

OL SU MIMO rate-2 SM with precoding – downselection proposal

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Source:

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Re:

TGm SDD: Other; in response to the TGm Call for Contributions and Comments 802.16m-08/040 for Session 58

Purpose:

Propose arguments and new SDD text as support to comment on SDD text. The goal is to limit the number of “FFS” items.

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Outline

- In the context of the studies made in the OL SU MIMO schemes, current SDD (80216m-08_003r5.doc) still contains a number of FFS schemes:
 - *For OL SU-MIMO, the following schemes are FFS: 4Tx rate-1 SFBC + Antenna hopping, **4Tx rate-2 Double SFBC + Antenna hopping**, **4Tx rate-2 SM + Antenna hopping**, 4Tx rate-3 SM + Antenna hopping, 4Tx rate-3 hybrid SM + SFBC + Antenna hopping.*
 - Note there are two rate-2 schemes
 - 4Tx rate-2 Double SFBC + Antenna hopping (DSFBC+AH)
 - 4Tx rate-2 SM + Antenna hopping (SM+AH)
 - For practical reasons, we want to limit the number of options and minimize complexity so **we propose to keep 4Tx rate-2 SM + Antenna hopping**

System aspects

- Channel estimation → favors **SM+AH**
 - DSFBC+AH needs for each symbol position 4 channel coefficients in channel estimator
 - SM+AH needs for each symbol position only 2 channel coefficients to be estimated
- Pilot structure requirements (11.5.3) → favors **SM+AH**
 - Dedicated pilot (DP) case
 - DSFBC+AH requires 4 stream pattern [overhead= $16/(18 \times 6)=14.8\%$]
 - SM+AH requires at least 2 stream pattern [overhead= $12/(18 \times 6)=11.1\%$]
 - Better performance with 4 stream pattern
 - Note that DP provides more flexibility on the precoder than CP
 - Common pilot (CP) case
 - Both schemes DSFBC+AH & SM+AH require 4 stream pattern [overhead= $16/(18 \times 6)=14.8\%$]

Implementation aspects

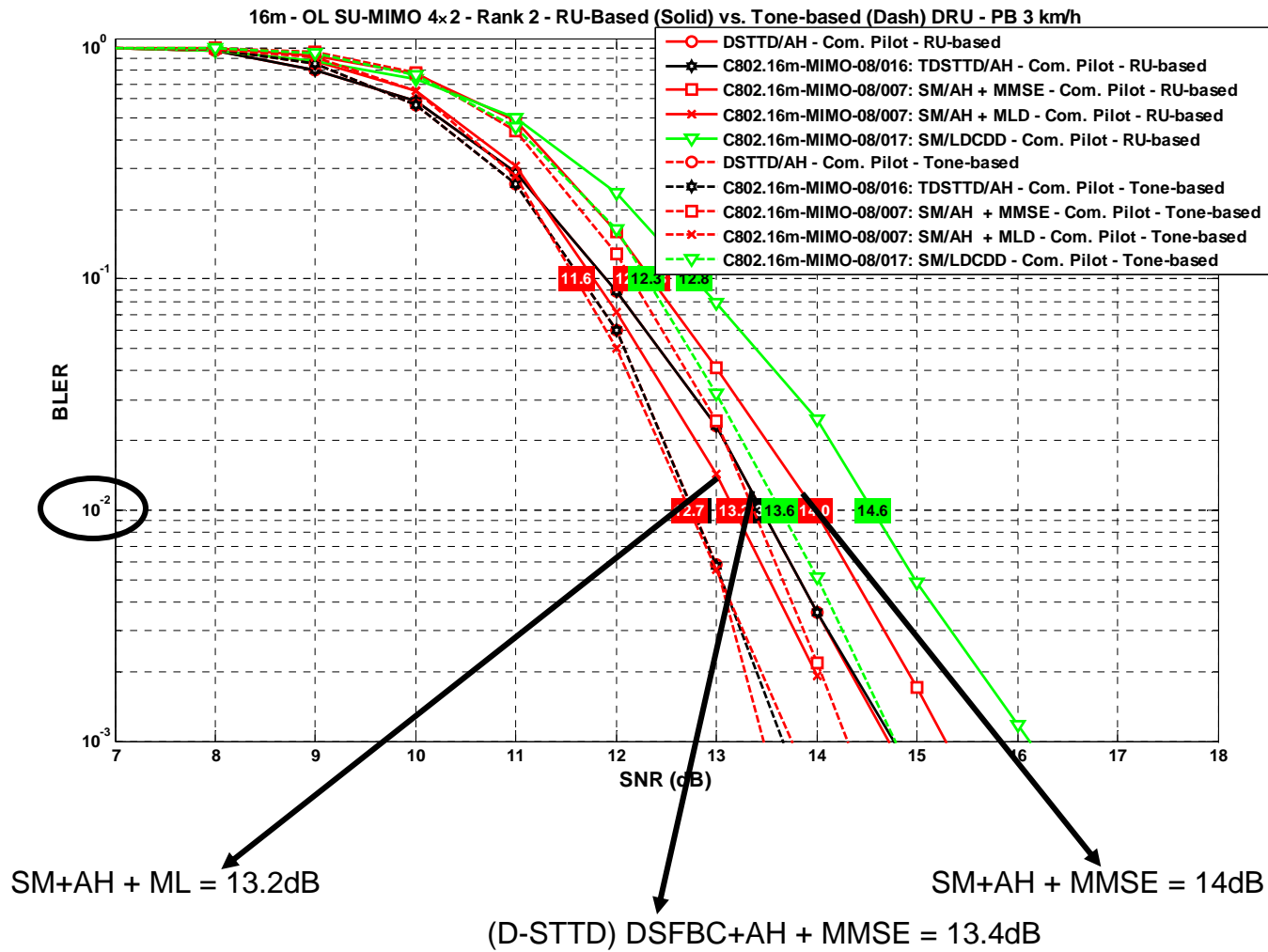
- Transmitter (BS) side → favors **SM+AH**
 - Number of RF chains
 - DSFBC+AH requires 4 RF chains
 - SM+AH can be implemented with an antenna switch (no frequency domain permutation), and 2 RF chains (interesting for femto BS)
- Receiver (MS) side → favors **SM+AH**
 - Decoding complexity
 - DSFBC+AH
 - ML detector is not straightforward
 - MMSE detector must be assumed
 - No matter the detector choice, a new one (compared to legacy 16e) has to be designed
 - SM+AH
 - Same decoder used in legacy 16e system for Matrix B can be used to decode SM+AH
 - ML detector is feasible, and many vendors have already implemented ML decoder of Matrix B in their chipsets
 - No extra detector is needed compared to legacy 16e
 - Channel estimation complexity
 - Complexity of DSFBC+AH= 2x complexity of SM+AH

Performance aspects

- DSFBC+AH compared to SM+AH → favors **SM+AH**
- Simulation assumptions
 - PedB/3kph (VehA/60kph available in C80216m-MIMO-08_058r1.ppt)
 - 16QAM 1/2
 - Resource allocation compatible with MIMO Rapporteur Group assumptions
 - Tone-based DRU
 - RU-based DRU
 - MMSE or ML receiver
 - DSFBC is replaced by Double STTD (C80216m-08_997.doc) that we suppose to have similar performance at low speed, and better performance at high speed (SM+AH performance should be less affected by speed than DSFBC+AH)
- Conclusions
 - MMSE detector: DSFBC+AH better than SM+AH (~0.6 dB)
 - ML detector (only with SM+AH): SM+AH better than DSFBC+AH with MMSE (~0.2 dB)
 - Valid for both tone- and RU- based DRU

Performance aspects

Source: C80216m-MIMO-08_058r1.ppt



Conclusion

- **SM+AH** is preferred to DSFBC+AH
 - System aspect: similar constraints but SM+AH offers more flexibility to the BS vendor (use of CP or DP, number of streams)
 - Implementation aspect
 - **No extra decoder for SM+AH** compared to legacy 16e → ML can be used
 - **Channel estimation complexity twice as low for SM+AH**
 - (for the BS, possibly only 2 RF chains)
 - Performance aspect: SM+AH with ML performs slightly better

SDD modification proposal

- Modify page 81, line 8, as follows:
 - For OL SU-MIMO, the following schemes are FFS: 4Tx rate-1 SFBC + Antenna hopping, ~~4Tx rate-2 Double SFBC + Antenna hopping, 4Tx rate-2 SM + Antenna hopping~~, ...
- Insert page 82, line 31, after “where \mathbf{W} is a 4×2 precoder.” the following:
 - W is selected from a codebook consisting of permutation matrices (mapping the 2 streams from the MIMO encoder on 2 antennas with a weight of 1).