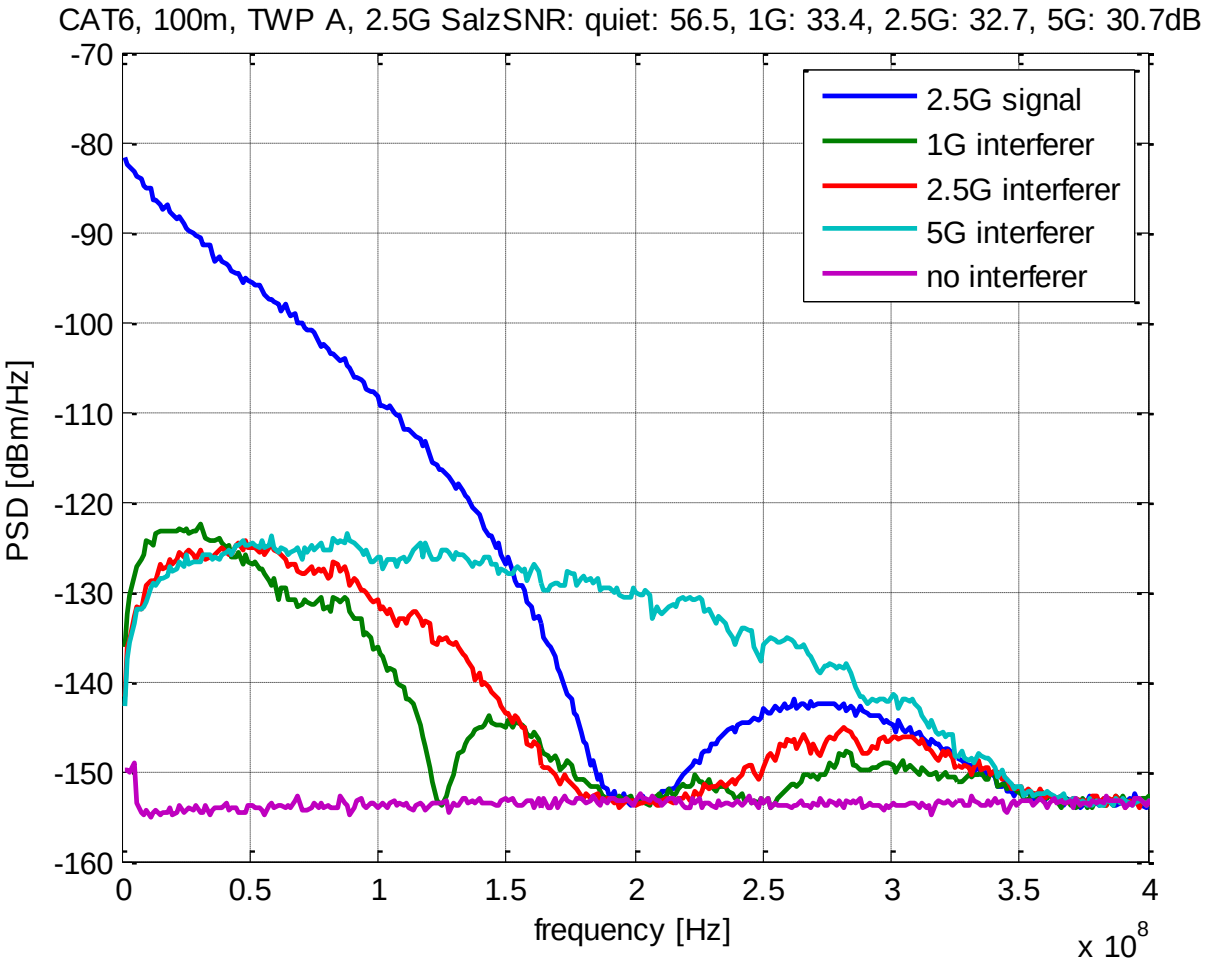
Comparison of signal PSD at MDI of receiver

- 100m CAT6
- At DC: 1G Power > 2.5G power > 5G power
- Minima
  - 1G: 125MHz
  - 2.5G: 200MHz



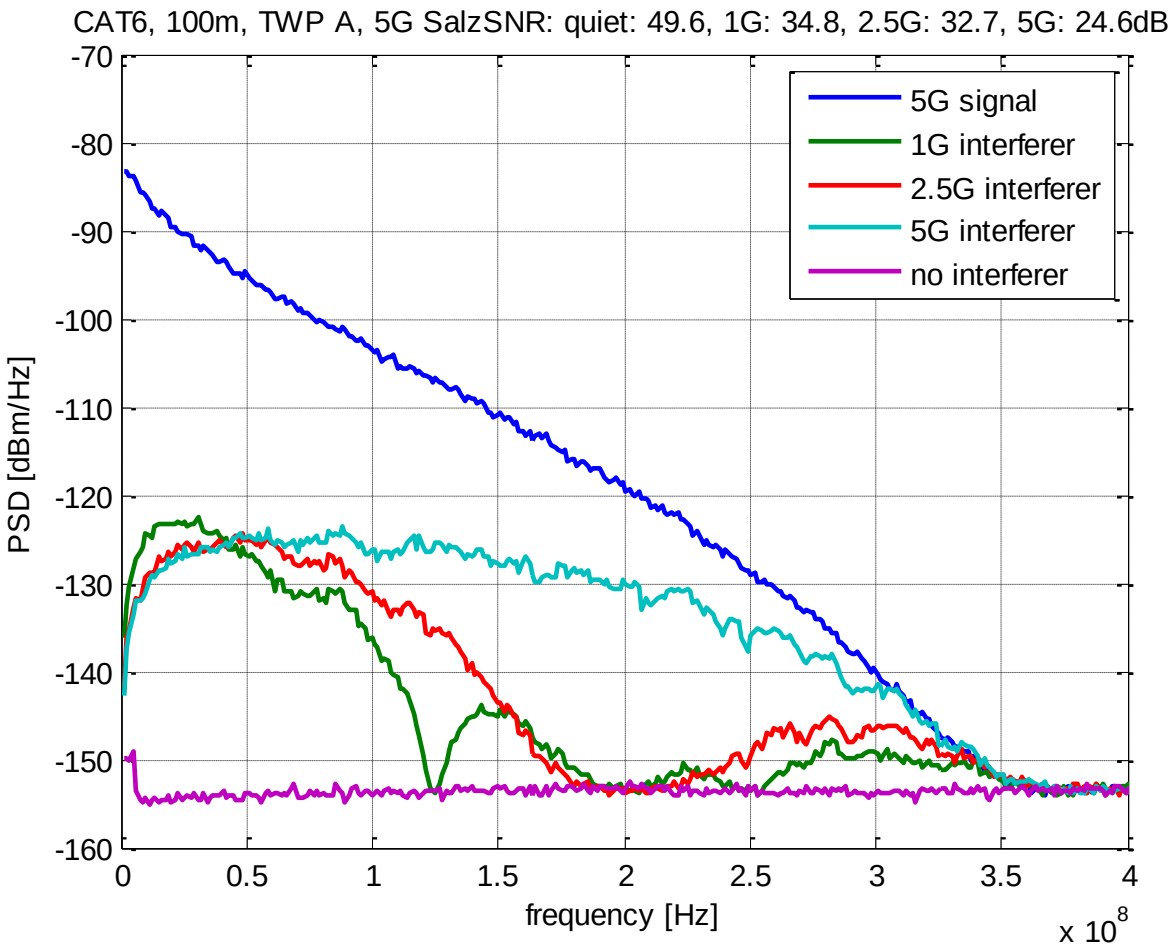
100m, 6 around 1 CAT6
Signal and noise for 2.5G signal

- 2.5G transmission has more than 30.7dB Salz SNR



100m, 6 around 1 CAT6
Signal and noise for 5G signal

- 5G signal and 5G interferers: 24.6dB



Conclusion

- Overall conclusion has not changed over the last twelve years (see below).
- 5G interferers result in the lowest Salz SNR.

Feasibility Study on High Speed Transmission over UTP Cables

IEEE Meeting July 03

Scott Powell

Broadcom

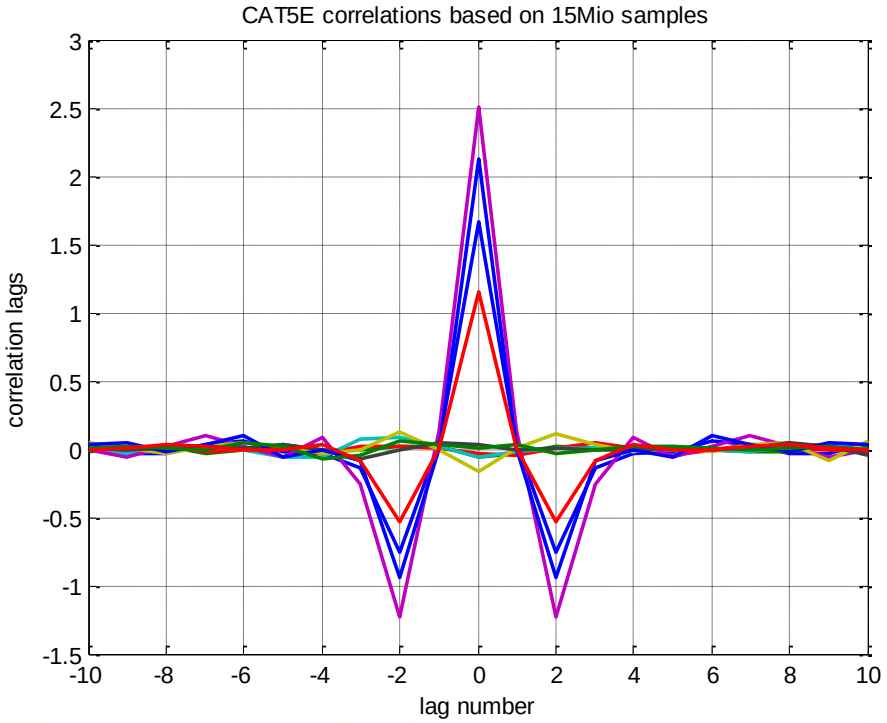
Summary

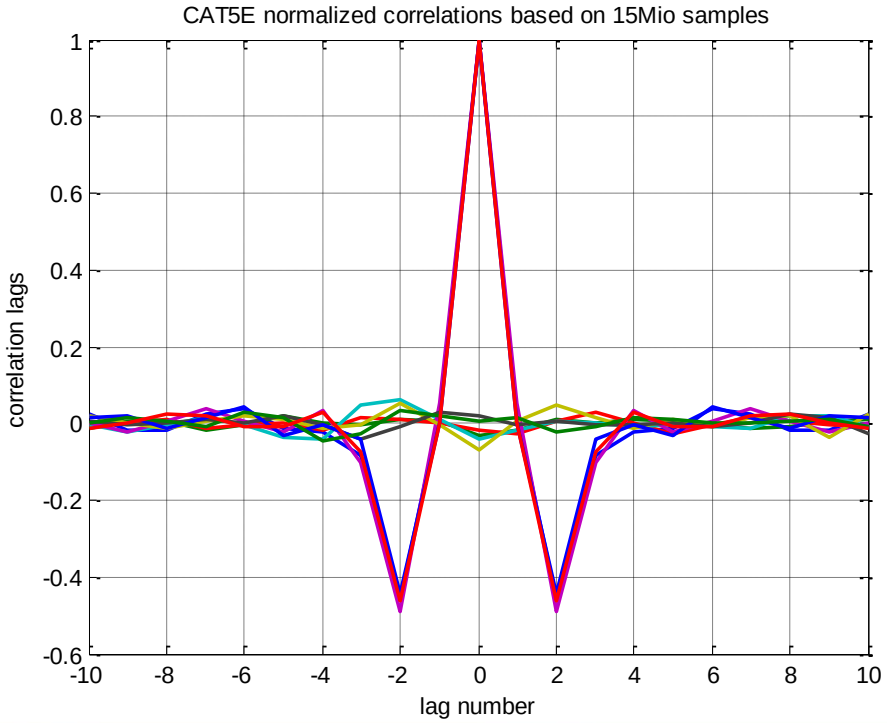
- 10Gbase-T on 100m Cat5e and Cat6 is not feasible
- 2.5Gbps is feasible on 100m Cat5e per ISO 11801 spec
- 5Gbps is feasible on 100m Cat6 with specified ANEXT

Multi-dimensional (four TWP) view

CAT5E

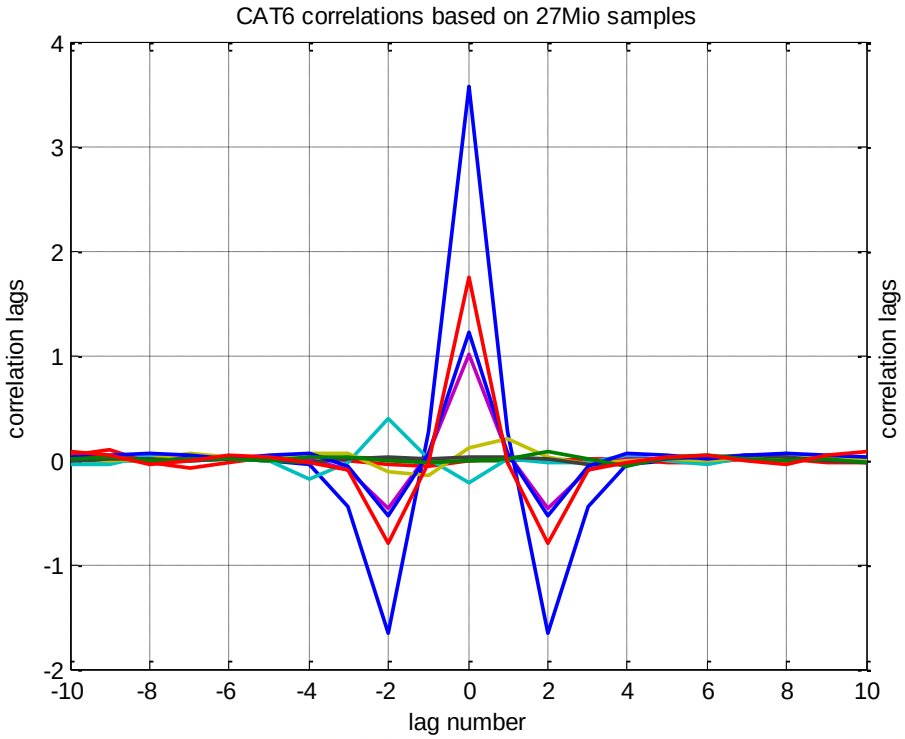
- At lag 0
  - The four autocorrelations are large, difference is less than 6dB.
  - Each noise is normalized, so that its autocorrelation at 0 is 1.
  - Can visually compare the amount of cross correlation.
- Estimating one noise, when given the other:
  - Reduction in noise power for normalized noise:$1 - E_{xy}^2$

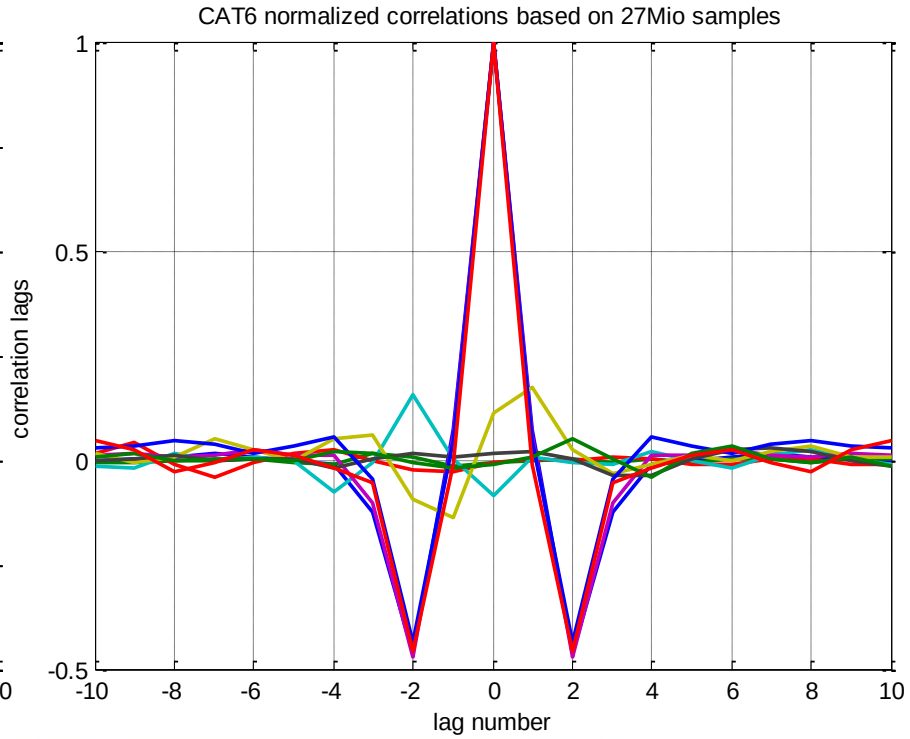




CAT6: some cross correlation for TWPA ↔ TWPD and TWPB ↔ TWPC

- At lag 0
  - The four autocorrelations are large, difference is less than 6dB.
  - Each noise is normalized, so that its autocorrelation at 0 is 1.
  - Can visually compare the amount of cross correlation.
- Estimating one noise, when given the other:
  - Reduction in noise power for normalized noise:$1 - E_{xy}^2$
  - Normalized correlations: max(abs(E_{xy}))<0.2





Supporters

- George Zimmerman, Commscope