802.16 Physical Layer

SYLLABUS

802.16 History

- What is 802.16?
- IEEE 802.16 task groups
- IEEE 802.16-2001, .16a and .16c overview
- IEEE 802.16-2004 overview
- Further 802.16 task groups
- What is WiMAX?
- Wireless HUMAN
- WirelessMAN-SC and SCa PHYs
- WirelessMAN-OFDM PHY

802.16-2004

- OFDMA symbol construction
- Subchannels and OFDMA slots
- Data regions and segments
- Permutation zones and modes
- PUSC and FUSC subcarrier permutations
- Adjacent subcarrier permutation
- OFDMA frame structure
- PUSC segmentation
- Frame Control Header
- Downlink and uplink map information

Introduction to OFDM

- Frequency selective fading challenges
- What's orthogonal about OFDM?
- The IDFT
- The cyclic prefix
- Windowing and oversampling
- OFDM Peak to Average Power Ratio
- Scrambling for PAPR reduction
- PAPR reduction error correction coding

802.16e

- The 802.16e standard
- Mobile WiMAX
- 802.16e PHY changes
- Compressed and reduced map messages
- Updated adaptive antenna system
- Revised space-time coding and handover
- MIMO midambles
- Pilot subcarriers for multiple antennas
- Data randomisation
- Symbol repetition
- Hybrid ARQ
- Low Density Parity Check (LDPC) code
- Improvements to power control

MIMO

- MIMO features
- Spectral efficiency and capacity
- Single-user versus multi-user
- The Alamouti scheme
- Delay diversity
- Narrowband versus wideband
- MIMO-OFDM

Synchronisation

- Carrier recovery
- Squaring & Costas loops
- PLLs
- Phase rotation
- Sampling rate conversion
- Symbol timing recovery
- Early/late gate detection
- Multirate and polyphase filters
- Delay locked loop timing and synchronisation
- Numerically controlled oscillators

OFDM Synchronisation

- Complex representation of OFDM symbols
- OFDM receiver structure
- Sensitivity to timing offsets
- Sensitivity to frequency impairments
- Sensitivity to frequency offsets
- OFDM symbol synchronisation
- Frequency synchronisation
- Phase / Amplitude recovery
- Channel estimation
- Pilot tracking
- Synchronisation for 802.16

OFDMA

- OFDMA advantages
- Full versus partial spectrum utilisation
- OFDMA versus MC-CDMA
- Frequency hopped OFDMA

802.20

- IEEE 802.20 PAR
- 802.20 modes of operation
- Comments from 802.16 group on 802.20
- 802.20 versus 802.16e
- 802.20 versus 3G
- 802.20 technology overview