Transmit Antenna Diversity Schemes

Document Number:
    IEEE C802.16m-08/484

Date Submitted:
    2008-05-05

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Re:
    IEEE 802.16m-08/016r1: Call for Contributions on Project 802.16m System Description Document (SDD), **Downlink MIMO schemes**.

Abstract:
    To propose transmit antenna diversity schemes in IEEE 802.16m systems

Purpose:
    For discussion and approval in TGm.

Diversity Schemes for 2 Tx Antennas

- 2 Tx antenna diversity schemes
  - Space-time block code (STBC): better performance
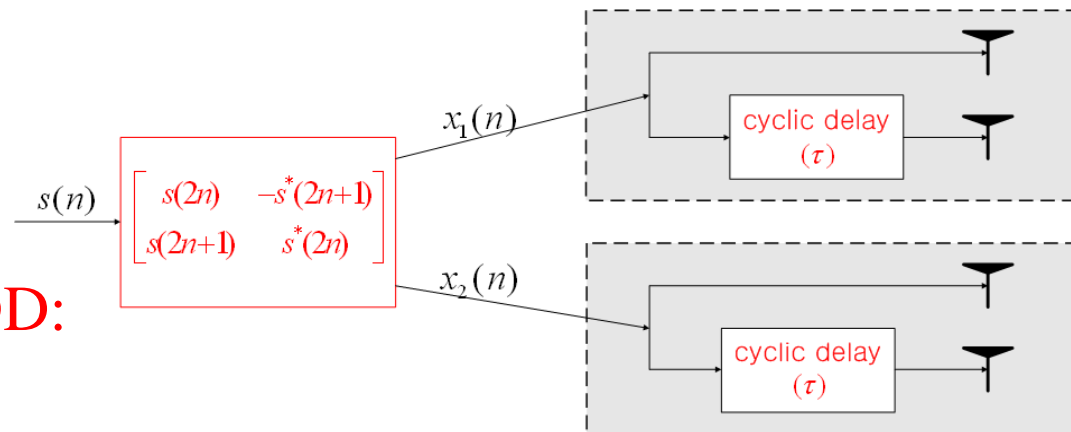 - Cyclic delay diversity (CDD): simpler structure
- 4 Tx antenna diversity schemes
  - STBC:
  $$\begin{bmatrix} s(4n) & -s^*(4n+1) & 0 & 0 \\ s(4n+1) & s^*(4n) & 0 & 0 \\ 0 & 0 & s(4n+2) & -s^*(4n+3) \\ 0 & 0 & s(4n+3) & s^*(4n+2) \end{bmatrix}$$

  - CDD

  - Combined STBC/CDD:

$$s(n) \rightarrow \begin{bmatrix} s(2n) & -s^*(2n+1) \\ s(2n+1) & s^*(2n) \end{bmatrix}$$

$x_1(n)$

$x_2(n)$

cyclic delay (τ)

cyclic delay (τ)

Considerations on Evaluating Tx Ant. Div. Schemes

- In CDD schemes, there may be two options:
  - 1st: Pilot signal is transmitted for each transmit antenna.
  - 2nd: Pilot signal is transmitted also by using CDD. (Pilot signal does not differentiate transmit antennas.)
- Performance comparison among candidate Tx ant. div. schemes may be affected by assumptions on pilot assignment and channel estimation.
  - E.g., If other neighboring resource tile pilots cannot be used for channel estimation in a resource tile, then the 2nd CDD scheme may have better performance than the STBC.
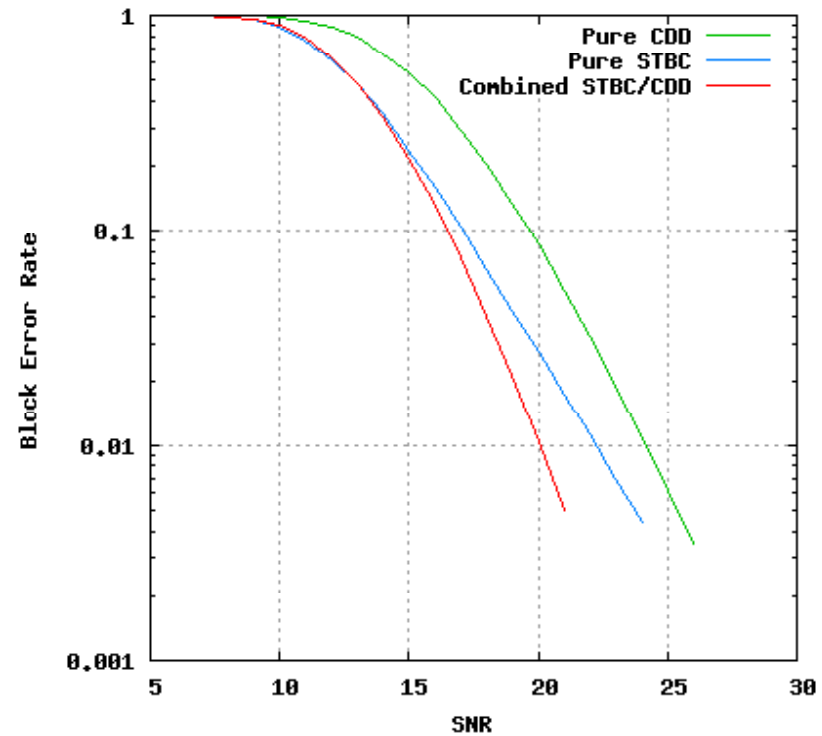
Comparison of 4 Tx Ant. Div. Schemes

"4 Tx and 2 Rx antennas"
with perfect channel estimation
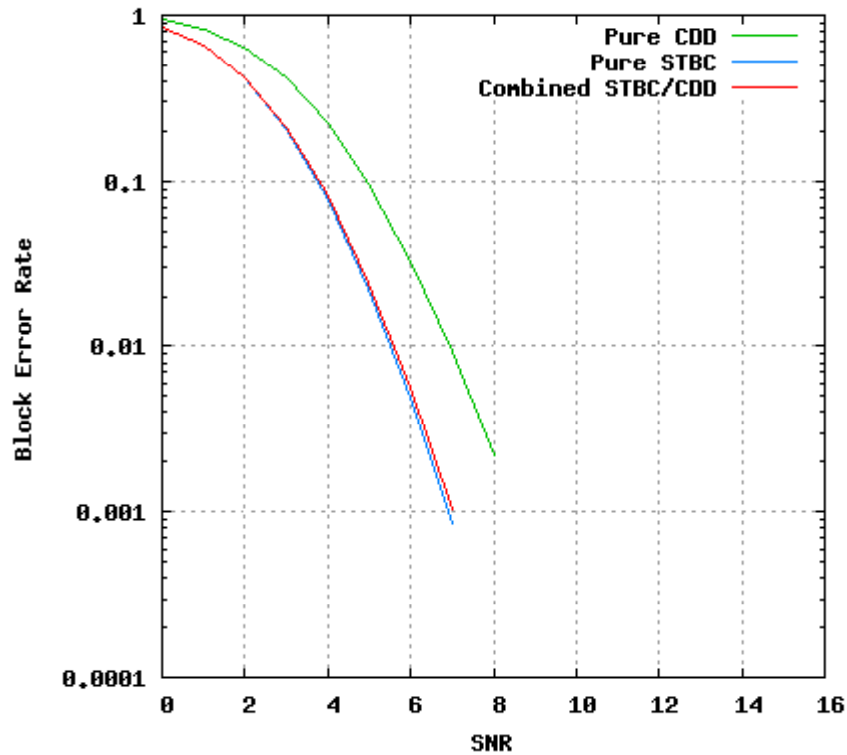
Flat fading
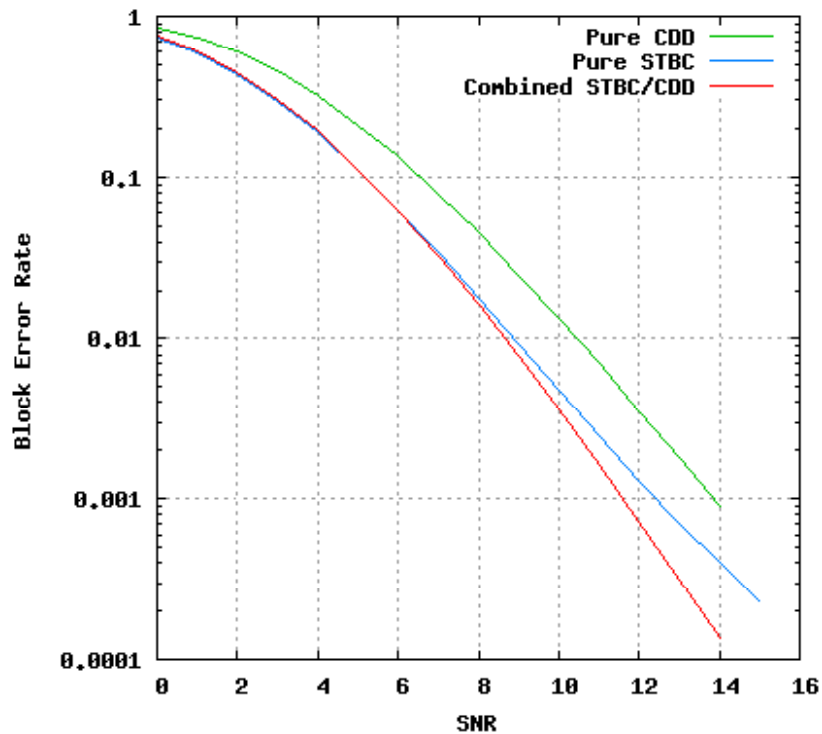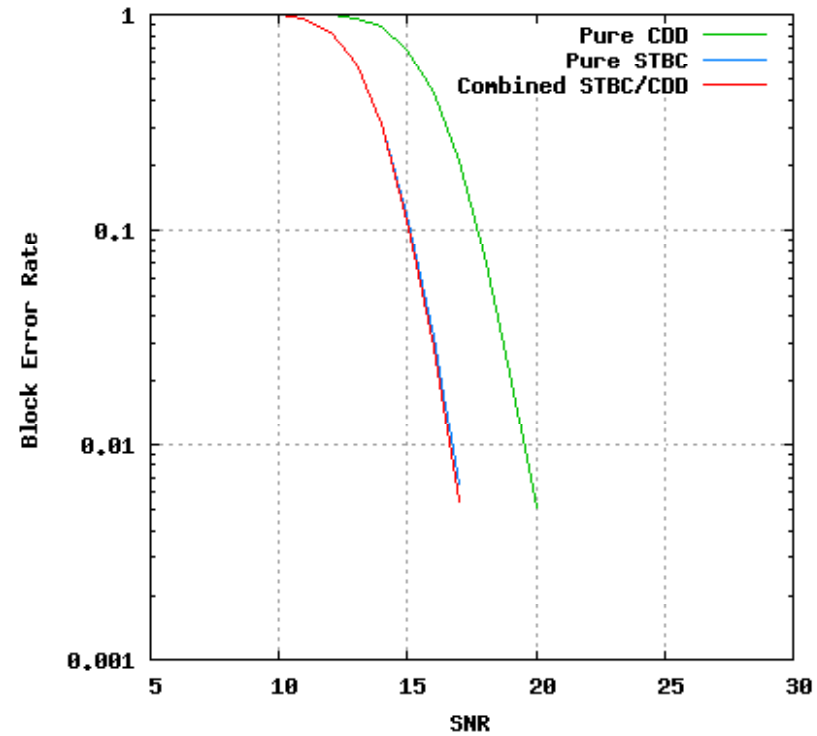
QPSK, ½ Turbo code

16 QAM, 5/6 Turbo code

Comparison of 4 Tx Ant. Div. Schemes (Cont'd)

"4 Tx and 2 Rx antennas"
with perfect channel estimation

TU channel (5 MHz)

QPSK, ½ Turbo code

16 QAM, 5/6 Turbo code

Comparison of 4 Tx Ant. Div. Schemes (Cont'd)

- Summary
  - CDD is outperformed by STBC and combined STBC/CDD.
  - Combined STBC/CDD outperforms the STBC when frequency-selectivity of channel is low and the code rate is high. Otherwise, both perform similarly.

Proposed Texts into SDD

X.y DL MIMO Schemes

X.y.z Transmit Antenna Diversity Schemes

- As open loop transmit antenna diversity schemes, the STBC (or SFBC) or CDD shall be considered for 2 transmit antennas and the STBC (or SFBC), CDD, or the combined STBC (or SFBC) and CDD scheme should be considered for 4 transmit antennas.