Downlink Control Channel Design Considerations for IEEE 802.16m

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RE:
TGm Call for comments on SDD, IEEE 802.16m-07/047, in the area of “Multiple access and multi antenna techniques”

Purpose:
To review and adopt

DL Control Channel Design Considerations

- DL control channel functions
  - **Delivers important PHY and MAC control information**
  - **Requires more reliable transmission than data traffic, and should not rely on re-transmissions (HARQ)**

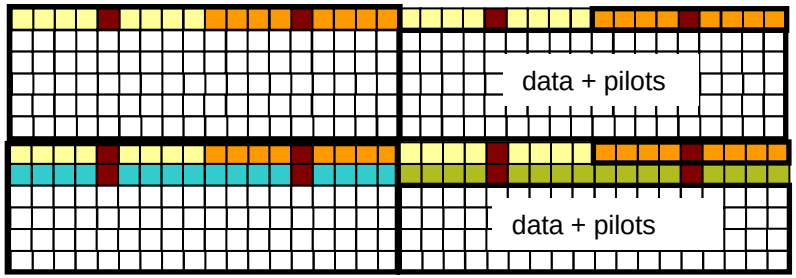
- DL control channel design should focus on
  - **Overhead**
  - **Performance**
  - **Complexity**
  - **Flexibility**
  - **Scalability**

DL Control Channel Design Options: Common / Dedicated

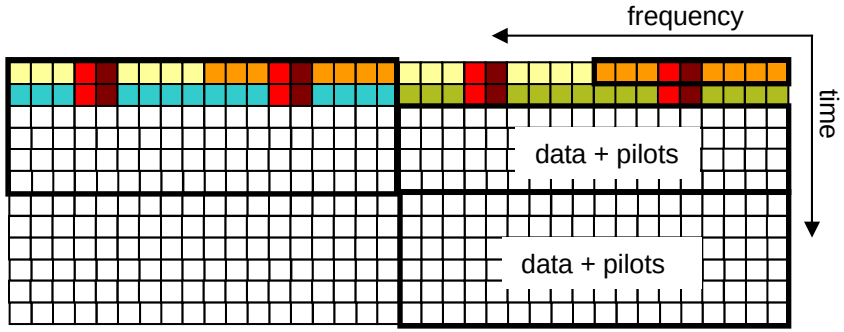
- Broadcast common control channel
  - Jointly coded
  - Broadcast control channel requires robust coding/modulation
    - Limited by worst user
    - Large overhead
  - Current 802.16e DL control channels
    - DCD/UCD, DL/UL MAP, FCH, Preamble
    - DL cell radius is limited by the DL control channel
  - 802.16m design should minimize control channel overhead
    - Hyper frame, Super frame, frame, sub-frame structure - broadcast information

- Per user dedicated control channel
  - Separately coded
  - Control Mini Tiles (CMT) distributed over the whole bandwidth for frequency diversity
  - Per user power control
  - Per user control channel enables beamforming for control channel
    - Increase in overall coverage and capacity
    - Reduced control channel overhead

DL Control Channel : Example



Ex: 1 or 2 baud control for 1 subframe, supporting 1 virtual antenna



Ex: 2 baud control for 2 subframes, supporting 2 virtual antennas

Pilot for virtual antenna-1

Pilot for virtual antenna-2

- TDM control and data regions
  - Control Mini-Tiles (CMT) as building block for control channel
    - **Distributed or localized in frequency (e.g. 9 subcarriers x 1 symbol)**
    - **Concatenated to reduce coding rate to improve cell coverage**
    - **Support user-specific beamforming, MCS, power control**
    - **Enable blind decoding of control information by the MS with limited complexity**
    - **Support multiple virtual antennas (to enable SFBC, beamforming)**
  - Flexible # of OFDM symbols for control varied based on system load, MS location etc.
    - **Lower overhead compared to fixed size control**
    - **Use Rate Matching for flexible data allocation**
    - **Indicated in every superframe or hyper frame**
  - Enable Microsleep to save MS power
    - **After reading control information on the DL, turning off RF functions until the next control channel**
    - **TDM control channel enables micro sleep**
    - **Enhanced micro sleep with subframe grouping [Motorola, C80216m-08_008.pdf]**
  - Subframe grouping [Motorola, **C80216m-08_008.pdf**]
    - **Reduced control overhead**
    - **Enhanced micro sleep**

Summary

- **Robust broadcast common control channel**
  - Reduced common control overhead
- **Per-user dedicated control channel**
  - TDM control region and data region
  - Enables micro-sleep, power control, beamforming, SFBC
  - Support distributed or located mini-tiles
  - Flexible control symbols and supports multiple code-rates
  - Enables blind decoding of control information by the MS
- **Control channel supports proposed backward compatible frame structure of 802.16m**

Proposed Text to 16m SDD (IEEE C802.16m-07/320r1)

- ***Insert the following text in Chapter 11 (Physical layer)***

- **11.x Downlink control channel**

The downlink control channel containing user specific information is carried over one or multiple of downlink control channels. Each downlink control channel is dedicated to one user, or one group of users. Further, each downlink control channel is multiplexed with DL data transmission in a TDM fashion. The control channel is composed of one or multiple of physical control mini-tiles (CMT).

Figure XX and YY shows two examples of downlink control channel.

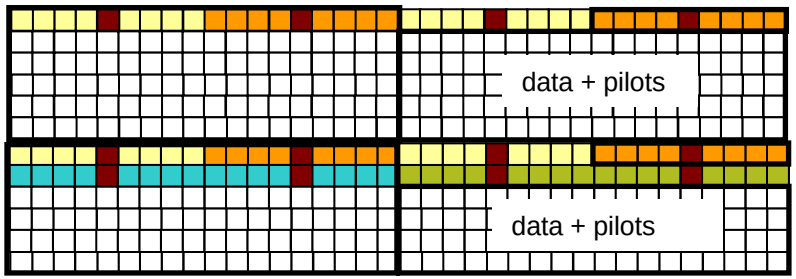


Fig XX: Example of 1 or 2 baud control for 1 subframe, supporting 1 virtual antenna

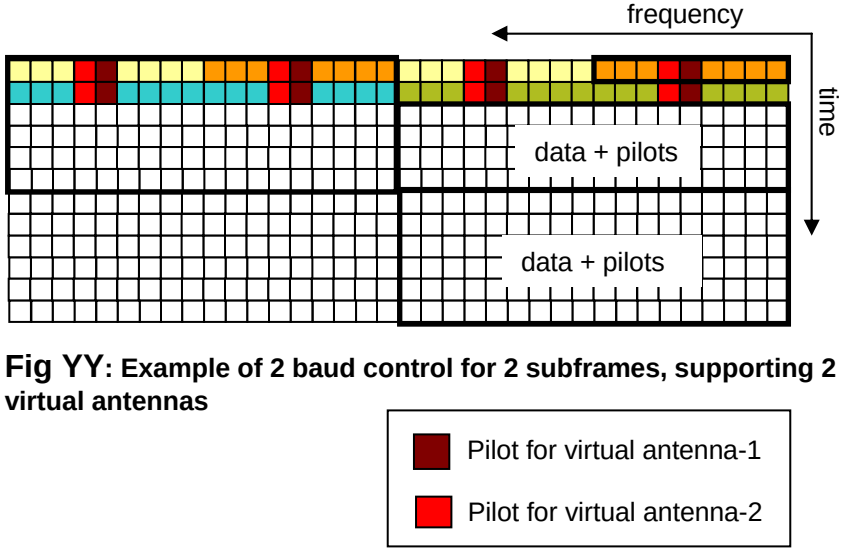


Fig YY: Example of 2 baud control for 2 subframes, supporting 2 virtual antennas

Proposed Text to 16m SDD (IEEE C802.16m-07/320r1)

- **The following topics are FFS**
  - Dimension and pilot structure for CMT
  - Transmission schemes to be supported for DL control channel
    - For example, beamforming, SFBC, CDD, etc
  - Control channel MCS
  - CMT permutation
    - Localized, distributed