



Future Wireless Technologies

MiMOMax Wireless Ltd

&

Radio Spectrum Efficiency

Aug 09

Overview

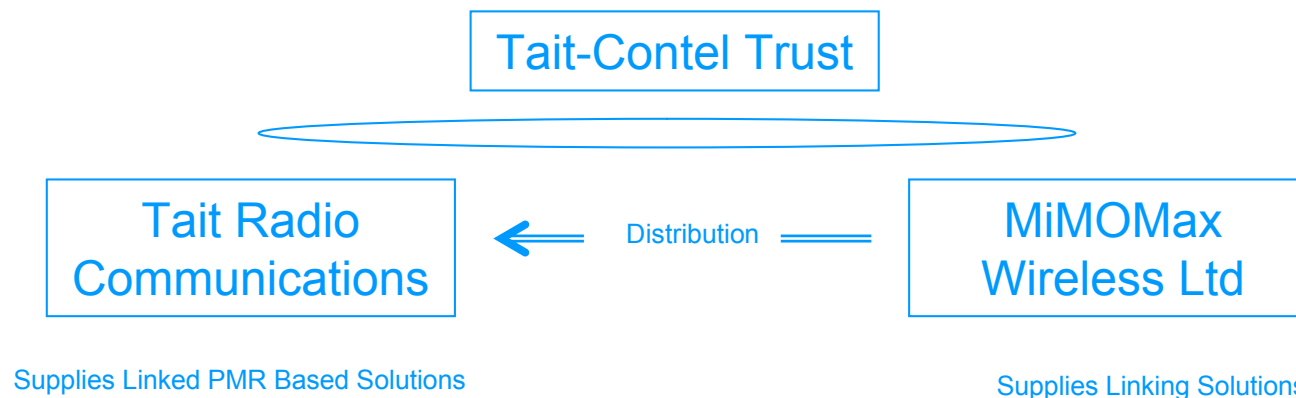
- Who are MiMOMax?
- Spectrum Limitations
- MiMOMax Vision
- What do MiMOMax do?
- MiMOMax's Messages



Who are MiMOMax?

Owned by the Tait-Contel Foundation and born from the
Wireless Research Labs at Tait
Radio Communications

Specialising in the Application of Advanced Wireless
Technologies to Mission-Critical Applications



Problem Space

“Spectrum: The Single most Valuable Resource in the Wireless Business Environment?”

They are “not” Making any More and there is no known way to make any more of it ...at any Cost



Spectrum Costs / Availability

Frequency usage fees within:

- Australia
- Singapore
- Taiwan Mobile
- French Govt

$$\begin{aligned}
 \text{FreqUsageFee} &= K \cdot (S_i, G_i) \cdot B_i \cdot A_i \\
 \text{FreqUsageFee} &= \begin{cases} (BW / 25 \text{ kHz}) \times \$300 & : BW < 1 \text{ MHz} \\ \left[\left((BW - 1 \text{ MHz}) / 1 \text{ MHz} \right) * \$300 \right] + \$12000 & : BW \geq 1 \text{ MHz} \end{cases} \\
 \text{FreqUsageFee} &= \left\{ \left(\frac{BW}{12.5 \text{ kHz}} \right) \times \left(\frac{W}{25 \text{ W}} \right) \times K \right\} \times d \\
 \text{FreqUsageFee} &= \begin{cases} a \cdot BW & : f_0 \leq 960 \text{ MHz} \\ a \cdot BW \cdot 0.96 & : f_0 > 960 \text{ MHz} \end{cases}
 \end{aligned}$$

In each of these licensing regimes, the frequency usage fee is tied to a Bandwidth multiplier.
i.e 2 x BW= 2 x Cost



MiMOMax Vision



*“To provide Spectrally Efficient,
High Performance, Fixed Wireless Solutions, for Mission
Critical Applications”*

Strategic Metaphor:

Spectrally Efficient Solutions



Traditional Radio Pipes

<p>Thin Pipe Low Speed Data & Voice</p>	Analogue Voice	Analogue <i>PMR</i>		300-4800 bps
<p>Medium Pipe High Speed Data & Voice</p>	DSP Based	<i>DSP PMR</i>		9k6-33kbps
<p>Fat Pipe Broadband</p>	Digital/U-Wave	<i>DMR</i>		33kbps 250kbs- > mb/s+

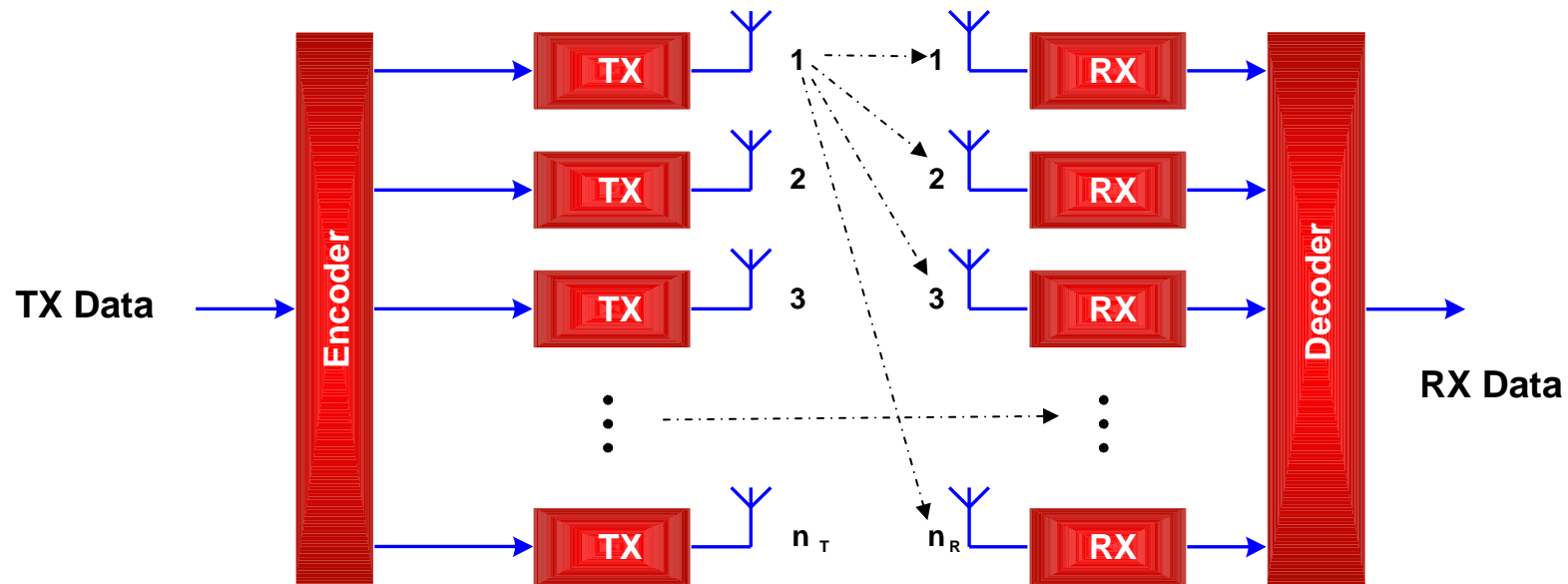


Basics

So how does MiMO Work?



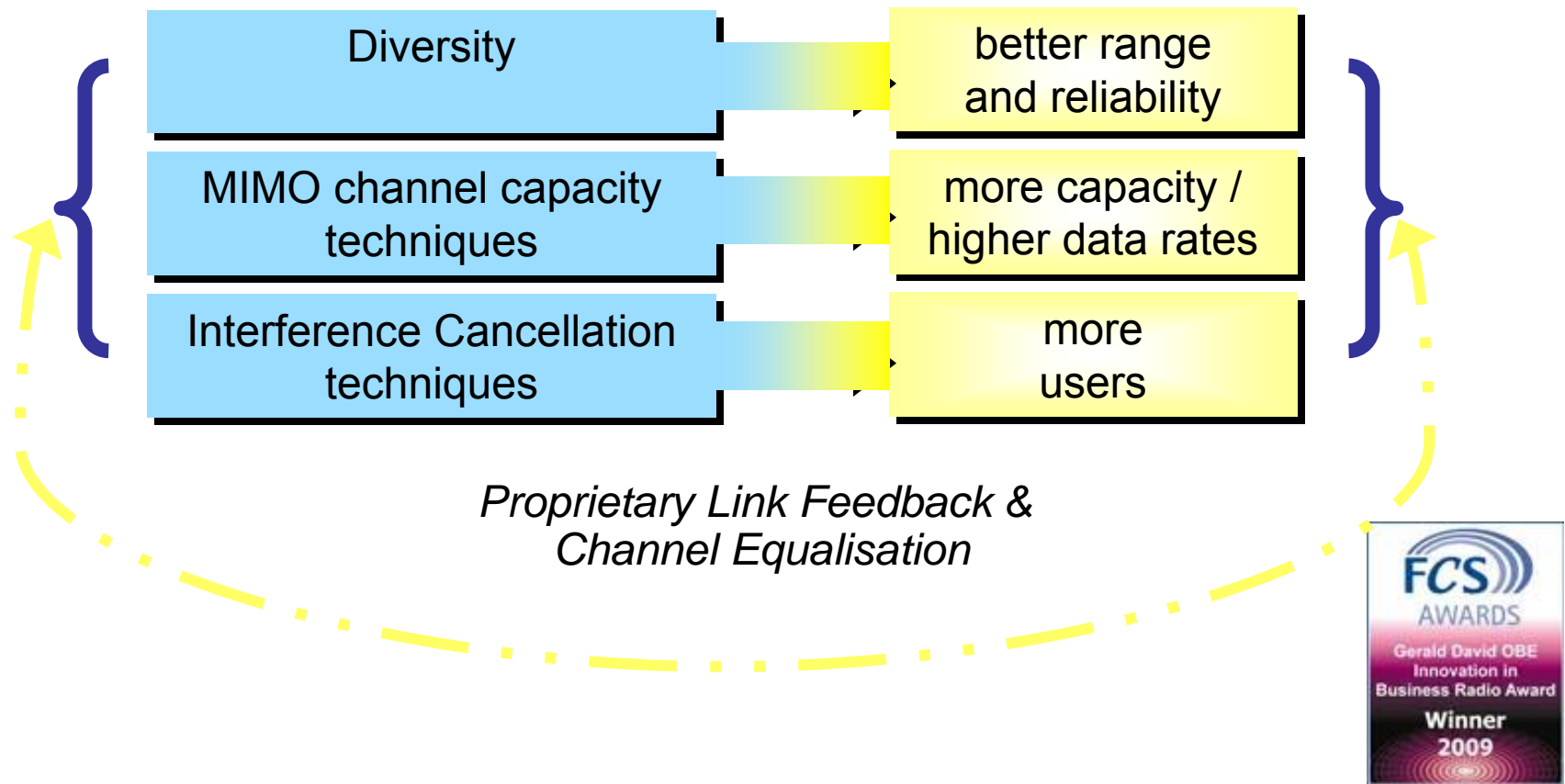
MiMO Concept



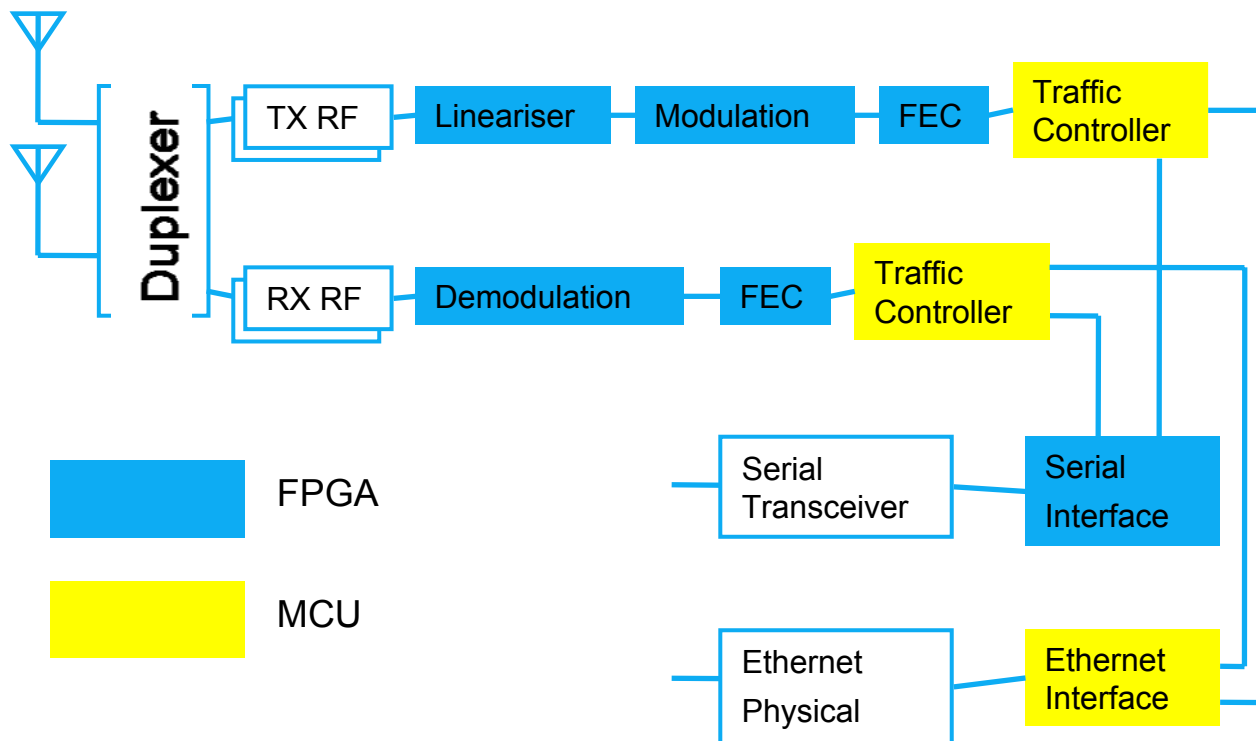
Total number of paths between TX and RX = $n_T \times n_R$.
 Can arrange as n_T channels each with diversity
 $= n_R \cdot n_T \times \text{data rate}$



Space-Time Techniques Employed



Functional Block Diagram



Linear Transmitter

- 256 QAM + $\beta = 0.1$ produces high PMPR ($\sim 10\text{db}$)
- Adjacent channel spec. requires very linear PA
- Use LDMOS amplifier biased in class AB
- IF based double loop digital Cartesian Feedback.
- Tx Pulse shaping filter 20 samples long
- $< -70\text{dBc}$ adjacent channel

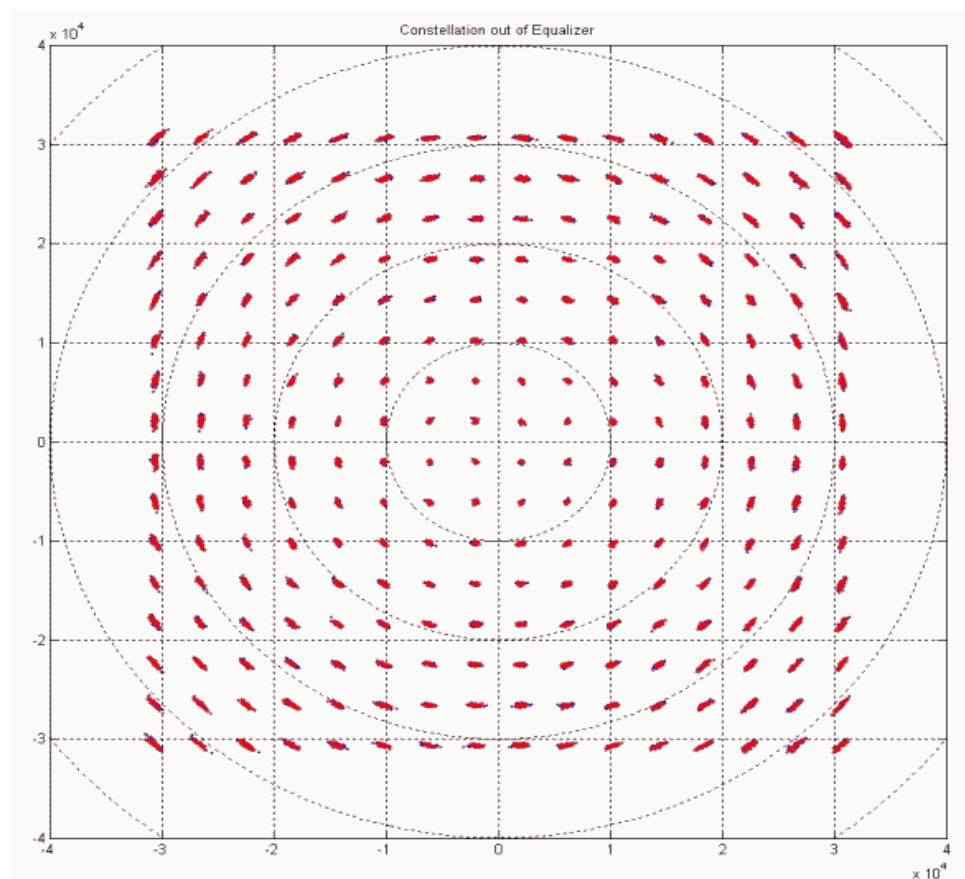


Receiver

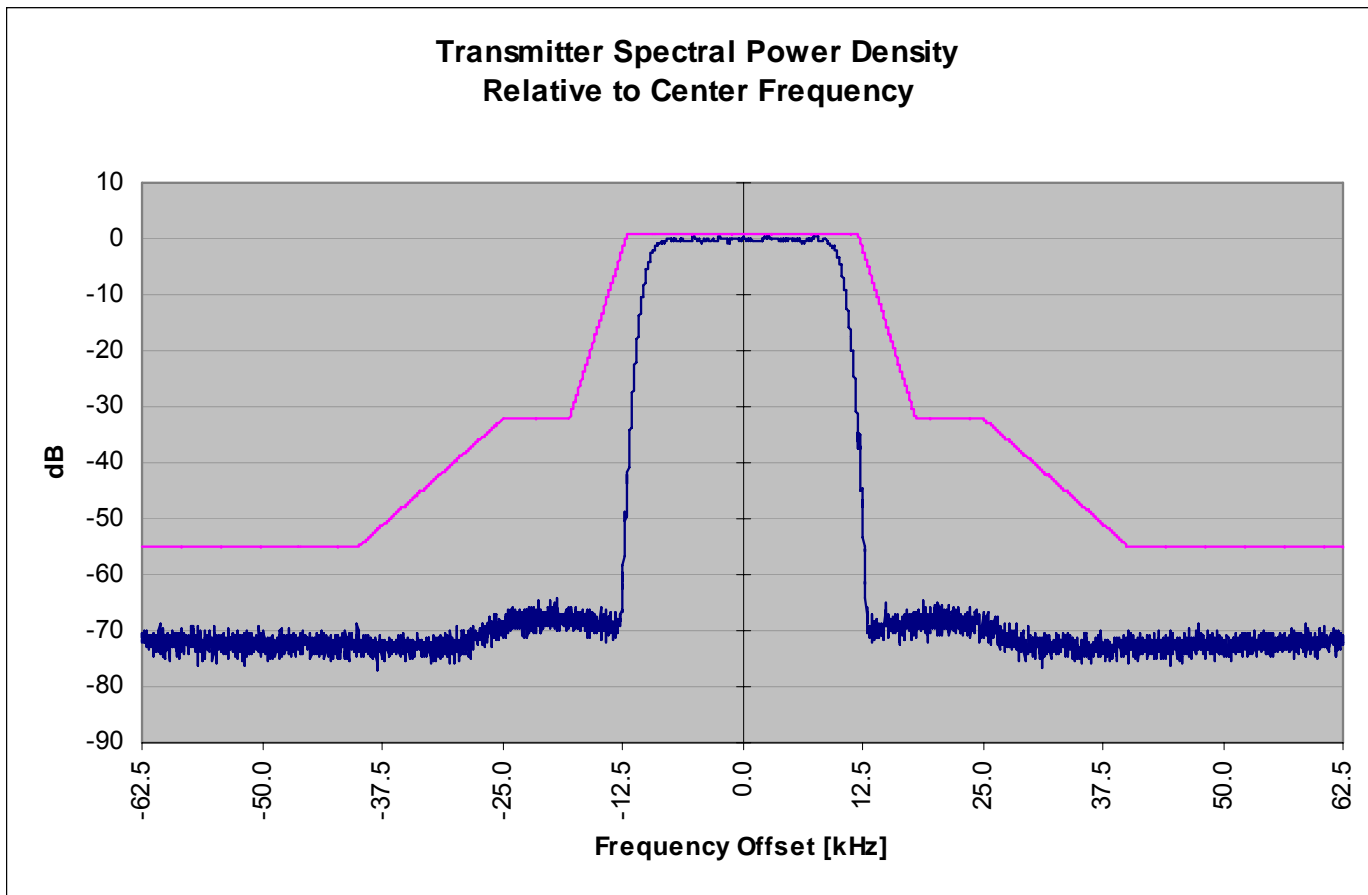
- 2 x single conversion superhet architecture, 45MHz IF, low side injection
- Switchable 20dB pin attenuator at ahead of LNA
- Low phase noise, low microphony LO
- 6 poles of crystal filter followed by digital channel filter
- Wide range DAC controlled AGC for each Rx
- Differential IF signal feed to 10 bit ADC @ 40MHz
- Decimated 500 x to give 4 x oversampled signal
- Decision Feedback Equaliser (DFE)
 - *Unscrambles the MIMO*
 - *Equalises the channel, path, TX & Rx filters*



256 QAM 25kHz



Transmitter Spectrum

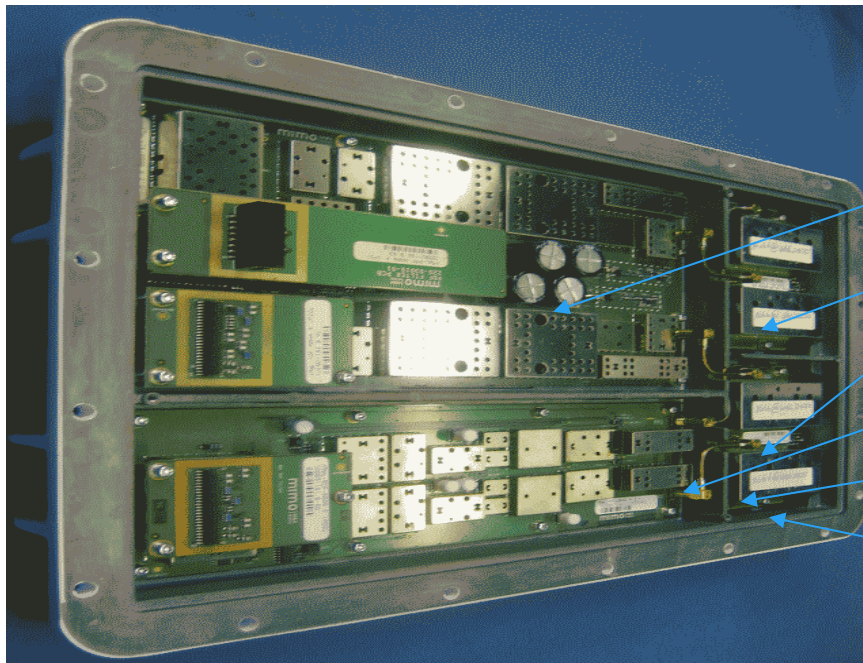


mimo|max
wireless

Series II 19in Rack



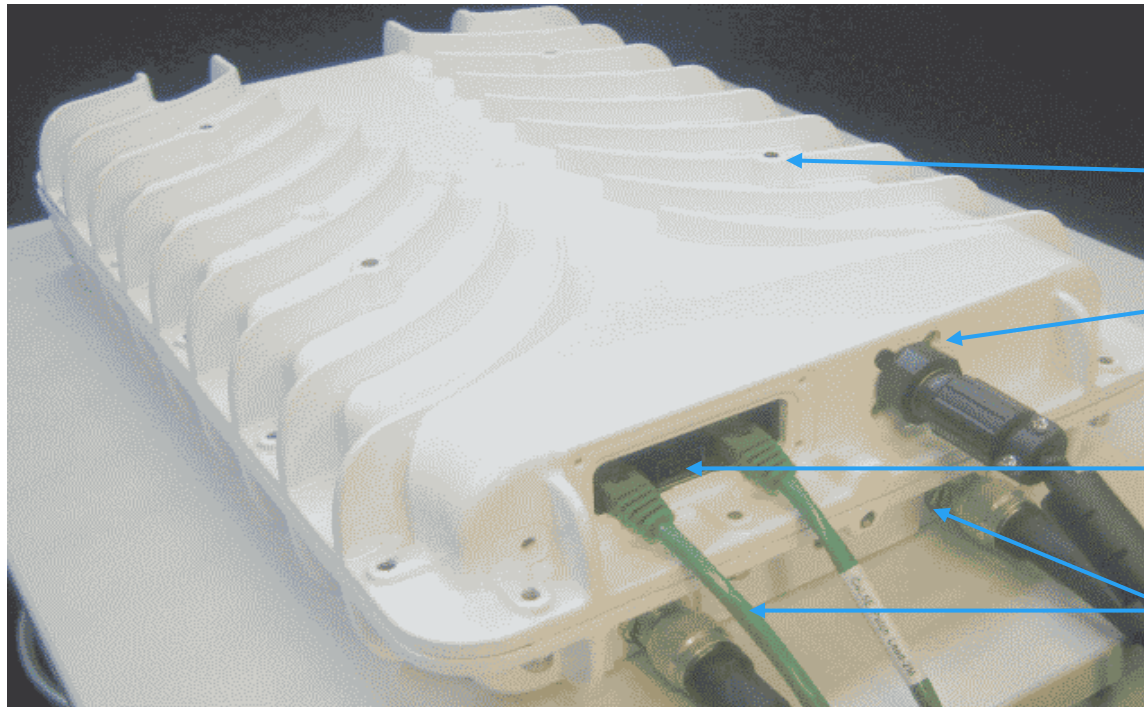
RF / PA/ Duplexer Module



- 2 x Ultra Linear PA's
- Internal Antenna Duplexers
- 2 x Low Noise Receivers
- EMI & Environmental Shielding Channel
- Solid Die Cast Clam Shell Construction



Outdoor Mount



Solar Guard
Mounts

Power
Connector

Ethernet &
H/S Sync
Serial

MiMO
Antennas

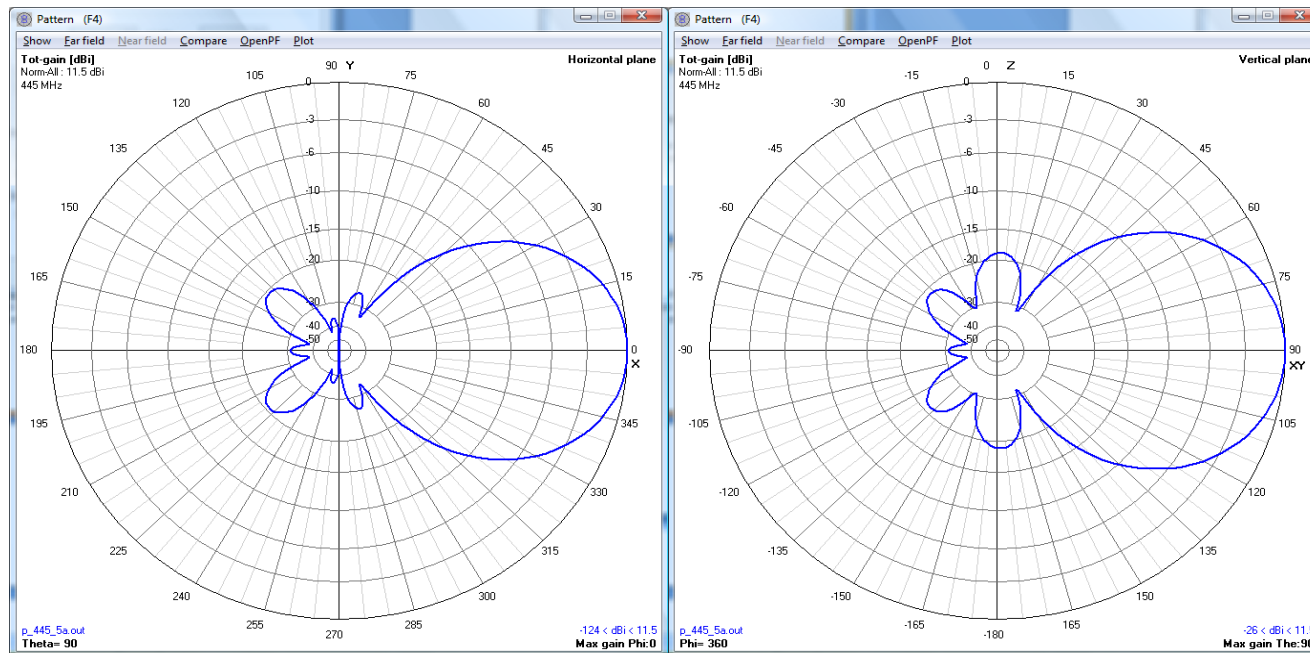


Loop Yagi Antenna

- Dual Polarized (H & V)
- 10 dBi+ Gain
- Compact Wide Beam-width
- Low visual impact



Loop Yagi Antenna



System Performance

- Radio Range (High Site) > 60km
- User data rate (Full Duplex) > 256kbps
- Ultra Low Latency <6mS
- Link Establishment approx 100mS
- Standby Power Consumption < 10W
- Installation *Semi Skilled*
- Link Cost *Competitive*

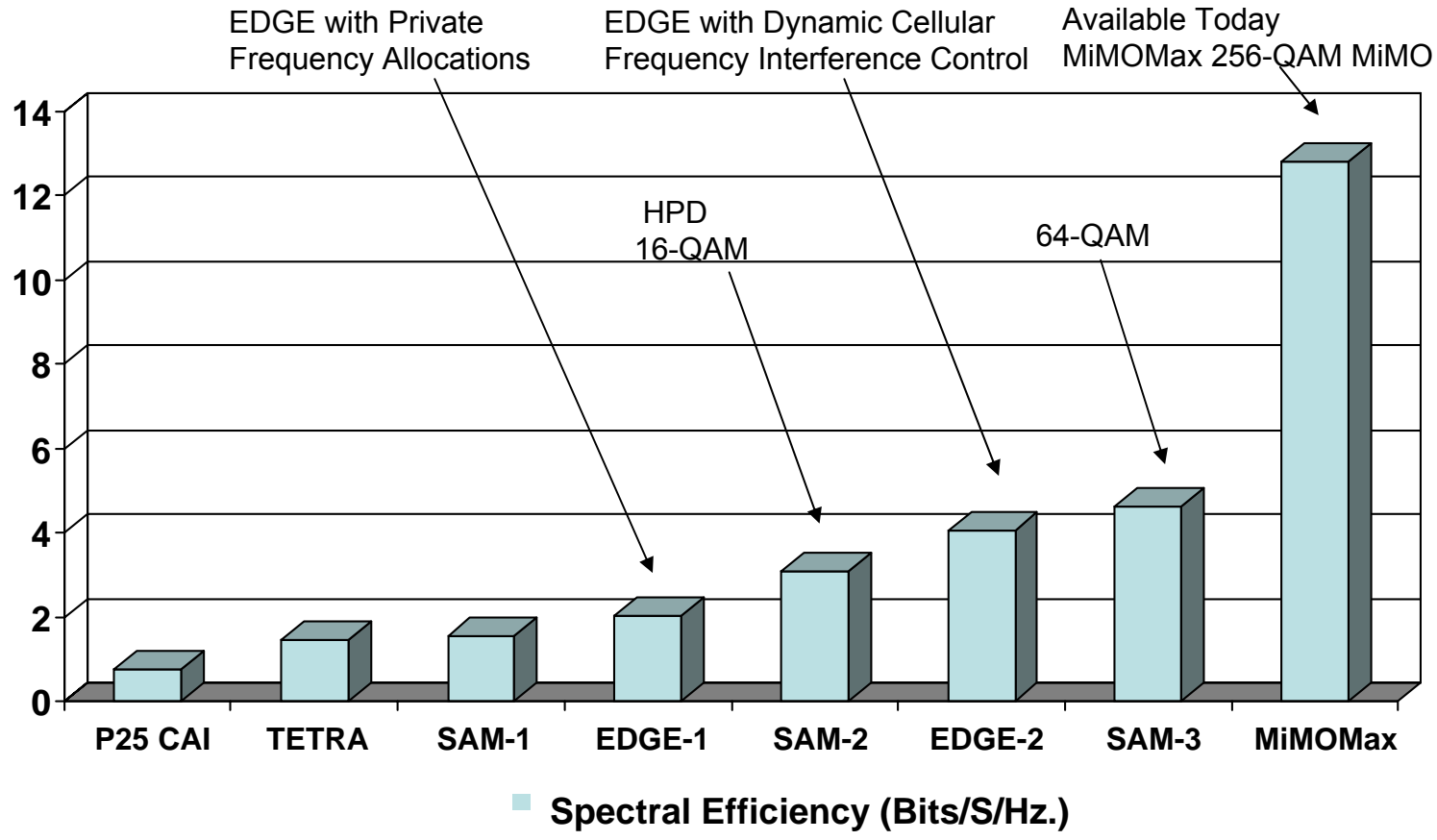


M-CAM - MiMOMax Cognizant Adaptive Modulation

	Modulation	12.5 kHz (Actual)	25 kHz (Actual)	50 kHz (Est)
Raw Data Rates	QPSK	40 kbps	80 kbps	160 kbps
	16- QAM	80 kbps	160 kbps	320 kbps
	64- QAM	120 kbps	240 kbps	480 kbps
Virtual Through Puts Much Higher	256- QAM	160 kbps	320 kbps	640 kbps



MiMOMax Spectral Efficiency Comparisons



MiMOMax Messages

- *Narrowband Channels Very Valuable for Delivering High Performance, Fixed Wireless, Mission Critical Solutions.*
- *Spectral Efficiencies over 5 times Currently Accepted Norms are Available Now! Environmentally Sound !*
- *MiMOMax Technologies have the Potential to Deliver Broadband in Narrow Band Channel*
- *We Push for the Continuation of the Provision for Channelization Plans that Support MiMOMax Advanced wireless Technologies*

