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Title	**Downlink MIMO High Level View for IEEE802.16m**	
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Re:	IEEE 802.16m-08/016r1 Call for Contributions on Project 802.16m System Description Document (SDD). Specific topic : Downlink MIMO schemes	
Abstract	Propose high level concept on IEEE 802.16m MIMO section	
Purpose	For IEEE 802.16m discussion and adoption	
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Downlink MIMO High Level View for IEEE802.16m

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Introduction

In this contribution, we propose high level concept on IEEE 802.16m MIMO section.

MIMO structure

Two type of codeword options are defined in IEEE 802.16e standard. The first codeword option is single codeword (SCW) and the other option is multiple codeword (MCW). The following figures show a baseband signal generation process of two type of MIMO structure.

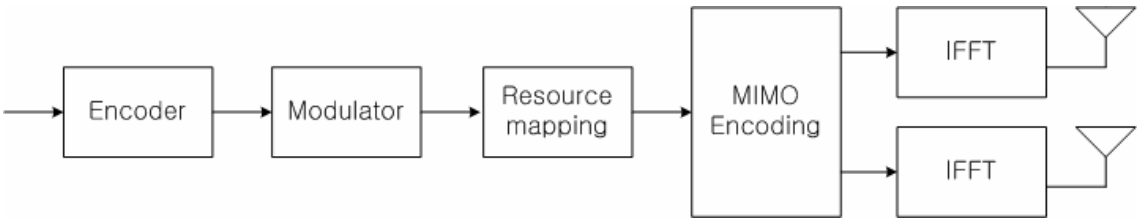

Fig 1 Vertical Encoding

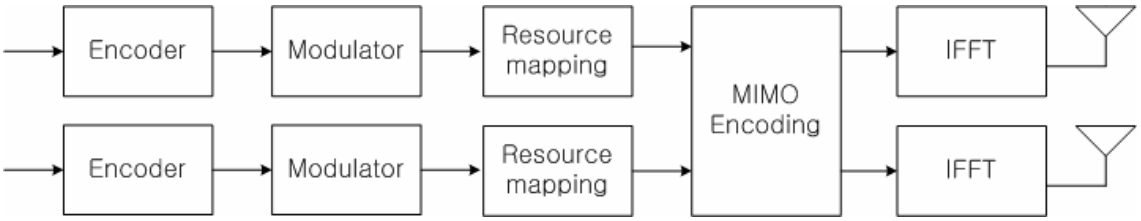

Fig 2 Horizontal Encoding

Fig 1 shows SCW or vertical encoding MIMO structure, and Fig 2 shows MCW or horizontal encoding MIMO structure. Each MIMO structure has pros and cons. Vertical encoding is a MIMO structure in IEEE 802.16e reference system, requires only one CQI, and spatial diversity can be obtained. Horizontal encoding requires multiple CQIs, and AMC per stream and codeword level SIC receiver can be implemented. The performance of two type of MIMO structure is almost same for same receiver type.

To reduce uplink feedback, we propose only one codeword per MS.

Open loop MIMO vs. Closed loop MIMO

Closed loop MIMO (CL-MIMO) scheme requires channel state information (CSI) such as precoding matrix index (PMI) or channel or covariance matrix in addition to CQI. Open loop MIMO (OL-MIMO) scheme requires only CQI. CL-MIMO is suitable for low speed user while OL-MIMO is suitable for high speed user, control channel or limited uplink feedback situation.

Transmit diversity is obtained by OL-MIMO. There are several STC matrices are defined in IEEE 802.16e system which requires different STC decoding module. To reduce options or complexity, a single or limited number of transmit diversity (TxD) scheme which can be extended to any number of transmit antennas and any number of streams is preferred. Transmit diversity scheme can be improved by more sophisticated receiver such as MLD decoder. If we restrict number of simultaneously transmit symbols to transmit rank, simple receiver can be implemented.

CL-MIMO can get beamforming gain as well as AMC gain. CL-MIMO is further classified into two schemes based on feedback. One is codebook based CL-MIMO and the other is analog feedback based CL-MIMO. Codebook based CL-MIMO requires very limited number of feedback information while flashlight effect can be reduced by codeword restriction.

Analog feedback based CL-MIMO has larger beamforming gain and less quantization error, however it suffers from large CQI mismatch and flashlight effect and it requires large feedback overhead.

To obtain maximum AMC gain and reduce flashlight effect, we propose codebook based precoding for IEEE 802.16m CL-MIMO.

SU-MIMO vs. MU-MIMO

For single user MIMO (SU-MIMO), each MS selects preferred rank, and feedback the rank and corresponding CQI and PMI. BS selects a MS to a resource block.

For multi user MIMO (MU-MIMO), each MS feedback CQI, PMI for a given MU-MIMO condition such as transmit rank, precoding matrix set, MU-MIMO type. BS selects MSs to a resource block with a certain criteria such as orthogonal transmission.

For OL-MIMO, it is hard to select MS preferred stream, we propose only SU-MIMO shall be used for this case. For CL-MIMO, system can be operated by SU-MIMO or MU-MIMO. The optimal performance shall follow envelop of the best MIMO mode. So, we propose SU/MU mode switching shall be done by each BS. Mode is a MIMO transmit scheme such as SU-MIMO mode, MU-MIMO with rank2, MU-MIMO with rank3, etc.

Collaborative MIMO

In IEEE 802.16e standard, MIMO macro diversity(MD) transmission technique has been defined as a solution of inter-cell interference problem. To obtain spatial diversity gain as well as macro diversity gain and to manage inter-cell interference, the downlink collaborative MIMO(Co-MIMO) should be one of IEEE 802.16m MIMO mode. Co-MIMO can be operated with/without uplink feedback.

Furthermore, Co-MIMO can efficiently coexists with conventional FFR scheme.

Proposed Texts

---------- Text Start ----------

11.x Multiple antenna transmission

11.x.1 MIMO structure

11.x.1.1 Vertical Encoding

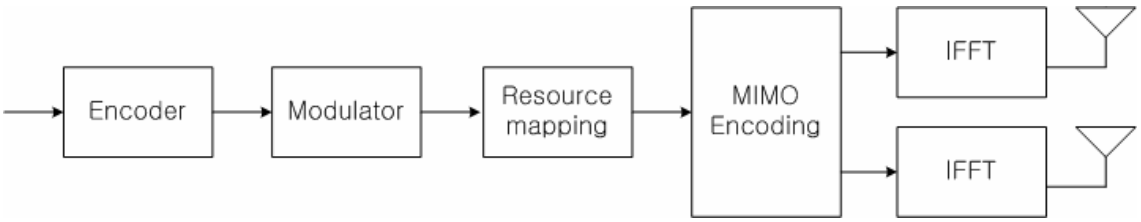

Fig 11.x.1 Vertical Encoding

Fig 11.x.1 shows vertical encoding or SCW MIMO structure. This structure shall be used for SU-MIMO.

11.x.1.2 Horizontal Encoding

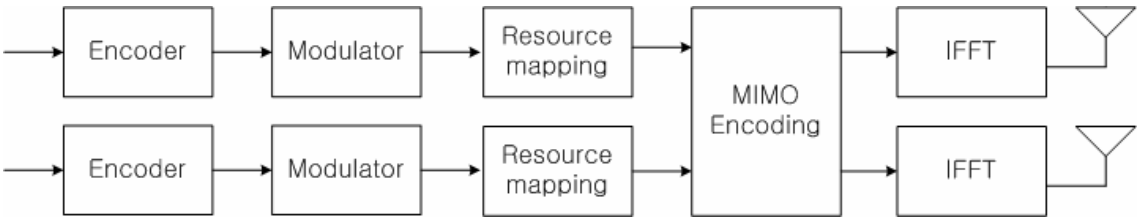

Fig 11.x.2 Horizontal Encoding

Fig 11.x.2 shows MCW or horizontal encoding MIMO structure. This structure shall be used for MU-MIMO. Each multiplexing chain shall be dedicated to each MS.

11.x.2 Downlink

11.x.2.1 Open-loop MIMO

Open loop MIMO (OL-MIMO) scheme requires only CQI. OL-MIMO is suitable for high speed user, control channel or limited uplink feedback situation.

To reduce options or complexity, a single or limited number of transmit diversity (TxD) scheme which can be extended to any number of transmit antennas and any number of streams is preferred. To implement simpler receiver, the number of simultaneously transmit symbols is same as transmit rank. Only SU-MIMO mode shall be used for OL-MIMO transmission.

11.x.2.2 Closed-loop MIMO

Closed loop MIMO (CL-MIMO) scheme requires channel state information (CSI) such as precoding matrix index (PMI) in addition to CQI. Codebook based precoding shall be used for both TDD and FDD.

Flashlight effect can be reduced by codeword restriction.

11.x.2.2.1 SU-MIMO

For single user MIMO, each MS selects preferred rank, and feedback the rank and corresponding CQI and PMI. BS selects a MS to a resource block.

11.x.2.2.2 MU-MIMO

For multi user MIMO, each MS feedback CQI, PMI for a given MU-MIMO condition such as transmit rank, precoding matrix set, MU-MIMO type. BS selects MSs to a resource block with a certain criteria such as orthogonal transmission.

11.x.2.2.3 Mode adaptation

SU/MU mode switching shall be done by each BS. Mode is a MIMO transmit scheme such as SU-MIMO mode, MU-MIMO with rank2, MU-MIMO with rank3, etc.

11.x.2.3 Collaborative MIMO

Collaborative MIMO (Co-MIMO) can obtain spatial and macro diversity gain. Co-MIMO can efficiently coexists with conventional FFR scheme. Co-MIMO can be operated with/without uplink feedback.

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