PHY Proposal for IEEE 802.16.3

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Venue: Tampa, Florida
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Purpose: To be considered by 802.16.3 Task Group as the 2-11GHz Licensed bands' FWA PHY Solution

IEEE 802.16.3   PHY proposal

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Key features of PHY proposal

- Single carrier modulation (QPSK/QAM)

- TDD duplexing

- Hybrid ARQ and variable-rate FEC coding

- Directional antennas + equalizer combat multipath

Single carrier Modulation

- Takes advantage of proven technology

- Re-use technology from 802.16.1 PHY

- Robust to frequency offsets

- Multiple QAM modulation levels –
  more flexible than TFM

Time-division-duplex (TDD)

1) Efficient statistical multiplexing of bursty sources

Asymmetric upstream/ downstream capacity

Dynamically-variable capacity allocation per-burst

A single sector can serve a mix of users with different upstream/ downstream capacities
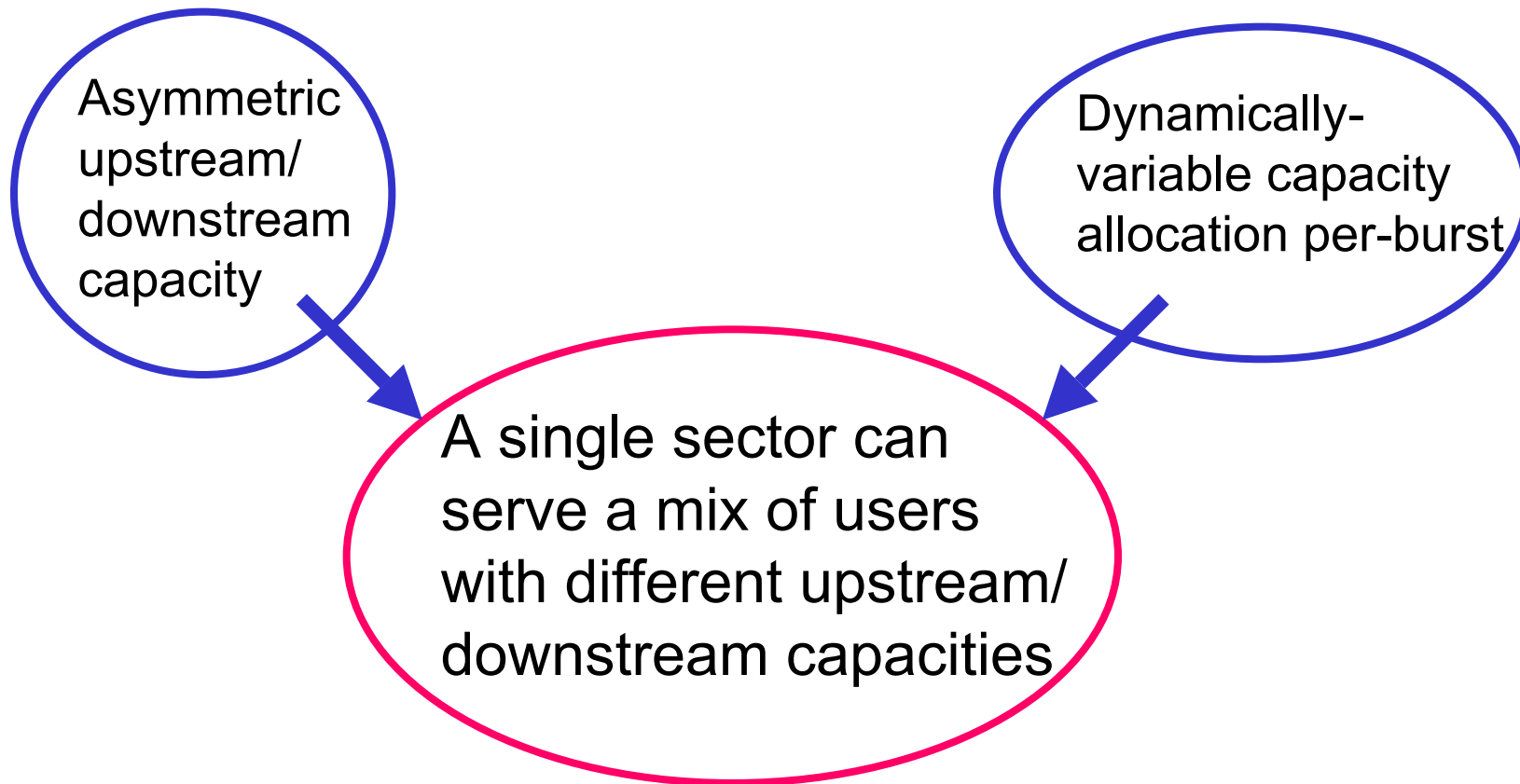
2) Reduced transceiver cost (no diplexor)
3) Reciprocal channels allow efficient antenna diversity & precoding

Hybrid ARQ and variable-rate FEC

- ARQ is very efficient for high SNR channels

- FEC needed for bad channels

- Combination of ARQ and FEC is best

- Variable-rate FEC allows some users
  to have heavier coding

Anti-multipath techniques

- Directional antennas limit multipath: symbol time T_s = 80ns
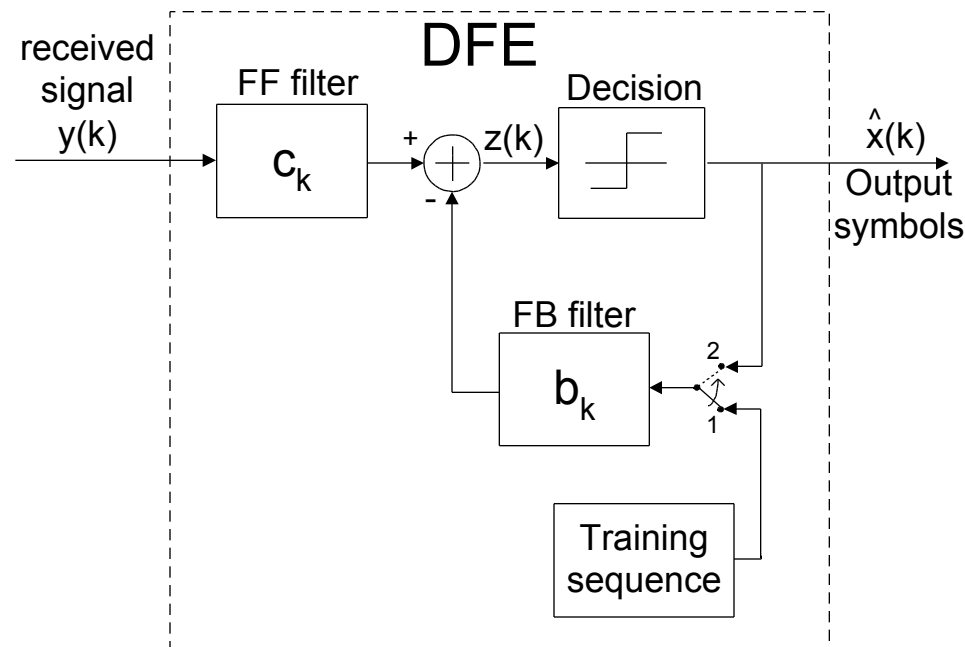 gives channel lengths from 10 - 30 symbols maximum (2.4µs)

2) Equalizer (DFE) removes ISI from signal

Example data rates

Gross and effective data rates assuming a MAC efficiency of 80% (typical figure for ARQ only)

Modulation scheme	Gross bit rate (Mbps)			Effective data rate (Mbps)		
	2.4GHz	3.5GHz	5GHz	2.4GHz	3.5GHz	5GHz
QPSK	8.3	4.2	25	6.6	3.3	20
16-QAM	16.7	8.3	50	13.4	6.7	40
64-QAM	25	12.5	75	20	10	60

Summary on Criteria

- **System Requirements:**
  The proposed PHY meets FRD Requirements
- **Channel Spectrum Efficiency:**
  Spectrum efficiency theoretically 2-6bps/Hz, and 1.6-5.4 bps/Hz with OHs
3. **Simplicity of Implementation:**
  PHY draws on 802.16.1 and uses Single-Carrier which is a proven technology
4. **Spectrum Resource Flexibility:**
  Proposal can be scaled to any channel spacing. TDD allows dynamic upstream/downstream capacity allocation
- **System Service Flexibility:**
  System can support a wide range of services
- **Protocol Interfacing Complexity:**
  PHY-MAC Interface is similar to 802.16.1; PHY delay <10 microseconds
- **Reference System Gain:**
  TBD for a Reference scenario
- **Robustness to Interference:**
  Directive antennas and Dynamic Frequency Selection can be used to minimize interference
- **Robustness to Channel Impairments**
  Equalizer able to cope with echoes spread over 10-30 symbols. Directional antennas limit delay spread.
- **Robustness to Radio:**
  PAPR much lower than OFDM, therefore less sensitive to amplifier non-linearity
- **Support for Advanced Antennas:**
  TDD system with reciprocal channels allows efficient antenna diversity and precoding techniques