Outline of an OFDM Based PHY Proposal for 802.16.3

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Purpose:
Outline of an OFDM based PHY proposal, using TDD and adaptive multibeam base station.

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Frequency Band Requirement
Spectral Efficiency Requirement

Requirements:
- 1.5 Mbps/user
- 500 HH/mi² & 10% penetration
- 5 MHz
- 2% activity factor
- based on portable business users
- expected to be higher for home users

Cell Radius (miles)
Spectral Efficiency (bps/cell/Hz)

WCS (5 MHz)
WCS (10 MHz)
MMDS (24 MHz)
3.5 GHz (14 MHz)
Spectral Efficiency Comparison

- Radix Single Cell: 16 bps/cell/Hz
- Radix Multicell: 10 bps/cell/Hz
- VOFDM Single Cell: < 4 bps/cell/Hz
- VOFDM Multicell: < 1 bps/cell/Hz
Summary of the Proposed PHY

- **OFDM for non-LOS propagation and multipath mitigation**
  - large FFT size for better performance
    - better equalization in Rayleigh environment
    - generous delay spread compensation
    - better performance with adaptive antenna
  - adaptive modulation
    - QPSK, 8PSK, 16 & 32 QAM
  - concatenated codes
    - Reed-Solomon or turbo codes
    - convolutional codes as part of TCM
  - flexible channelization and frame structure
    - optimized for adaptive antenna processing
    - reduced synchronization overhead
Summary of the Proposed PHY (cont.)

• Adaptive multibeam
  – simultaneously steers a beam toward a desired CPE and nulls toward interferers ==> orders of magnitude increase in SNR and SINR
  – full frequency reuse between cells (n = 1)
  – many times frequency reuse within a cell (SDMA)

• TDD as the duplexing method
  – provides path reciprocity
  – reduces cost of subscriber stations

• Hybrid contention + reservation multiple access
  – TDMA/FDMA in both directions
  – contention is best for bursty traffic
    • SDMA reduces contention and improves throughput
  – bandwidth reservation for priority flows
Adaptive Multibeam vs Sectorized Antenna

- beam patterns are not fixed
- dynamically creates a beam toward a CPE for a session
  - beam width not constrained by the need to cover a cell
- simultaneously steer nulls toward interferers
Cost and Complexity

• Adaptive multibeam
  – builds on digital processing architecture of OFDM
  – using industry standard processor modules
  – innovative algorithms implemented in DSP software
  – proven technology successfully deployed in both military and commercial applications

• Increased cell radius and improved coverage
  – fewer base stations required
  – decoupled range and capacity allows flexible deployment
    • beam width not constrained by cell coverage
    • provides required range with smaller base stations
    • scale up capacity by adding processing modules

• Does not increases the cost of subscriber stations
Coverage Comparison - Area
Coverage Comparison - Range

Radix

VOFDM

WCS band
100 ft. BS antenna ht.
30 ft. SS antenna ht.
Implications for MAC Protocol

• adaptively formed beams are point-to-point
  – no broadcast mechanism
  – continuous TDM is not appropriate
  – FDMA/TDMA is more suitable

• contention based approach is very efficient
  – spatial division reduces contention
  – best for bursty traffic

• bandwidth reservation for priority flows
Thank You