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Project	**IEEE 802.16 Broadband Wireless Access Working Group <**http://ieee802.org/16**>**
Title	**MIMO Strategies for the IEEE 802.16m Downlink**
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Re:	TGm Call for Contributions on Project 802.16m System Description Document (SDD), IEEE 802.16m-08/016r1 Topic: Downlink MIMO Schemes
Abstract	This contribution proposes text for the SDD on downlink MIMO schemes
Purpose	Discussion and adoption of SDD text
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1   *Proposed text for DL MIMO Schemes in the SDD:*

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14   ## *11.7 Downlink MIMO Transmission Schemes*

15   The downlink shall support a variety of downlink MIMO transmission schemes to enable the system to
16   be optimized to the deployment scenario and antenna array configuration.

17   ### **11.7.1   Transmission Methods for Broadcast Control Channel**

18   The broadcast control channel (BCH) shall be transmitted in a manner that appears to be a single
19   transmit antenna to the mobile station.   Base stations with multiple transmit antennas may employ
20   transparent antenna aggregation techniques such as low-delay cyclic delay diversity on the BCH.

21   ### **11.7.2   Transmission methods for Dedicated/Unicast Control Channels**

22   The following transmission methodologies are supported on the dedicated/unicast control channels:

23   • Single Antenna or multi-antenna with transparent antenna aggregation (low delay CDD)

24   • Two-antenna Space-Frequency Block Coding (SFBC)

25   • Beamforming may be employed on the dedicated/unicast control channels. If the beamforming
26   is enabled via TDD reciprocity exploitation or analog feedback, then the pilots of the
27   dedicated/unicast control must be dedicated.

28   The Broadcast Control Channel (BCH) shall indicate the transmission methodology employed on the
29   dedicated/unicast control channels. The BCH shall also indicate the pilot type (whether dedicated or
30   common) used on the dedicated/unicast control. The BCH shall also indicate whether the data portion of
31   the subframe employs common pilots throughout the subframe so as to enable an MS to know whether
32   or not all pilots in the subframe can be used to decode the dedicated/unicast control channel.

33   ### **11.7.3   Transmission methods for DL Unicast Data Channels**

34   The MIMO transmission schemes for the DL unicast data channels are categorized as either being
35   closed-loop (i.e., leveraging some level of DL channel state information (CSI) via TDD reciprocity or
36   feedback) or open-loop (not leveraging DL CSI).

The dedicated/unicast control channel for a particular DL allocation will indicate the following characteristics of the DL allocation:

- Transmission mode

- Pilot type (dedicated or common)

11.7.3.1   Open-Loop Transmission Methods for DL Data Channels

The downlink data channels shall support the following transmission schemes:

- Single Antenna Methods
    - o Transparent antenna aggregation, e.g., low delay Cyclic Delay Diversity (CDD)
    - o Multi-tap CDD
- Two-TX-Antenna Methods
    - o Space-Frequency Block Coding (SFBC)
    - o Space-Time Block Coding (STBC)
    - o Open-Loop MIMO - Multi-Code Word (MCW)
- Four-TX-Antenna Methods for up to rank 4 transmission (MCW)

11.7.3.2   Closed-Loop Transmission Methods for DL Data Channels

The downlink data channels shall support the following closed loop transmission schemes

- SU-MIMO based on UL Channel Sounding or Analog Feedback. Beamforming is a special case of SU-MIMO where only one data stream is beamformed to a single user. SU-MIMO with more than one stream is transmitted in multi-code-word (MCW) fashion. Transmissions of this type are used with dedicated pilots on the downlink. Up to four data streams shall be supported.

- SU-MIMO based on codebook feedback. SU-MIMO with more than one stream is transmitted in multi-code-word (MCW) fashion. Up to four data streams shall be supported.

- MU-MIMO based on UL Channel Sounding or Analog Feedback. Two or more MSs are each allocated a single data stream on the same time-frequency allocation.

11.7.3.3   Enablers for Closed-Loop Transmission Methods for DL Data Channels

The following feedback schemes are used to enable the closed-loop transmission schemes of the previous subsection:

- Uplink Channel Sounding (ULCS): ULCS is used to provide the BS with an UL reference signal that can enable the BS to compute transmit weights for SU-MIMO or MU-MIMO transmission.

- Analog Feedback. The ULCS signaling shall have a mode where the transmitted reference signal includes analog feedback methodologies such as eigenvector feedback or covariance feedback.

- Codebook Feedback. The system shall support MIMO codebooks for 2 and 4 transmit antennas that are optimized for SU-MIMO transmission with up to rank 4 transmission.

- DL MIMO Midamble. The downlink shall support the transmission of a MIMO midamble that enables the MS to estimate the multi-antenna downlink channel response for up to four BS

transmit antennas. The MIMO midamble enables the MS to perform Analog feedback and precoder-matrix-index feedback.