COMMS 2017
CONNECT

Presentation Title:

Radio based SCADA telemetry for utilities: deployment and testing

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SCADA wireless introduction

Spectrum is available to utilities worldwide

- 150, 400, 450, and 900 MHz licensed
- 220, 360, and 700 MHz country specific
- 12.5, 25 kHz typical, and 50 kHz case-by-case

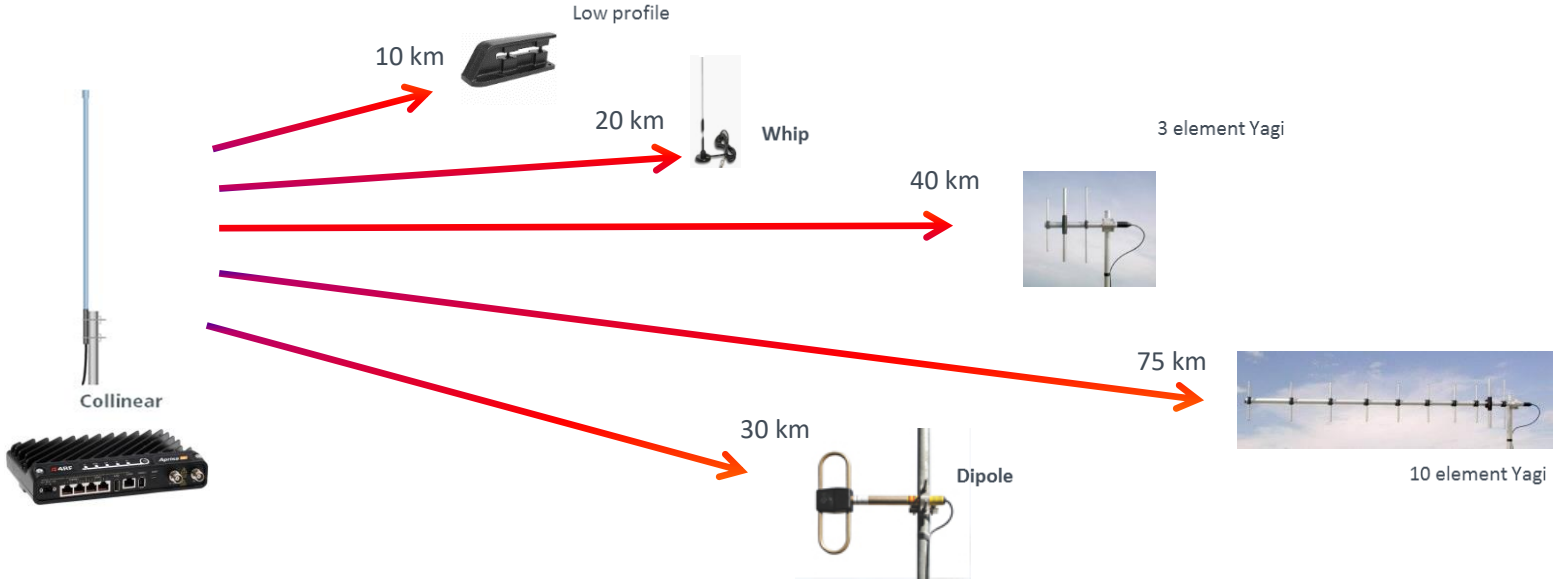
Point to multipoint systems, now called **field area networks** or FAN

- Practical, multi-vendor, speeds to 400+ kbps, excellent range
- Utility owned solution, no reliance on other providers
- Flexible solution in disparate narrow channel radio spectrum

Narrow channel QAM technology delivering near broadband capacity

Radio delivers range

Examples of maximum UHF range for typical antennas in QPSK mode 37dBm, ignoring terrain and local obstructions



Multi vendor FAN offerings

Single carrier QAM, FEC, Ethernet and serial with variable OTA packet sizes to suit payload

- QPSK, 16 QAM, and 64 QAM with variable FEC
- Adaptive coding and modulation
- Raw rates to 240 kbps, duplex rates to 480 kbps

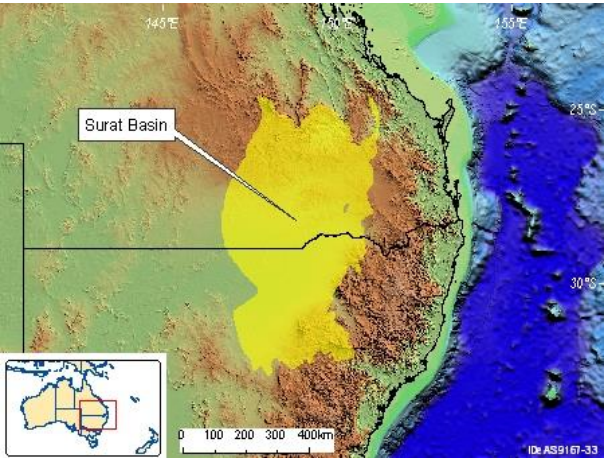
Suitable for ACMA bands at 150, 400 and 450 MHz

- Meets utility needs with support for serial and IP

Electricity, water, oil and gas applications

LNG production – NLOS

150 wells, 400 sq km terrain
UHF system, 30m tower master tower



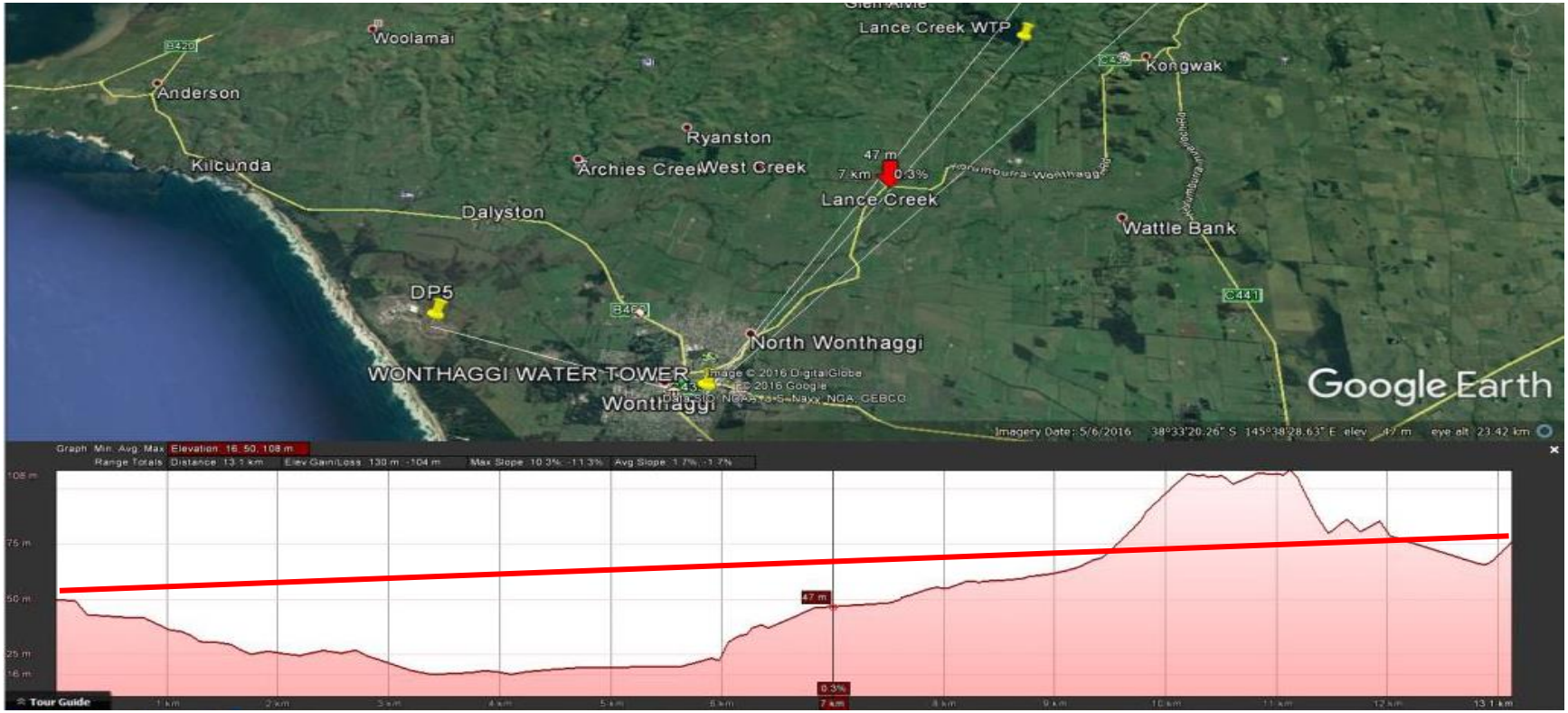
UHF in the Surat basin

400 MHz workhorse band for SCADA radio

Good range reasonable antennas

Paths to 100 km or more

Water catchment – path obstructions common



VHF in South Gippsland

Difficult terrain, significantly obstructed

VHF works well compared with UHF

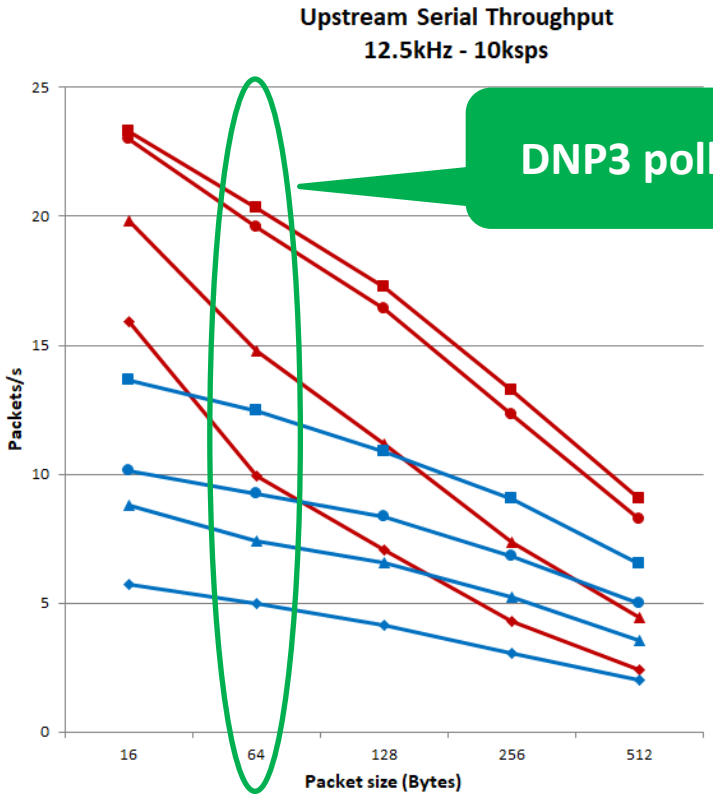
Lance Creek link

- Antenna test heights 1m and 6m
- RSSI = -76 dBm, 64 QAM

Fade margins

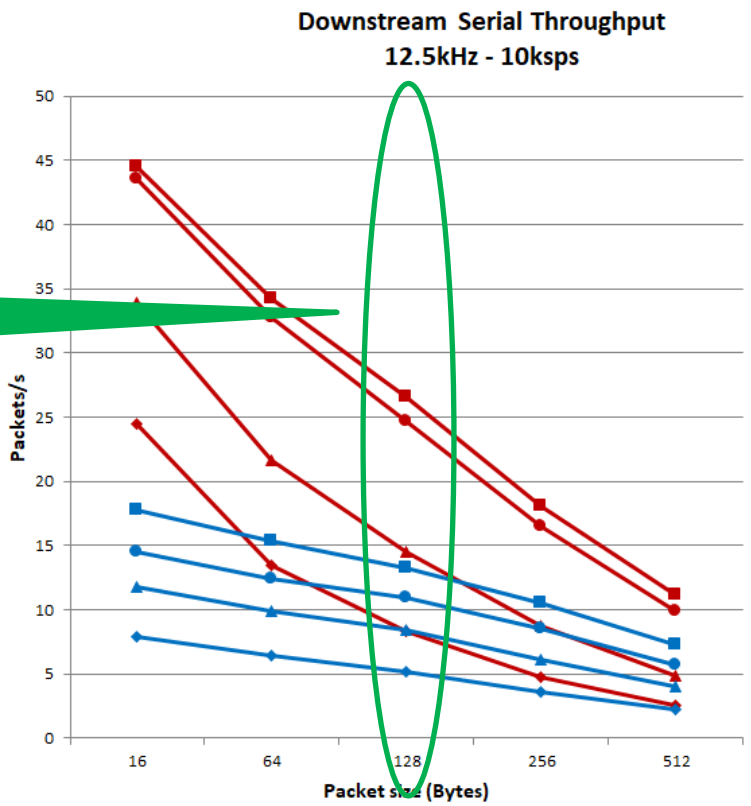
- 12.5 kHz = 38 dB
- 25 kHz = 36 dB
- 50.0 kHz = 33 dB

Don’t judge radios by datasheet …



DNP3 poll

DNP3 response



Do judge radios by testing

DNP3 64/128 use case

Radio A (blue) 16 QAM

- 12.5 kHz speed 40 kbps

Radio B (red) QPSK

- 12.5 kHz speed 20 kbps

Which is faster?

Do judge radios by testing

DNP3 64/128 use case

Radio A (blue) 16 QAM X

- 12.5 kHz datasheet speed 40 kbps

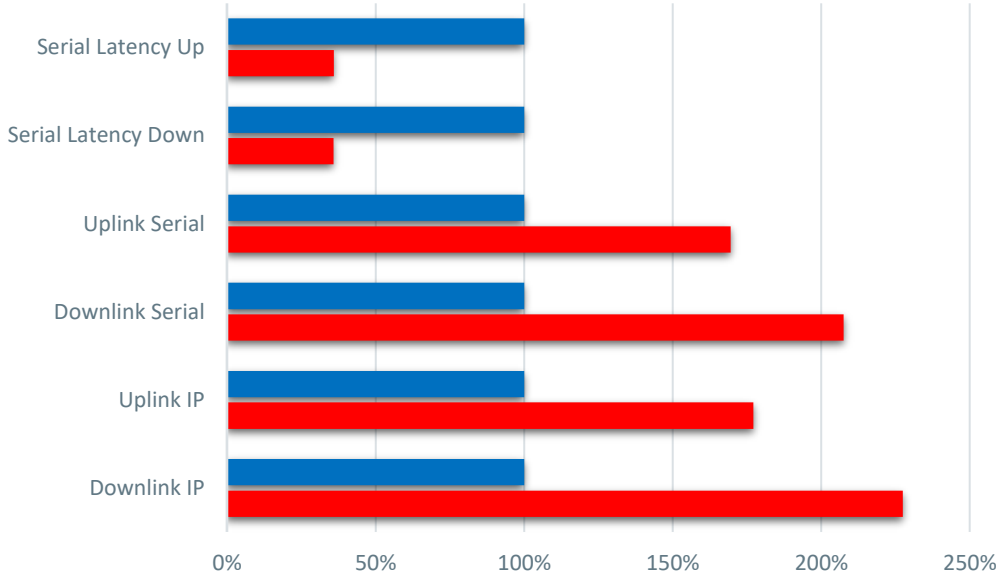
Radio B (red) QPSK √

- 12.5 kHz datasheet speed 20 kbps

Red has 10 dB more system gain

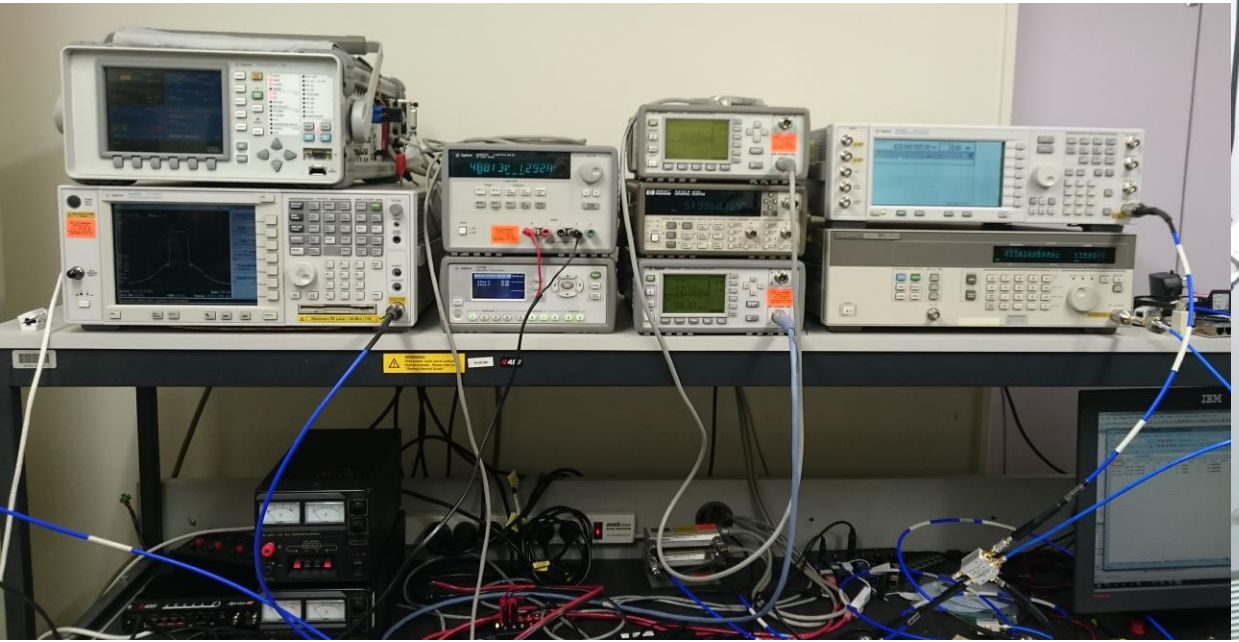
- QPSK needs less SNR than 16 QAM

But red beats blue with more than 1.5 times useful throughput and less than half the latency



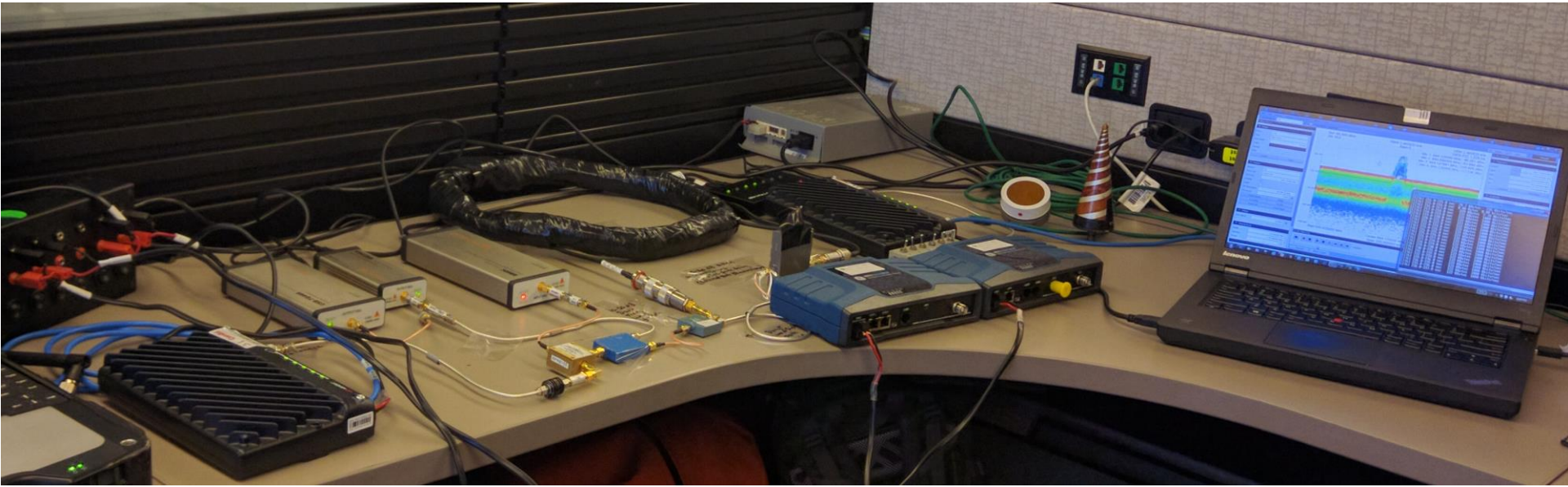
End user testing

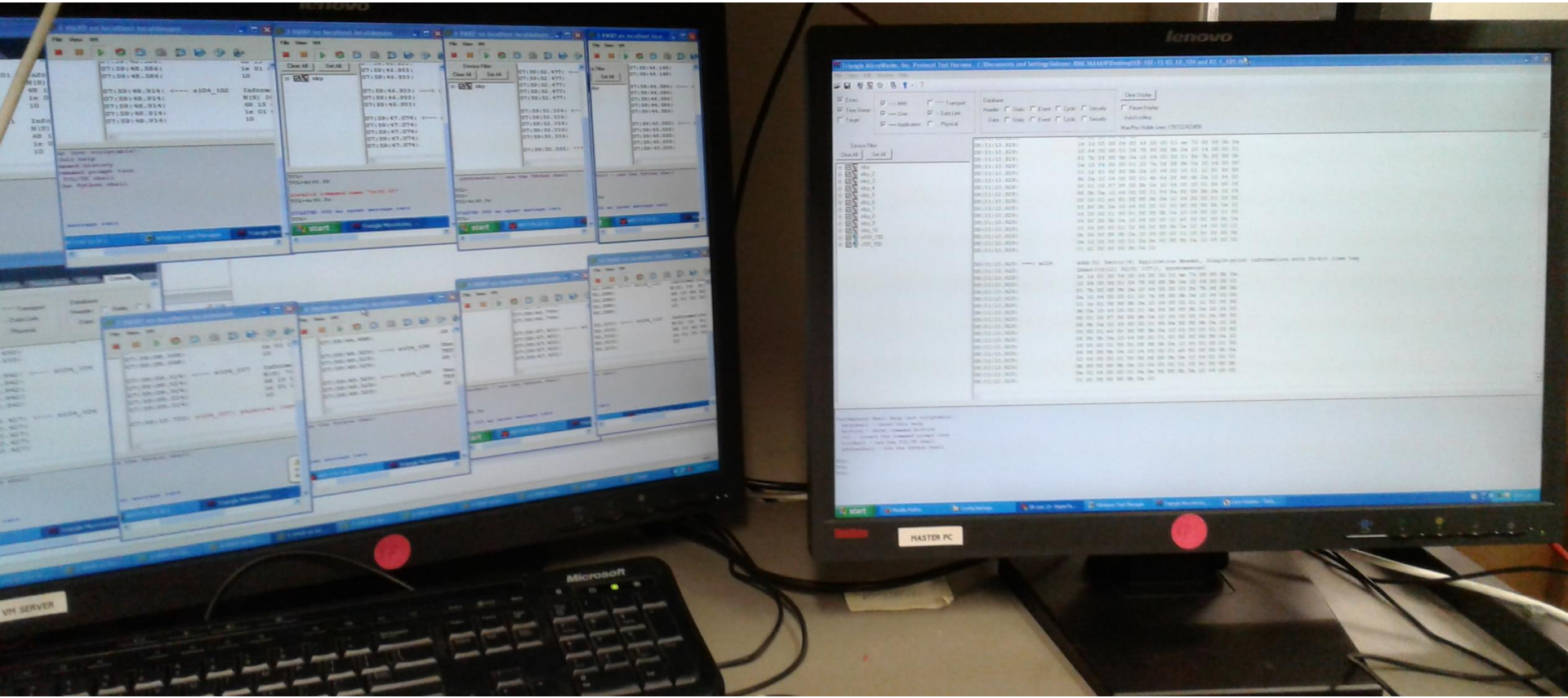
Complex …



End user testing

… or simple




lenovo
Microsoft
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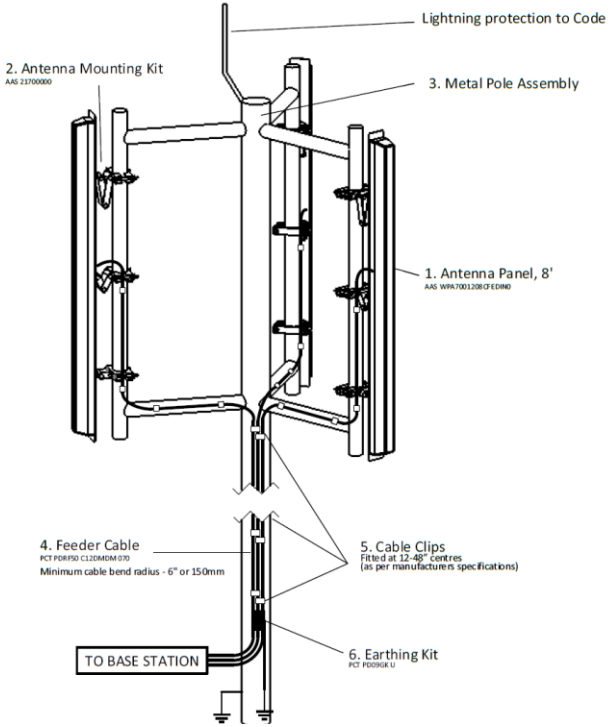
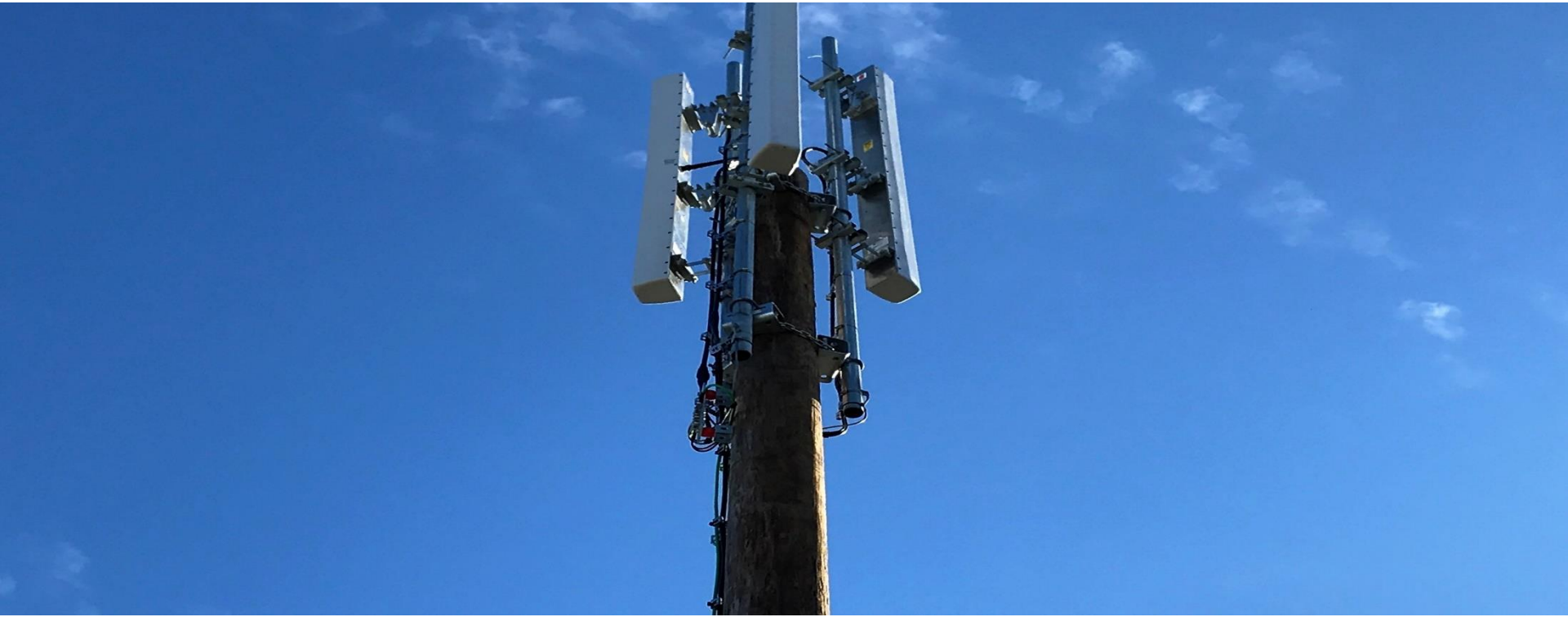
New high density networks at 700 MHz

FAN not ‘cellular’ but *cell* based

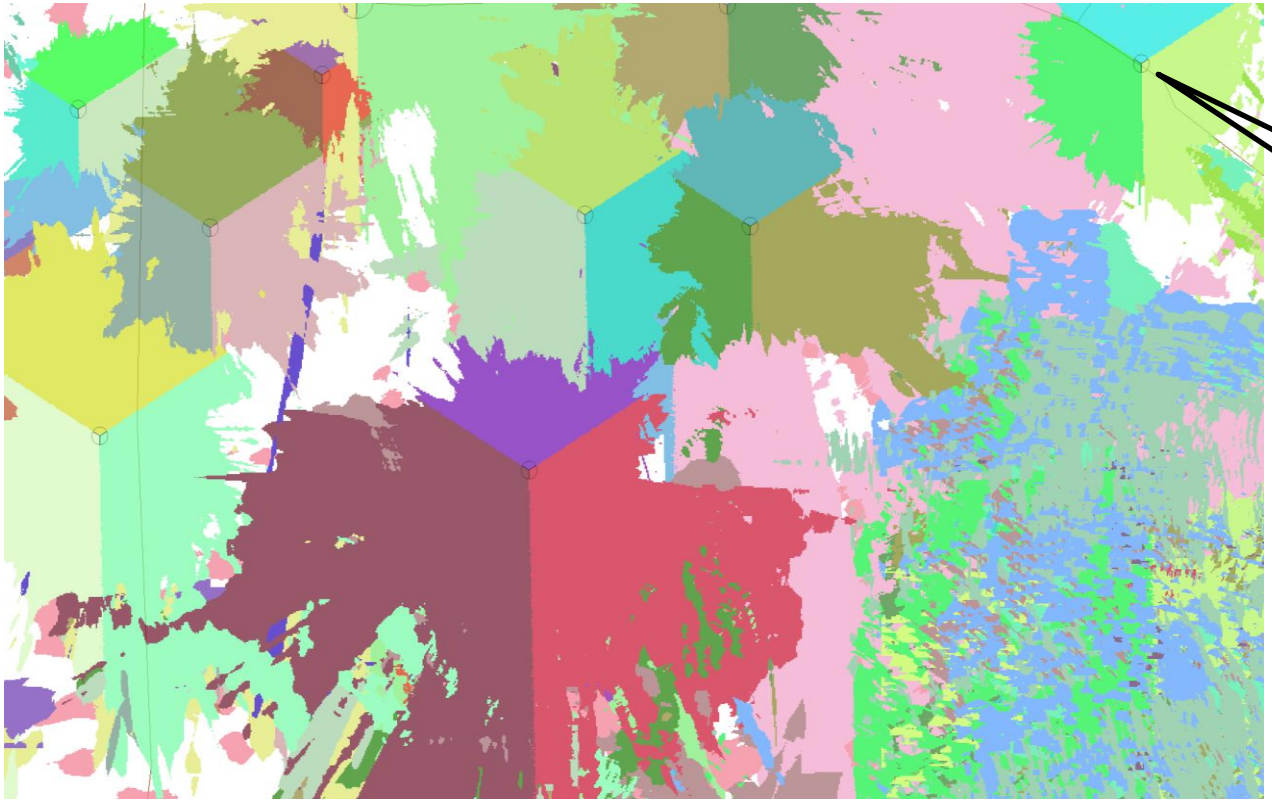
Cells sectors for capacity and system gain



FAN antennas chain mount, wood pole



Example coverage – FAN with 120º sectors



Base stations with three sector coverage

Best server plots for multiple base stations indicate which sector has best signal

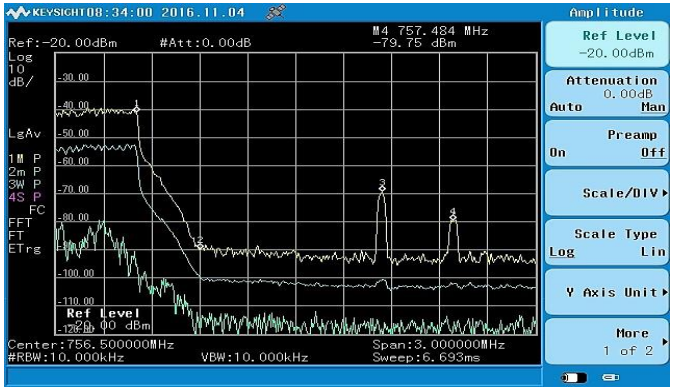
Thousands of remotes …

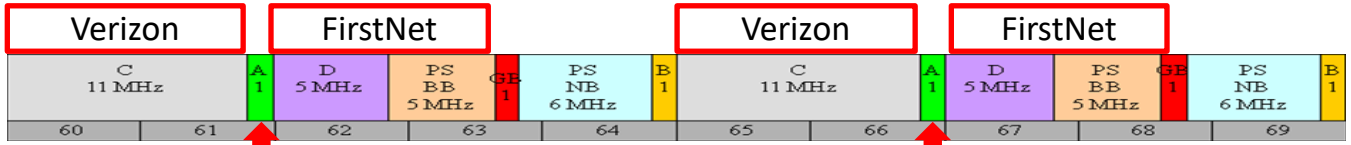
700 MHz challenges – the noisy neighbours

Interference important, need to properly manage co-site signal levels

Worst case example: 21 Verizon antennas on 3 poles, 150 ft away

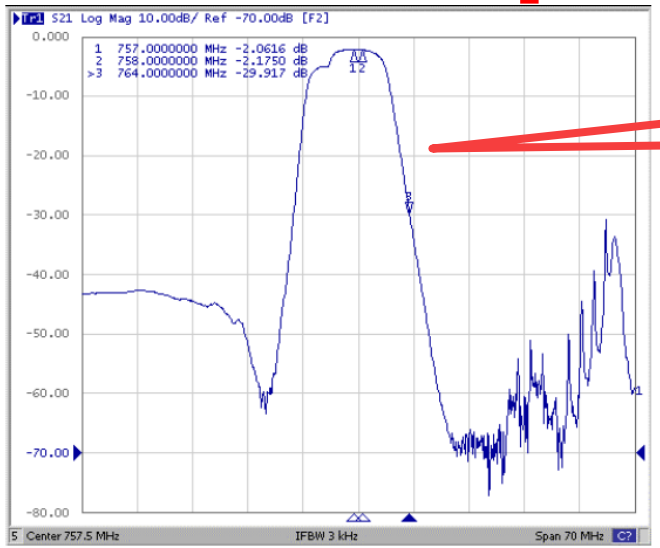
10MHz wide LTE carrier, rez bandwidth of 10kHz, actual power 30dB above SA plot, power level was -35dBm, total power at RX input -5dBm

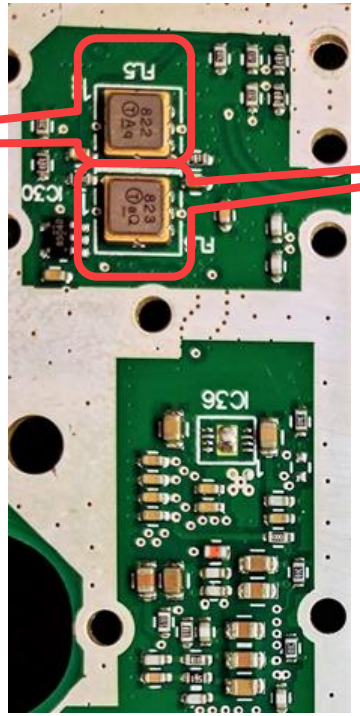


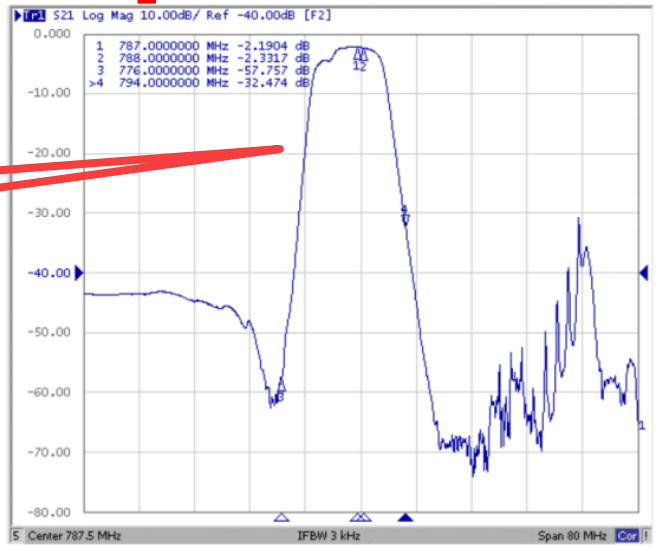


Downlink

Uplink







757-758 and 787-788 MHz SAW filters

Real filters not just signal processing

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