



Challenges in the design of a high bit-rate  
microwave radio link

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# Structure of presentation

- Context – the microwave point to point radio link market
- Designing and manufacturing the radio – the challenges we solved
- Operating performance
- The future

# Context

## The microwave links market

- Markets include telcos, councils, energy and mining companies that need to transfer massive amounts of data between two points via radio
  - Internet backhaul a growing niche
- Physical-layer communications
  - Ethernet (IP) or synchronous inputs at high Mbps rates
  - Some layer 2/3 functions relating to Ethernet switching
- Maximum throughput determined by bandwidth licenced from ACMA
  - and modulation schemes supported by the radio
  - spectral efficiencies up to 8 bps/Hz

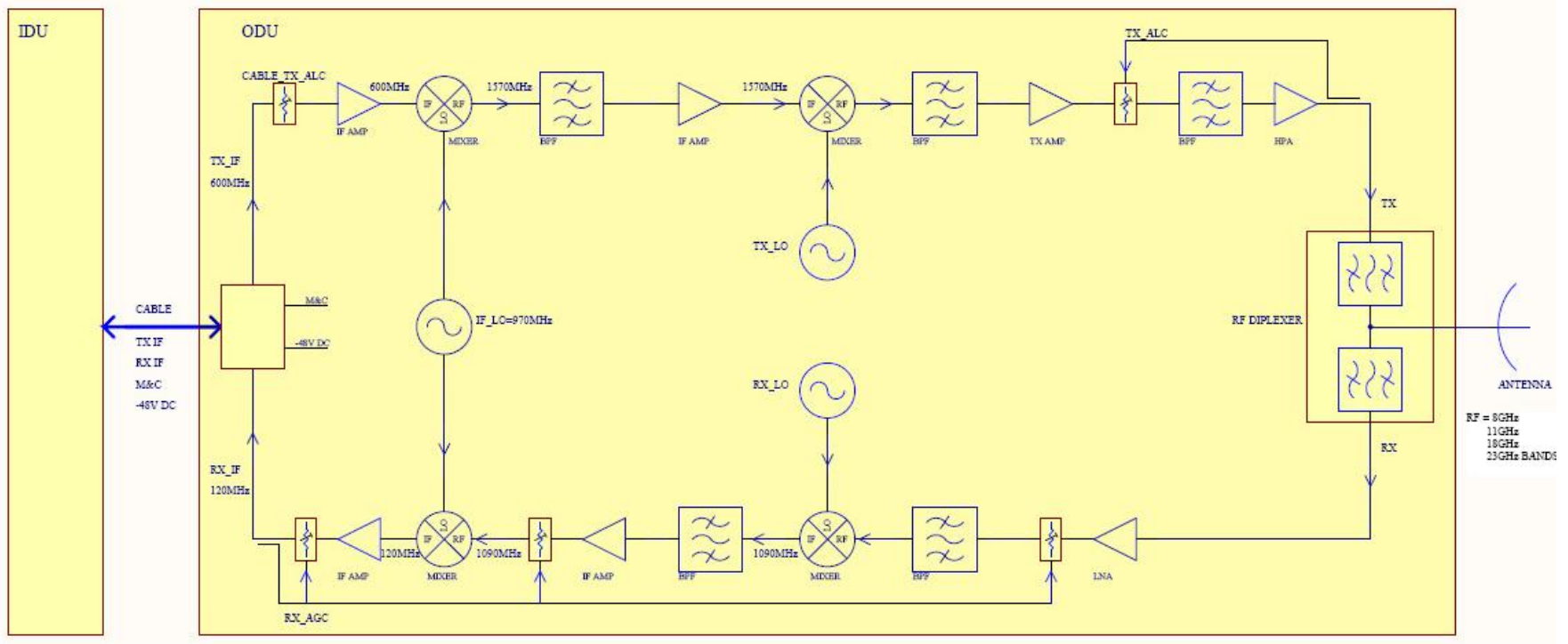
# Designing the radio – the challenges

## The air interface specification

- Operating RF bands at 8, 11, 13, 15, 18, 23 GHz
- Channel bandwidths of 13.5, 27, 40, and 55 MHz
- Threshold sensitivity down to -89dBm at .0001% ber
- Transmit power up to +31dBm

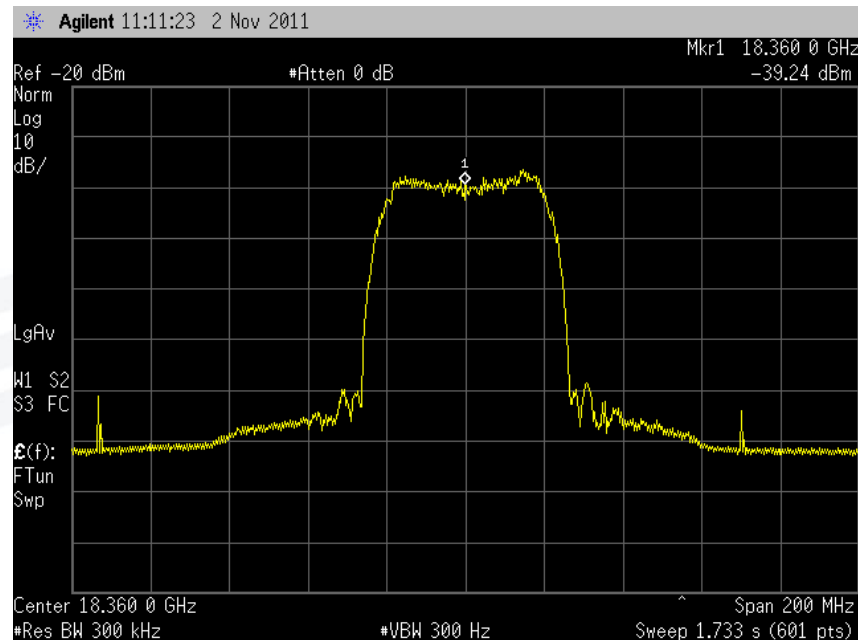
# Designing the radio – the challenges

## RF architecture – Outdoor unit



# Designing the radio – the challenges

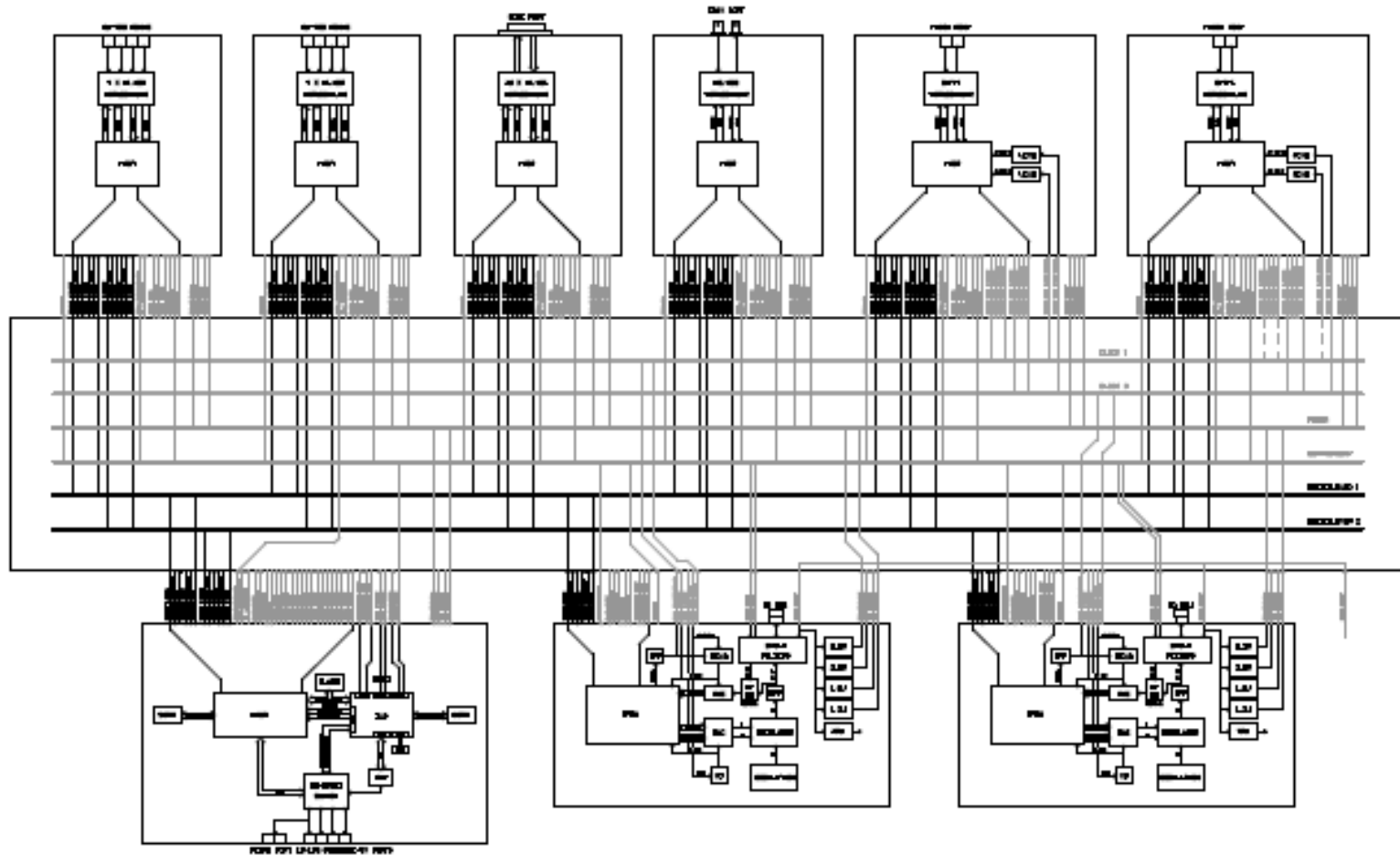
## RF architecture – Outdoor unit



RF Tx output spectrum showing limited extent of spectral regrowth

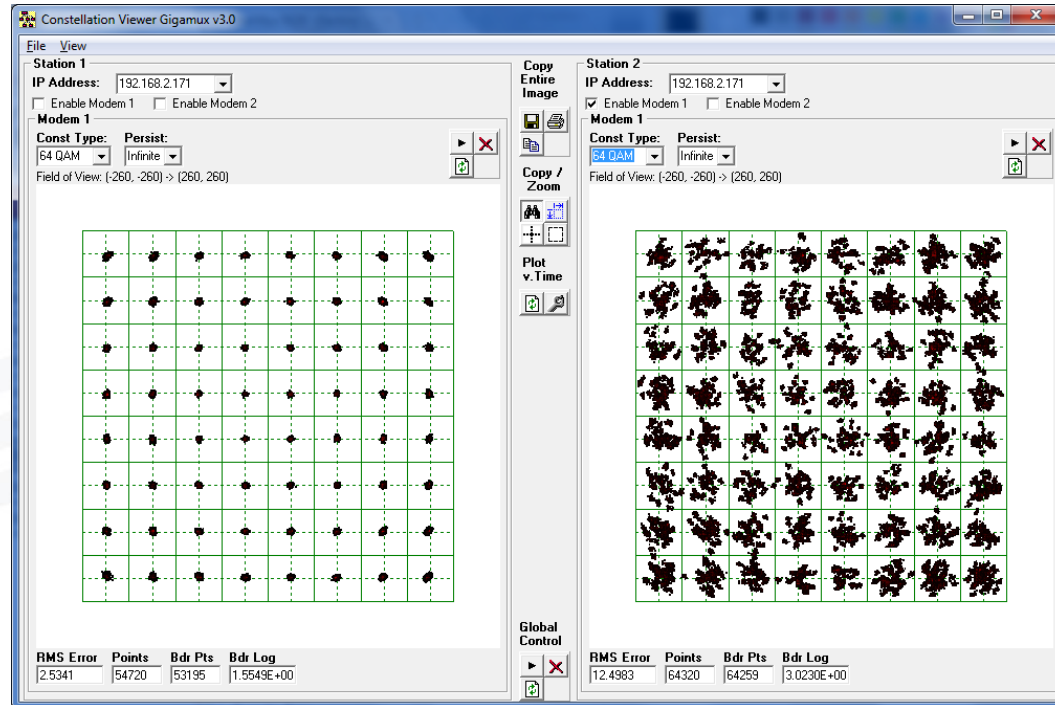
# Designing the radio – the challenges

## Baseband modem – the indoor unit



# Designing the radio – the challenges

## Equalisation (64 QAM)

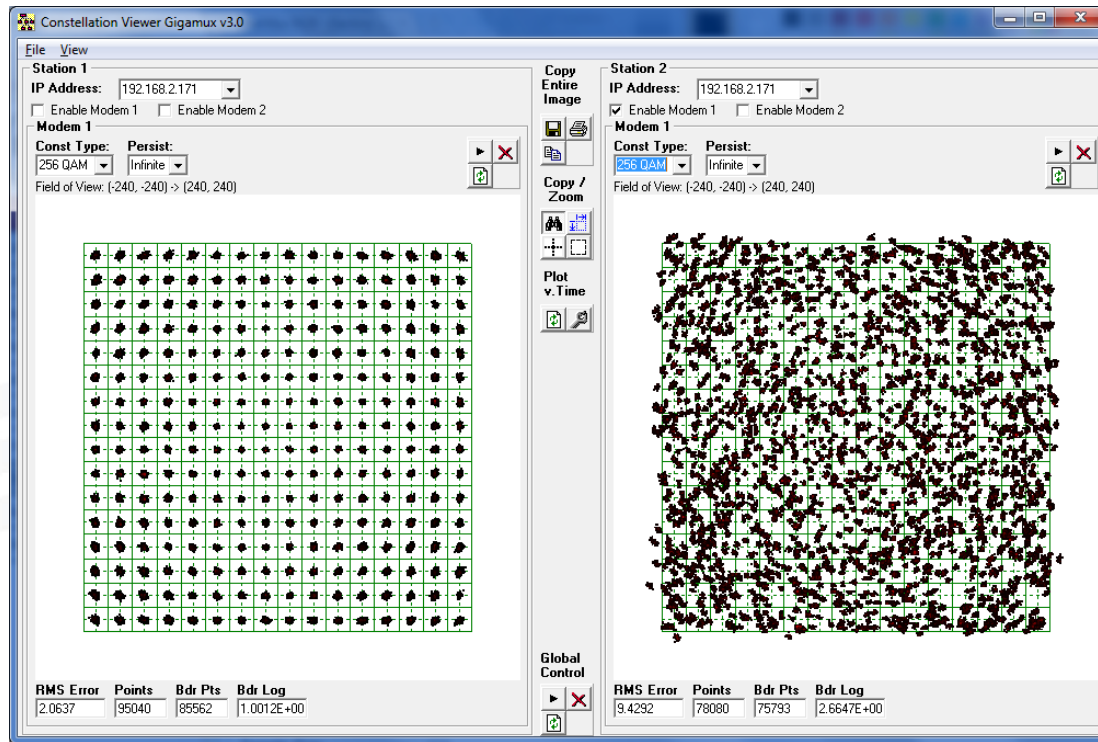


After Equalisation

Pre-Equalisation

# Designing the radio – the challenges

## Equalisation (256 QAM)

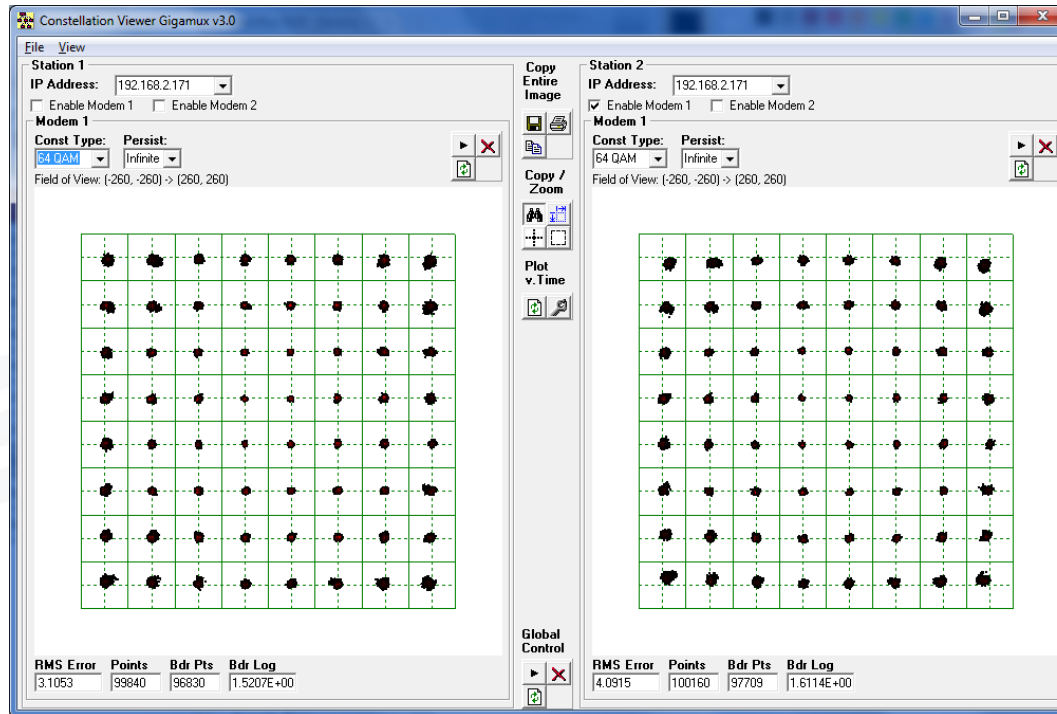


After Equalisation

Pre-Equalisation

# Designing the radio – the challenges

## Linearisation (64 QAM)

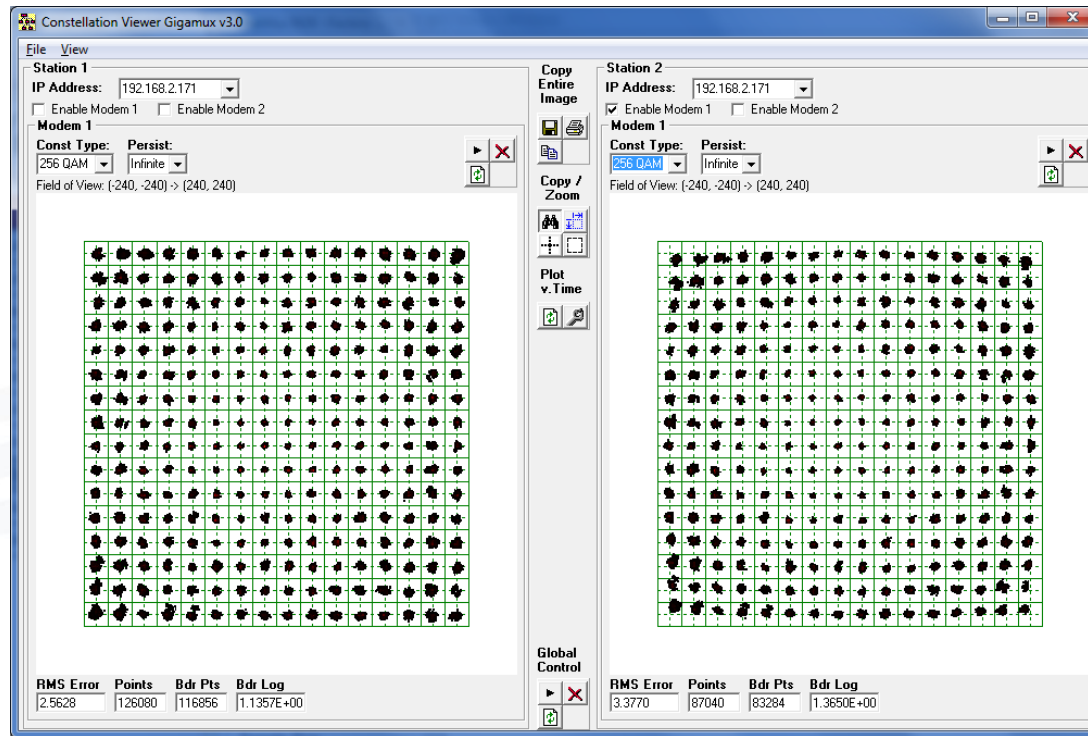


After Linearisation

Pre-Linearisation

# Designing the radio – the challenges

## Linearisation (256 QAM)

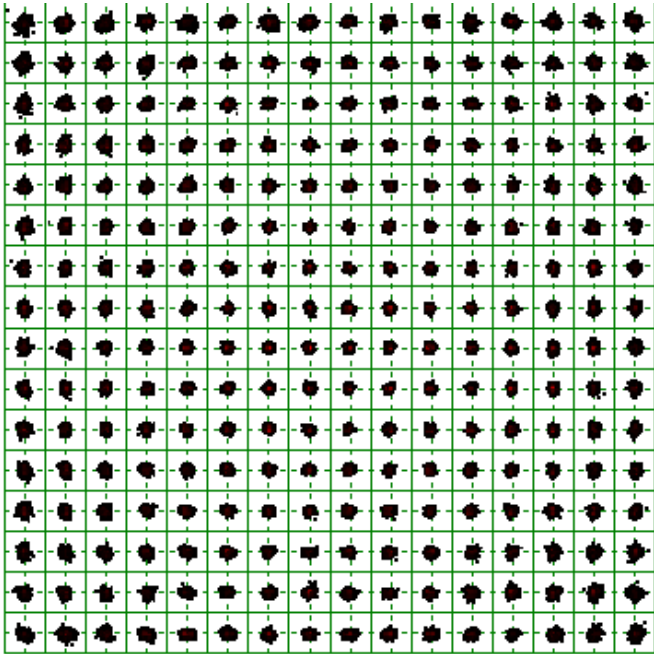


After Linearisation

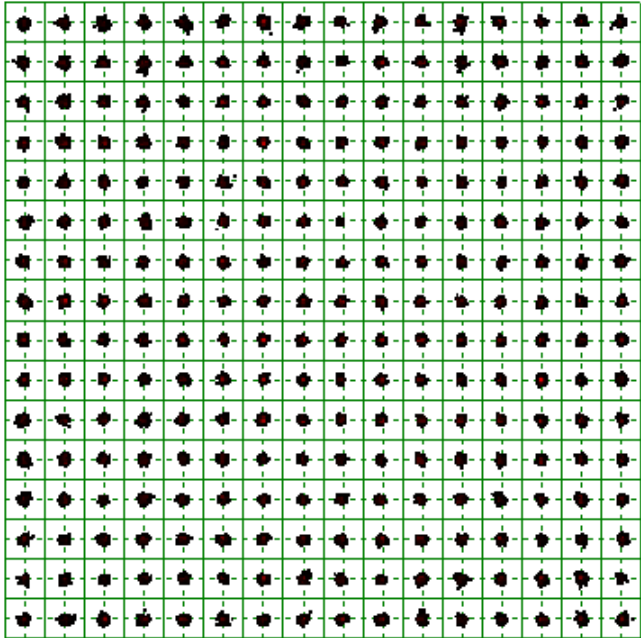
Pre-Linearisation

# Designing the radio – the challenges

## Phase jitter



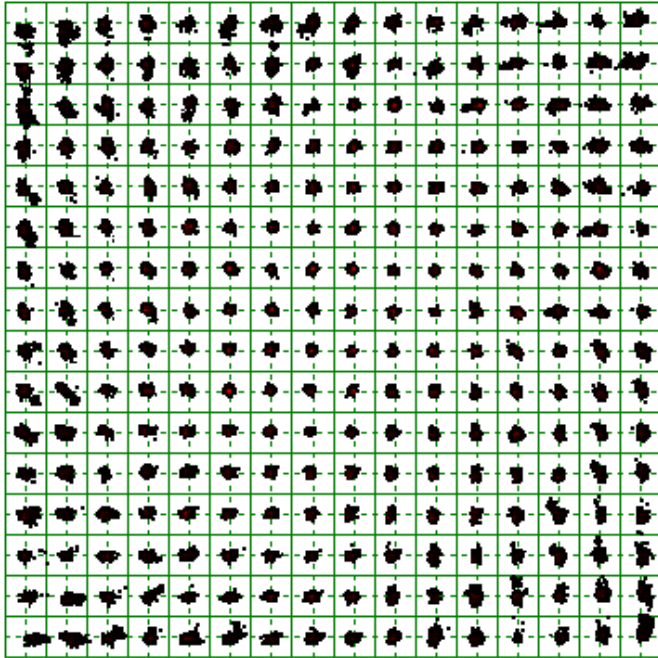
Old VCXO with jitter



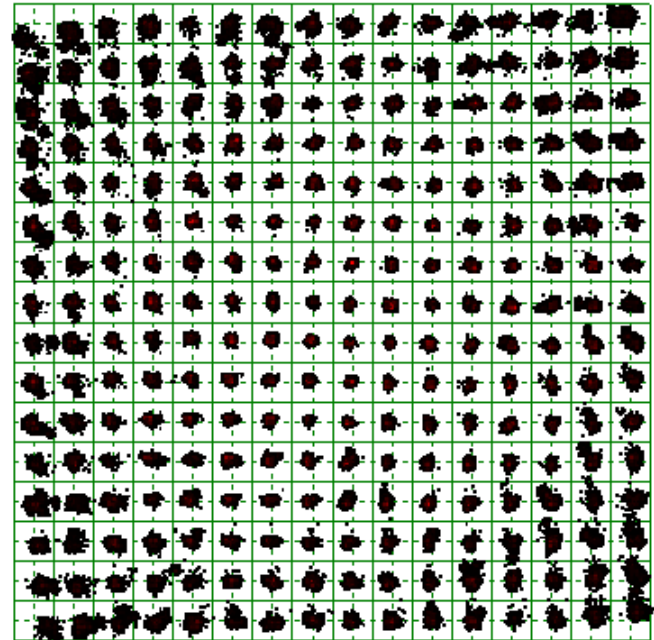
New VCXO with lower jitter

# Designing the radio – the challenges

## Response to overdrive



Overdriven RX causing compression



Overdriven Tx causing compression

# Designing the radio – the challenges





# Typical Operating performance

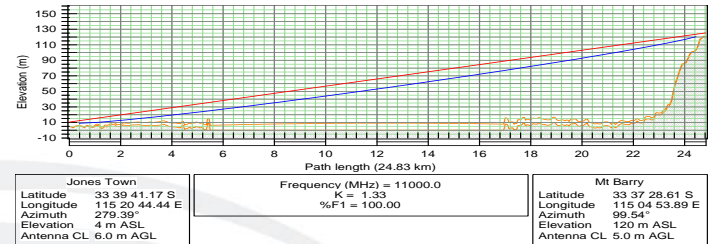


- 1 to 70 km
- $<10^{-13}$  errors/second
- 200,000 hours for ODU and IDU
- Data rates to 620Mbps in 1RU IDU

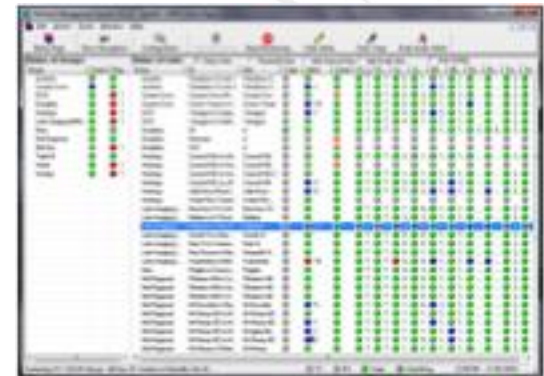


# Sales Support

- Pre-Sales
  - Path and Network Analysis
  - Freq assignment and registration
- Post Sales
  - 24 Month unlimited warranty
  - Installation and Commissioning
  - Fault diagnosis and rectification
  - 24 Hour Monitoring
  - Extended warranty
  - In-Country Repair



Path Profiling



Network Monitoring

# The future

- E1000 – gigabit radio
- First product will use increased spectrum to double two-way capacity to 1000Mbps
- State-of-the-art techniques to further increase spectral efficiency
  - 2.5Gbps throughput
- Release March 2012



# Conclusion

- A sophisticated, state of the art radio product can be designed and supported in Australia
- Deep pockets of expertise – design, manufacture, and network management exist locally
- EM Clarity has integrated a world-class product design and product manufacturing team into a seamless sales and support operation

