Project	**IEEE 802.16 Broadband Wireless Access Working Group <**http://ieee802.org/16**>**
Title	**Classification of DL MIMO Modes**
Date Submitted	**2008-05-13**
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Re:	Call for Contributions on Project 802.16m System Description Document (SDD) IEEE 802.16-08/016r1 Subject: DL MIMO schemes
Abstract	The antenna configurations in 802.16m (up to 4x4) and the different operation scenarios allow a variety of multi-antenna transmission schemes, which are required to improve the performance under different channel conditions. This document proposes means for classificaton of DL MIMO modes to be supported by 16m and proposes some new modes.
Purpose	TGm should review and adopt the text in this contribution and provide means in the SDD and the amendment to classify and support the variety of DL MIMO modes to be defined in IEEE 802.16m.
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Classification of DL MIMO Modes

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Introduction

To meet 16m and IMT-Advanced requirements for spectral effciency and throughput, it is required to define an appropriate number of different MIMO modes to improve the performance under different channel conditions. According to [1] §5.7, in 16m a minimum requirement of 2 TX antennas at the BS and 2 RX antennas at the MS is foreseen. Target antenna configuration is 4 x 4. IEEE 802.16m shall further support single-user and multi-user MIMO techniques. This allows a variety of possible antenna configurations and transmission schemes to be defined in the 16m TG.. This contribution proposes means for classification of DL MIMO modes in IEEE 802.16m. Objective is to identify required modes and to avoid unnecessary options. Furthermore the classification will help to optimize control structures for these MIMO modes. Some examples of existing and new DL MIMO modes for 802.16m are given, but the definition of the complete set of DL MIMO modes is for further study.

DL MIMO Modes

The DL MIMO modes are characterized by

- Number of Tx antennas
- Number of encoded data streams
- Number of mobile stations (MSs) served, each MS being identified e.g. by the CID of its connection.
- Number of used orthogonal pilot patterns
- Matrix that maps information symbols to time slots and antennas
- Mapping of encoded data streams to matrix elements

Examples are shown in Table 1.

Matrix definitions A2, B2, A4, B4 and C4 are defined according to [2], § 8.4.8 and the number refers to the number of TX antennas. Matrix D4 is defined as

$$[s_1].$$

Number of Tx antennas	Number of encoded data streams	Number of orthogonal pilot patterns	Matrix	Mapping of encoded streams to matrix elements	Number of subscriber stations	Comment
2	1	2	A2	Encoded stream #0: S1, S2	1	STC
2	1	2	B2	Encoded stream #0: S1, S2	1	SM vertical encoding
2	2	2	B2	Encoded stream #0: S1 Encoded stream #1: S2	1	SM horizontal encoding
2	2	2	B2	Encoded stream #0:	2	SM horizontal

				S1 Encoded stream #1: S2		encoding
4	1	4	A4	Encoded stream #0: S1, S2, S3, S4	1	STC
4	1	4	B4	Encoded stream #0: S1, S2, S3, S4	1	SM
4	2	4	B4	Encoded stream #0: S1, S2, S5, S7 Encoded stream #1: S3, S4, S6, S8	2	SM
4	4	4	C4	Encoded stream #0: S1 Encoded stream #1: S2 Encoded stream #2: S3 Encoded stream #3: S4	4	MU-MIMO, 4 users
1	2	1	D1	Encoded stream #0: S1 Encoded stream #1: S1	2	Superposition
2	4	2	B2	Encoded stream #0: S1 Encoded stream #1: S1 Encoded stream #2: S2 Encoded stream #4: S2	4	Superposition

Table 1: Existing and new DL MIMO modes

To achieve capacity in broadcast channels, modes with number of streams larger than the number of antennas at the transmitter are included. These allow significant improvement of system throughput by applying multi-user techniques different from conventional SDMA. For these, joint detection may be required at the receiver.

Proposed Text for SDD

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IEEE 802.16m supports different DL MIMO modes for different channel conditions. The modes are characterized by

- Number of Tx antennas
- Number of encoded data streams
- Number of mobile stations (MSs) served, each MS being identified e.g. by the CID of its connection.
- Number of used orthogonal pilot patterns
- Matrix that maps information symbols to time slots and antennas
- Mapping of encoded data streams to matrix elements

Examples for MIMO modes are given in Table 1. Additional MIMO modes and the required control structures are for further study.

[*Note to the Editor: add Table 1 here*]

-------------------------------- End of text --------------------------------

Abbreviations

SU-MIMO	single-user MIMO
MU-MIMO	multi-user MIMO
STC	Space Time Coding
SM	Spatial Multiplexing
CID	Connection Identifier
SDMA	Space-division multiple access

References

[1] IEEE 802.16m-07/002r4, "IEEE 802.16m System Requirements Document"

[2] IEEE P802.16Rev2/D4, Draft Standard for Local and Metropolitan Area Networks, Part 16: Air Interface for Broadband Wireless Access Systems