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

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Base Contribution:

16m SDD text (80216m-08_003r5.doc)

Purpose:

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

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/(18x6)=14.8%]
    - SM+AH requires at least 2 stream pattern [overhead=12/(18x6)=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/(18x6)=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

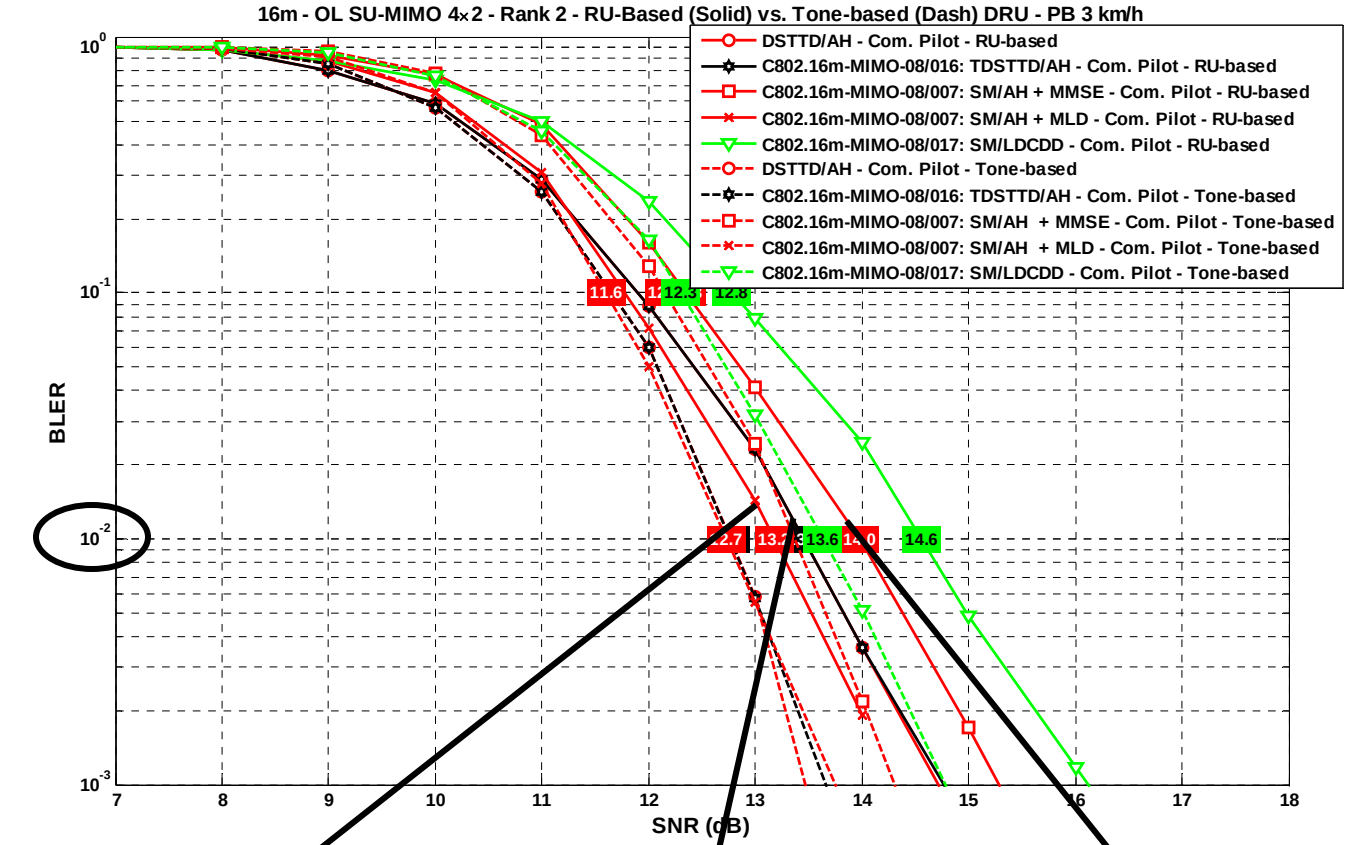
- DSFBC+AH compared to SM+AH ➔ favors **SM+AH**

- 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)

Performance aspects

Source: C80216m-MIMO-08_058r1.ppt



SM+AH + ML = 13.2dB

(D-STTD) DSFBC+AH + MMSE = 13.4dB

SM+AH + MMSE = 14dB

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 **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).