Technical Overview

Employed Multi-path and Delay-Spread Mitigation Techniques

MicroMAX-SDR utilizes the cyclic prefix duration included in 802.16 to cater for delay spread and effects of multi-path. Guard ratios of between ¼ and 1/32 are programmable resulting in peak delay spread immunity between 2us and 16us respectively for a 3.5MHz channel bandwidth.

802.16e standard will introduce the OFDMA access method. This allows the system to restrict certain tones within the OFDM waveform to any individual subscriber unit. By avoiding null traffic channels due to deep fading and/or narrowband interference, the system provides optimum performance in a multi-path environment. OFDMA enjoys the finest granularity and better uplink power efficiency than traditional OFDM/TDMA systems. Radio resource allocation is implemented at the base station and users are notified of the channel assignment through a multiple access protocol. MicroMAX-SDR is upgradeable to 802.16e via a software upgrade.

Benefits of using Orthogonal Frequency Division Multiple Access

- In the uplink each subscriber is assigned 1 to 59 sub-channels. when assigned sub-channels, a subscriber concentrates its power on these sub-channels.
- It solves the Multipath problem and reduces Multipath Interference
- It has high Spectral efficiency
- It supports smart antenna technology: Smart antennas provide greater capacity and performance benefits than standard antennas because they can be used to customize and fine-tune antenna coverage patterns that match the traffic conditions in a wireless network or that are better suited for complex radio frequency (RF) environments. Furthermore, smart antennas provide maximum flexibility by enabling wireless network operators to change antenna patterns to adjust to the changing traffic or RF conditions in the network.
  - RX/TX antenna diversity
  - Space Time Coding (STC)
- It is an efficient modulation
  - QPSK, QAM16, QAM64 per sub carrier
  - FEC rates ranging from 1/2 to 3/4
  - Guard intervals of 1/32, 1/16, 1/8 and 1/4
- Supports adaptive modulation on a per subchannel basis
- The efficient use of pilots minimizes requirement for preambles for channel estimation
- External, narrow band interference is rejected through frequency domain processing
- External, burst interference is rejected by virtue of the OFDMA symbol length and the per sub-channel interleaving
- Inter-cell interference is mitigated by use different sub-carriers in sub-channels

Spectral Efficiency

The network spectral efficiencies for MicroMAX-SDR, MicroMAX-SDR and HiperMAX assuming 3.5MHz FDD channels are as follows:

Mod/FEC	Gross Throughput (Mb/s)		Occupied Bandwidth (Mhz)	Spectral Efficiency (b/s/Hz) per RF Channel
	Downlink	Uplink		
64QAM3/4	13.1	13.1	3.5	3.7
64QAM1/2	11.5	11.6	3.5	3.3
16QAM3/4	8.7	8.7	3.5	2.5
16QAM1/2	5.8	5.8	3.5	1.7
QPSK3/4	4.4	4.4	3.5	1.3
QPSK1/2	2.9	2.9	3.5	0.8
BPSK1/2	1.4	1.4	3.5	0.4

Note: Figures above are based on Gross throughput. Maximum achievable net throughput is in the region of 85% of gross downlink throughput and 75% of gross uplink throughput which is required to accommodate overhead including Pre-amble, DL&UL Maps, DLFP and Mid-ambles.

Adaptive Modulation

Adaptive modulation techniques, for maximizing system throughput by monitoring link quality and selecting the highest usable adaptive burst profile, are used throughout the MicroMAX-SDR product range. Within each burst, data transmitted over the air is padded with redundant information to make it more resistant to errors introduced by interference. The coding rate is the ratio of user-data to the total data transmitted (which includes redundant error correction data. Protocol features allow for adaptive modulation to be employed in both downlink and uplink. Modulations ranging BPSK 1/2 to 64QAM 3/4 may be employed.

Burst Profiling

All MicroMAX-SDR Base stations, operating using FDD or TDD in the downlink and uplink support burst profiles which are adaptive on a per terminal basis. Burst profiles are used to define modulation and FEC levels using the DCD and UCD messaging schemes and are invoked through downlink and uplink MAP messaging. RF link control functions within the Base station and the ST continuously monitor receiver SNR and adapt modulation accordingly.

STC

Space Time Coding is a method of transmit diversity using two antennas, is used within the MicroMAX-SDR product. This mode may be used to improve link robustness.

MRC

Maximal-ratio combining is a form of diversity combiner in which (a) the signals from each channel are added together, (b) the gain of each channel is adjusted to ensure each channel is proportional to the rms signal level in each channel and inversely proportional to the mean square noise level in that channel, and (c) the same proportionality constant is used for all channels.

Software Defined Radio using picoChip

MicroMAX-SDR Base stations are fully upgradeable and future-proof due to the use of picoChip technology. PicoChip provides high performance processing arrays which have been optimized for use within the wireless industry. This enables the complete radio and digital signal processing functions to be soft-defined within devices which have replaced the need to incorporate inflexible FPGA and ASIC silicon. PicoChip devices are fully reprogrammable to allow the 802.16 PHY to be completely upgraded, through the use of a simple software download, as the WiMAX standard evolves. Using picoChip, the ASMAX MicroMAX-SDR Base stations will always remain compliant with this emerging standard.

Key benefits of using picoChip within the MicroMAX-SDR Base stations:

- Software defined: Fully Scalable & Future Proof
- Full support for 802.16-2004 (256 OFDM PHY)
- Upgradeable to 802.16e to support hand held devices
- Support for 1X scalable PHY & OFDMA
- FDD or TDD; 3.5MHz / 7MHz / 10MHz
- Software defined RF (industry standard OBSAI RP3-01 interface)
- Advanced feature options: Smart antennas & diversity, SDMA