# Proposal for IEEE 802.16m DL Pilot for MIMO Channel Measurement

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Re: IEEE 802.16m-08/016r1 – Call for Contributions on Project 802.16m System Description Document (SDD), on the topic of "Downlink MIMO schemes"

Purpose: Adopt the proposal into the IEEE 802.16m System Description Document

# Scope

- This contribution proposes downlink pilot structure for CQI and MIMO channel measurements
- Details of proposed DL MIMO schemes are in separate contributions: C802.16m-08/342, C802.16m-08/345, C802.16m-08/346.

# DL pilot for Channel Measurement: Overview

- The availability of DL channel state information at the BS is essential to enable the following features:
  - Link adaptation
  - Frequency selective scheduling
  - Closed-loop MIMO/beamforming
- Channel state information includes
  - Channel quality indicator (CQI)
  - Precoding matrix, or precoding matrix index of codebook
  - rank of channel matrix
- The following methods can be used for channel measurement
  - MS measures channel information using DL common pilot and feedback to BS (DL channel measurement pilots are proposed in this contribution)
  - BS measures channel information using UL sounding pilot (see C802.16m-08/349)
  - The two methods are complimentary

# DL pilot for Channel Measurement: Considerations

- DL pilot for channel measurement depends on the following system designs
  - Frame structure
  - Channelization
  - Pilot structure for channel estimation
- Measurement bandwidth
  - Full band measurement or configurable bandwidth segment measurement
- Location within a radio frame
  - Need to be able to track channel changes
- Number of Antenna supported
  - Support up to 8 effective physical antennas
- Power allocation
  - Proper boost level for reliable measurement
  - Offset for different sector/cell
- Overhead consideration
- Applicability to FDD and TDD system

# DL pilot for Channel Measurement: Design (1/2)

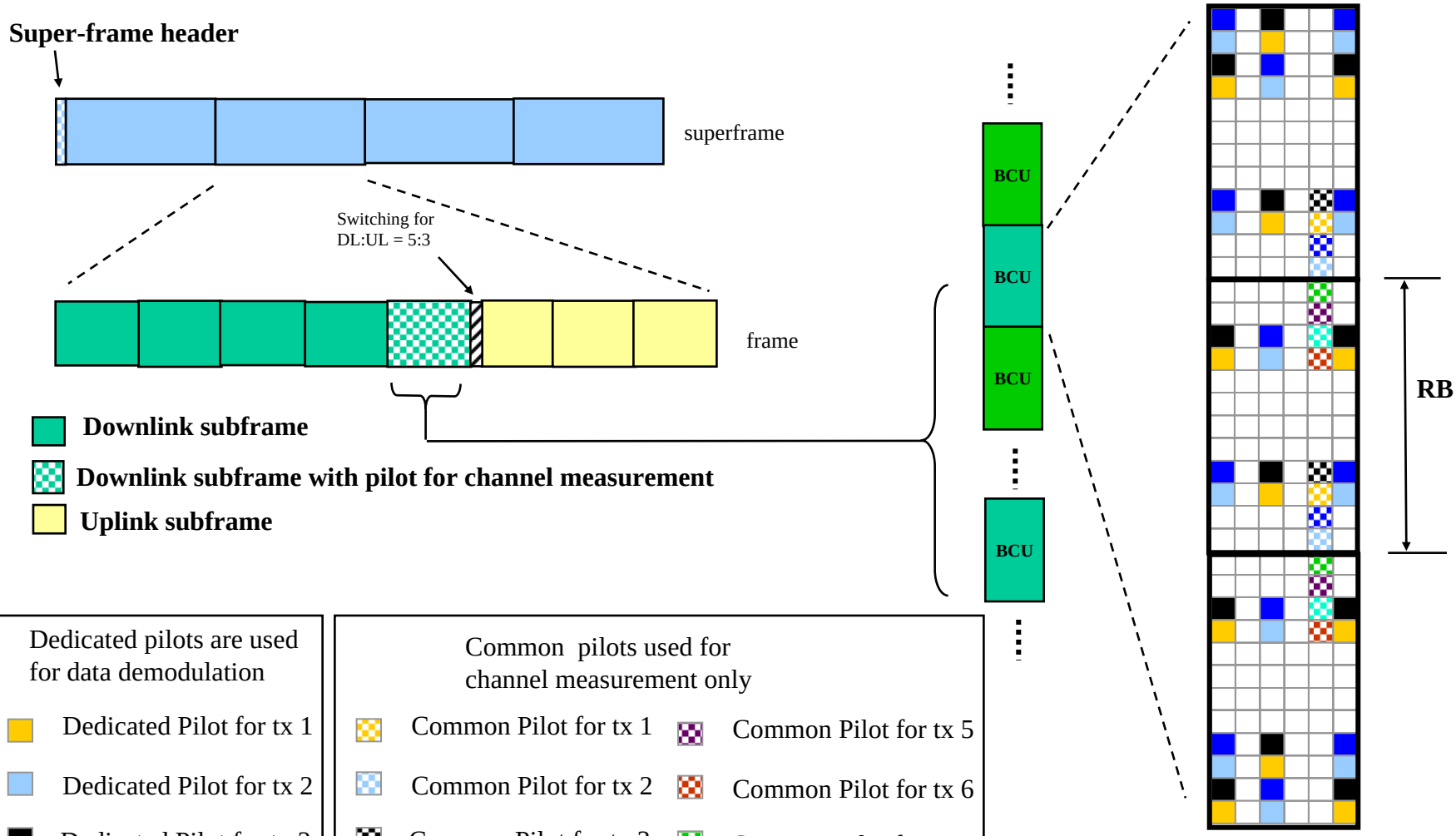
- Common pilots used for channel estimation of each MIMO stream can also be used for channel measurement. However, there are two issues:
  - The number of MIMO streams may be less than the number of effective physical antennas
  - The is no common pilots in dedicated pilot resource blocks, thus MS will not be able to measure the full band channel state information.
- Additional channel measurement pilots are allocated on an as needed basis to an RB/BCU regardless of whether it is a common or dedicated pilot RB/BCU, to facilitate CQI and MIMO channel measurement across the band
  - Scenario 1: Pilot for additional effective physical transmit antennas are added to a common pilot RB/BCU to enable CQI and MIMO channel measurement of those additional transmit antennas
  - Scenario 2: pilots for all physical transmit antennas are added to a dedicated pilot BCU to enable CQI and MIMO channel measurement of all transmit antennas.
  - Scenario 3: which sub-frame(s) the channel measurement pilots are located are configurable by the superframe configuration control. They can be allocated periodically to one or more sub-frames within a radio frame.

# DL pilot for Channel Measurement: Design 2/2

- Location within radio frame
  - Two possible options are considered:
    - Option 1: Fixed location within a radio frame, e.g. last DL Sub-frame within a radio frame contains pilots for channel measurement
    - Option 2: which sub-frame(s) the channel measurement pilots are located are configurable by the superframe configuration control
  - Located at OFDM symbols that do not contain regular pilots for channel estimation
    - More room for additional (up to 8 ) antenna support
    - More room for offset from sector to sector (if power boosted)
- In a BCU (36x6) that contains dedicated pilot for channel estimation
  - Pilots for channel measurement are allocated to support up to 8 antenna.
  - 2-3 pilots per transmit antenna are allocated for channel measurement. All located in the same OFDM symbol
- In a BCU (36x6) that contains common pilot for channel estimation
  - Channel measurement can be performed using the same common pilots used for channel estimation
  - Pilots for channel measurement are allocated for additional antennas which are not supported by common pilots for channel estimation .
  - 2-3 pilots per transmit antenna for additional antennas measurement. All located in the same OFDM symbol

# DL pilot for Channel Measurement:

Example 1: BCU that contains dedicated pilots for channel estimation, 2 pilots for ch. Measurement per antenna. Support measurement of up to 8 antennas




Dedicated pilots are used for data demodulation

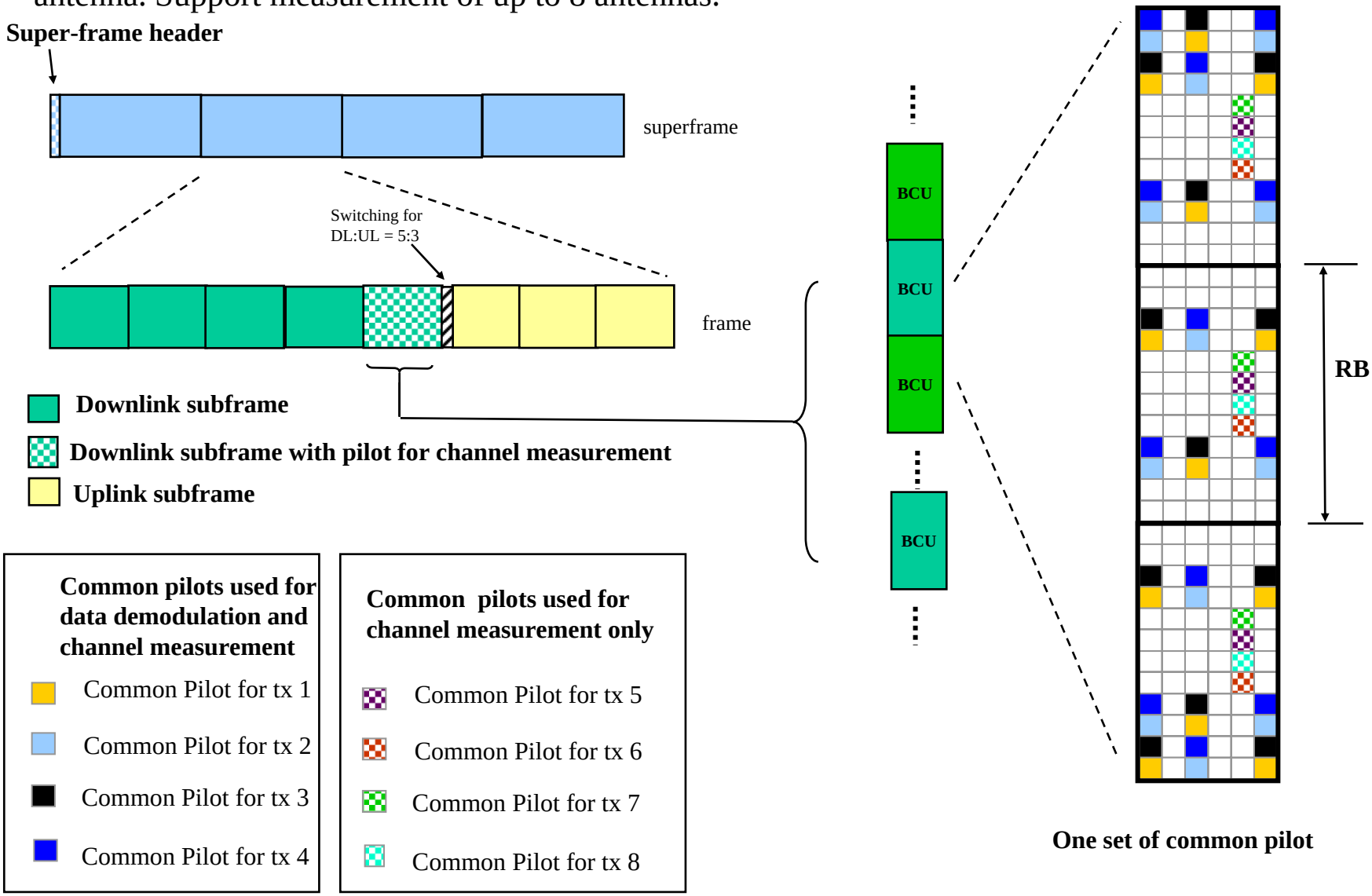
- Dedicated Pilot for tx 1
- Dedicated Pilot for tx 2
- Dedicated Pilot for tx 3
- Dedicated Pilot for tx 4

Common pilots used for channel measurement only

- Common Pilot for tx 1
- Common Pilot for tx 2
- Common Pilot for tx 3
- Common Pilot for tx 4
- Common Pilot for tx 5
- Common Pilot for tx 6
- Common Pilot for tx 7
- Common Pilot for tx 8

# DL pilot for Channel Measurement:

Example 2: BCU that contains common pilots for channel estimation, 3 pilots for each additional antenna. Support measurement of up to 8 antennas.



# Summary

- DL pilot design for channel measurement is proposed
- Pilot for additional physical transmit antennas are added to a common pilot BCU to enable CQI and MIMO channel measurement of those additional physical transmit antennas
- Pilots for all physical transmit antennas are added to a dedicated pilot BCU to enable CQI and MIMO channel measurement of all physical transmit antennas.
- Which sub-frame(s) the channel measurement pilots are located are configurable by the superframe configuration control.

# Text Recommendations for SDD Section 11 Physical Layer

- Section 11.x DL Pilot
  - Section 11.x.x DL common pilot for MIMO channel measurement

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