



## Frequency control solutions for WiMAX applications

Access to broadband is growing rapidly all over the globe. Many governments see this access as critical in the advancement of economic growth and development. In many areas of the world, WiMAX is rapidly establishing itself as a key element in delivering ubiquitous broadband access over the 'last mile' for fixed and mobile users. Total WiMAX subscriptions are set to rise dramatically with a CAGR (2007-2012) of over 80%, resulting in excess of 130 million worldwide by 2012\*.

### WiMAX deployment challenges

Widespread deployment of WiMAX will require high levels of performance while demanding low costs in manufacture and installation. In TDD modes, WiMAX specifications demand synchronisation between neighbouring cells within 1 µsec to ensure the system can operate at full capacity. Frequency synchronisation within  $\pm 30 \times 10^{-9}$  (30 ppb) is required for successful hand-over to support mobility. WiMAX and the emerging LTE technologies use the highly efficient OFDMA modulation method to achieve unprecedented throughput per MHz of licensed spectrum. Carrier phase jitter introduces Inter-Carrier Interference (ICI) resulting in excess Error Vector Magnitude (EVM) that degrades range and throughput.

\*Source: WiMAX Forum 2008

Parameter	Test Condition	Max
Frequency Accuracy	Stand-alone mobile (1% sub-carrier spacing)	$\pm 2$ ppm $\pm 30$ ppb
Jitter	$\ll -30$ dB EVM, 64-QAM at 2.5 GHz	0.5 psec
Time alignment	TDD systems	1 µsec

### WiMAX timing solutions

Achieving a sufficiently high density of WiMAX base station deployments relies on the adoption of a variety of connection methods including DSL, cable and other wireless technologies. Time-domain synchronization delivered by these back-haul methods is challenging and typically suffers

from jitter far higher than specified in the WiMAX standard. The base station's local crystal-controlled reference provides both the 'flywheel' that maintains time alignment despite network jitter and the low phase noise that controls EVM maintaining link quality and throughput. Rakon's high quality, low cost TCXO, TC/OCXO hybrid and oven-controlled oscillators complement network-based synchronization methods. Some of these methods are described below.

#### IEEE.1588 Protocol based solutions

- IEEE1588 is the Precision Time Protocol standard that defines a method of passing accurate timestamps of packet arrival and transmission across a network
- IEEE1588 V2 will deliver high performance synchronisation in the telecoms market with further deployment

#### "Enhanced" NTP (Network Time Protocol) solutions

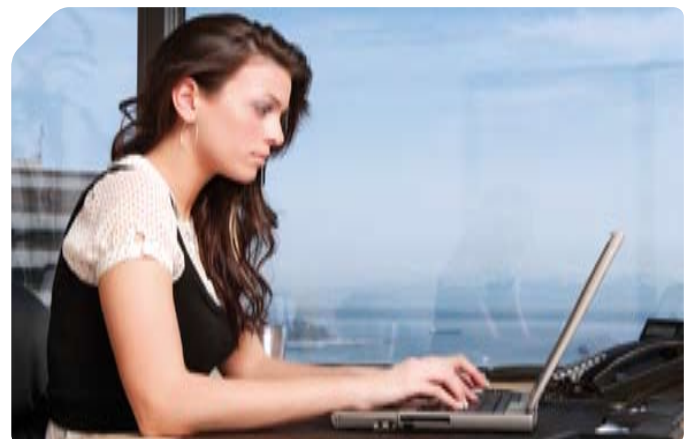
- Relatively coarse time accuracy at low cost and low data rate
- Places greater emphasis on the time and frequency hold-over capability of the local crystal reference

#### Wireless "listen"

- Useful where a synchronised wireless network is available (e.g. "overlay" deployments or where wireless is used for back-haul)
- Monitoring receiver specifications are specific to each deployment

#### GPS based solutions

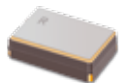
- Ubiquitous source of time and frequency
- Indoor reception requires network aiding and excellent oscillator phase stability



## Rakon oscillators for WiMAX

A WiMAX application's specific oscillator requirements will depend on the particulars of the deployment and the class of service to be offered. If your application requires complete timing autonomy then Rakon's high end OCXOs will satisfy your timing needs. Some of the previously mentioned disciplining solutions (refer to front page) do not deliver the synchronisation accuracy required by the WiMAX standard. Rakon has a range of TCXO or OCXO products that provide the time alignment accuracy required. Contact your local sales office to discuss your requirements. Rakon can offer the best solution for your needs.

### Typical Pluto SMD TCXO specification



5.0 x 3.2 x 1.65 mm

Parameter	Test Condition	Max
Frequency stability with temperature	Over any 24 hours at a fixed supply voltage and load	40°C to 60°C ±80 ppb
		0°C to 70°C ±100 ppb
		-20°C to 70°C ±250 ppb
Phase noise	Typical @ 19.2 MHz	10 Hz -89 dBc/Hz
		100 Hz -111 dBc/Hz
		1 kHz -124 dBc/Hz
		10 kHz -133 dBc/Hz
Frequency stability over time	at 25°C	24 hrs ±20 ppb
		1 month ±200 ppb
		1 year ±1 ppm

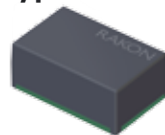
### Typical Manta SMD TCXO



7.0 x 5.0 x 1.88 mm

Parameter	Test Condition	Max
Frequency stability with temperature	Over any 24 hours at a fixed supply voltage and load	0°C to 60°C ±140 ppb
		-20°C to 70°C ±280 ppb
		-40°C to 85°C ±500 ppb
Phase noise	Typical @ 44.8 MHz	10 Hz -92 dBc/Hz
		100 Hz -119 dBc/Hz
		1 kHz -139 dBc/Hz
		10 kHz -148 dBc/Hz
Frequency stability over time	at 25°C	1 year ±1 ppm

### Typical Triton SMD OCXO specification



14.6 x 9.7 x 6.2 mm

Parameter	Test Condition	Max
Frequency stability with temperature	Fixed supply voltage and load	-0°C to 70°C ±35 ppb
		-20°C to 70°C ±50 ppb
Phase noise	Typical @ 19.2 MHz	10 Hz -89 dBc/Hz
		100 Hz -109 dBc/Hz
		1 kHz -129 dBc/Hz
		10 kHz -134 dBc/Hz
Frequency stability over time	at 25°C	24 hrs ±20 ppb
		5 days ±60 ppb
		1 year ±1 ppm

### Typical CFPO6 OCXO *Two package options available*



20.7 x 20.7 x 13.0 mm

25.4 x 25.4 x 17.7 mm

Parameter	Test Condition	Max
Frequency stability with temperature	Fixed supply voltage and load	-20°C to 70°C ±5 ppb
Phase noise	Typical @ 10 MHz	10 Hz -127 dBc/Hz
		100 Hz -140 dBc/Hz
		1 kHz -148 dBc/Hz
		10 kHz -152 dBc/Hz
Frequency stability over time	at 25°C	24 hrs ±0.5 ppb
		1 year ±50 ppb

### Why Rakon for WiMAX?

- Rakon has a range of high quality low cost oscillators to provide the 'flywheel' needed to smooth out the jitter from a disciplining technology
- Rakon has a range of oven oscillators for WiMAX applications requiring timing autonomy

- Rakon has a pedigree in developing and supplying ultra-stable oscillator products
- Rakon has an unrivalled wealth of experience in oscillator ASIC design and in the design and manufacture of crystals
- Rakon has a proven track record in meeting the price points and high volume capacity requirements of the rapidly growing consumer GPS market

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