Closed-loop MIMO performance with 8 Tx antennas

Document Number:
IEEE C802.16m-08/623
Date Submitted:
2008-07-14
Source:

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Venue:
RE: Call for comments on DL MIMO SDD text (IEEE C80216m-08_657r2)
Base Contribution:
IEEE C802.16m-08/623
Purpose:
Adoption of the proposed text for the 802.16m SDD.
Notice:

Release:

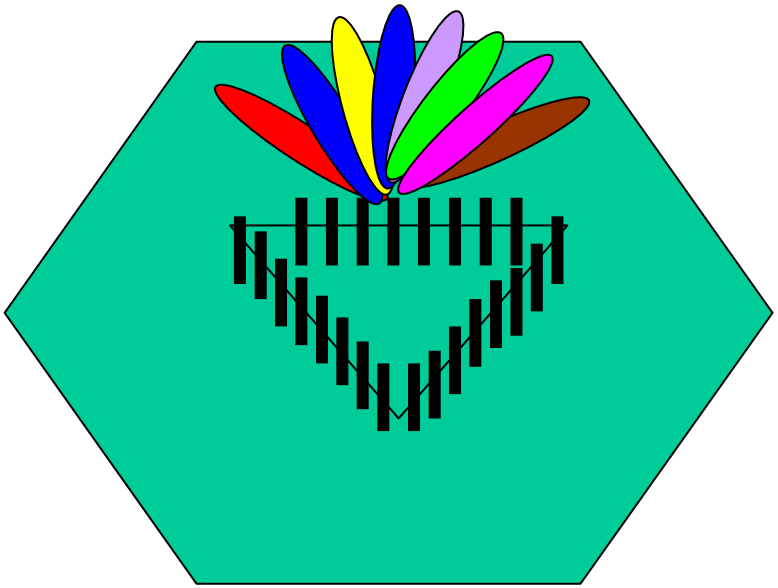
Patent Policy:

Background

- Antenna configurations in C80216m-DL_MIMO-08_008
  - 2×2, 4×2, and 4×4
  - Support of 8Tx FFS
- IMT-Advanced peak rate requirement
  - 100Mbps mobility
  - 1Gbps nomadic
- The latest IMT-Advanced Evaluation Methodology (ITU-R WP 5D IMT.EVAL) proposes 8Tx antenna configuration
- LTE-Advanced is considering support of 8×4 and 8×8 antenna configuration

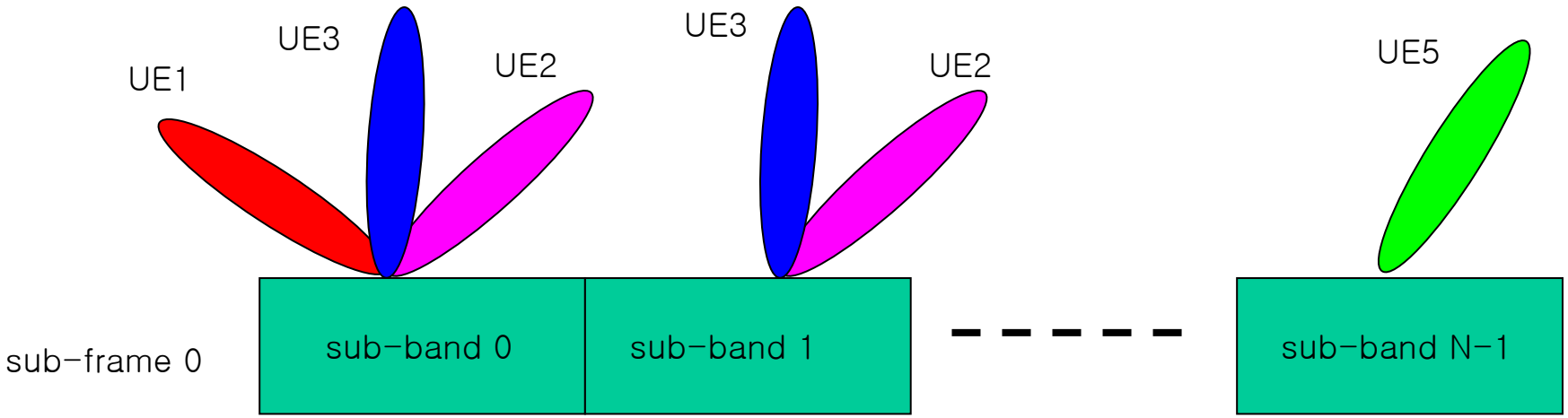
BS with 8Tx antennas (correlated deployment)

- Uniform linear array with ½λ spacing



- 3-bit DFT-based codebook for 3-sector cells

Multi-user beamforming (one layer per user)

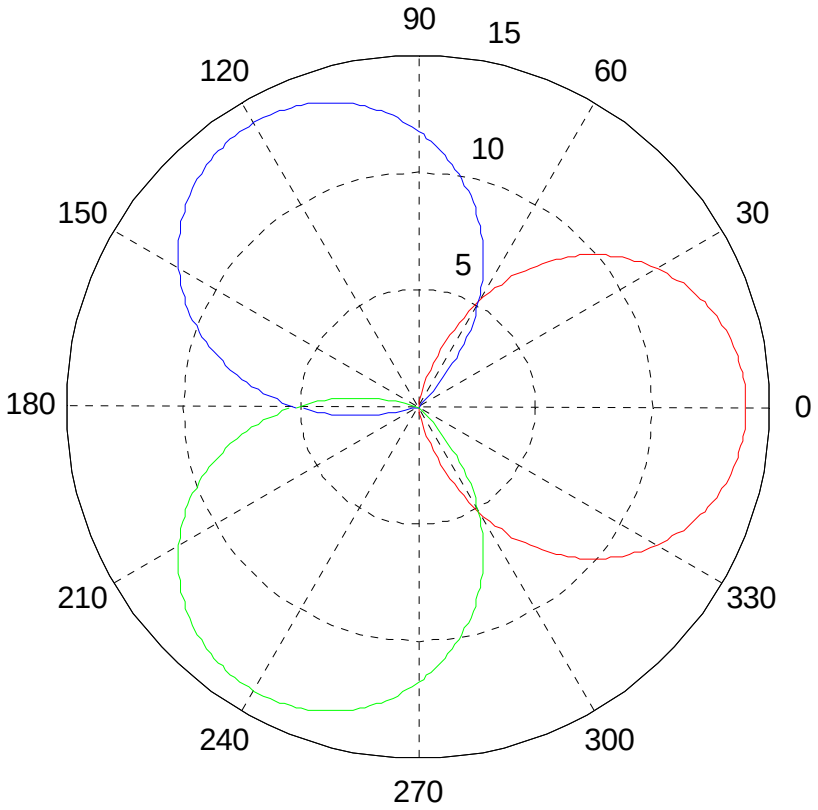


- MU-MIMO is based on *scheduling-directed beamfomring* algorithm

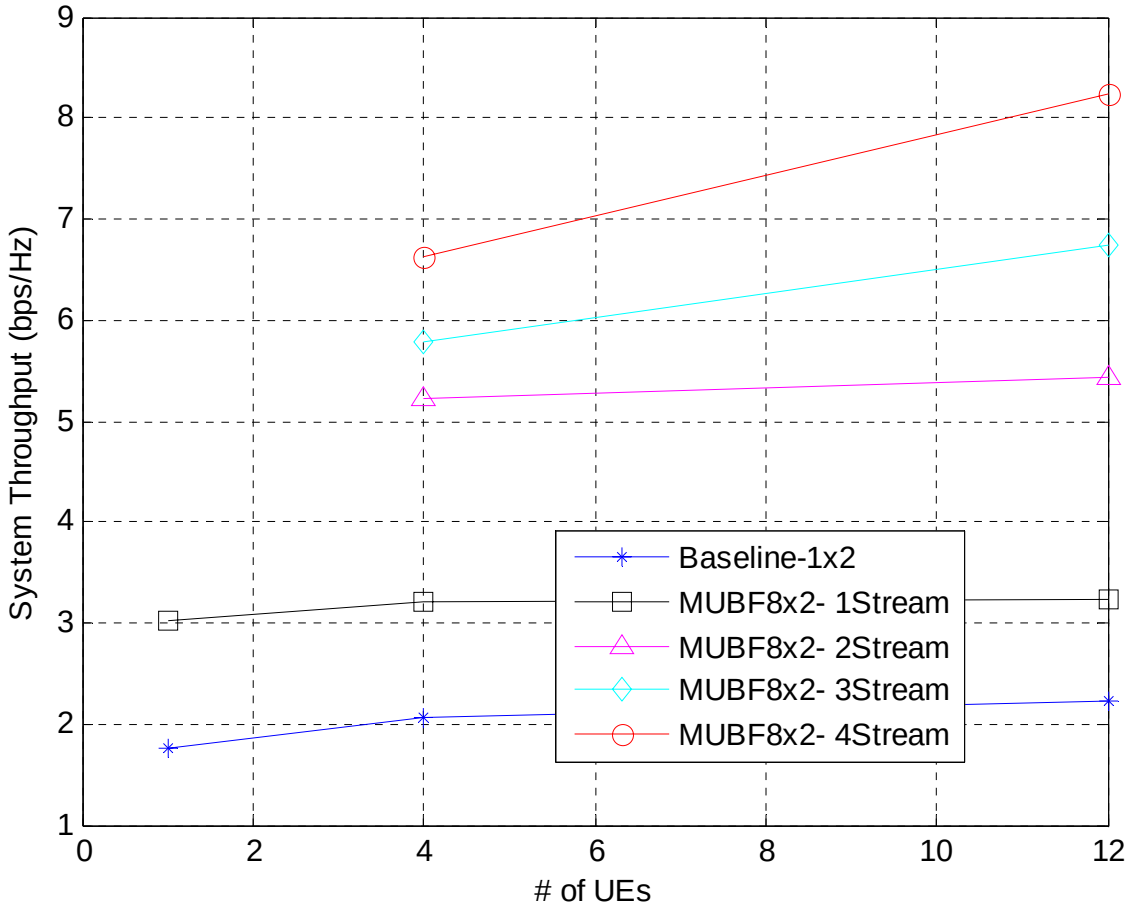
Simulation configurations - macro cell

Parameter	Assumption
Cellular Layout	Hexagonal grid, 19 cell sites, 3 sectors per site
Inter-site distance	500m
Distance-dependent path loss	L= 128.1 + 37.6log$_{10}$(.R), R in kilometers
Shadowing standard deviation	8 dB
Correlation distance of Shadowing	50 m
Penetration Loss	20dB
Antenna pattern	= 70 degrees, A_m = 20 dB 
Carrier Frequency / Bandwidth	2GHz
Channel model	Spatial Channel Model (SCM) simulations
UE speeds of interest	3km/h
Total BS TX power (Ptotal)	46dBm - 10MHz carrier
Users dropped uniformly in entire cell	
Minimum distance between UE and cell	>= 35 meters

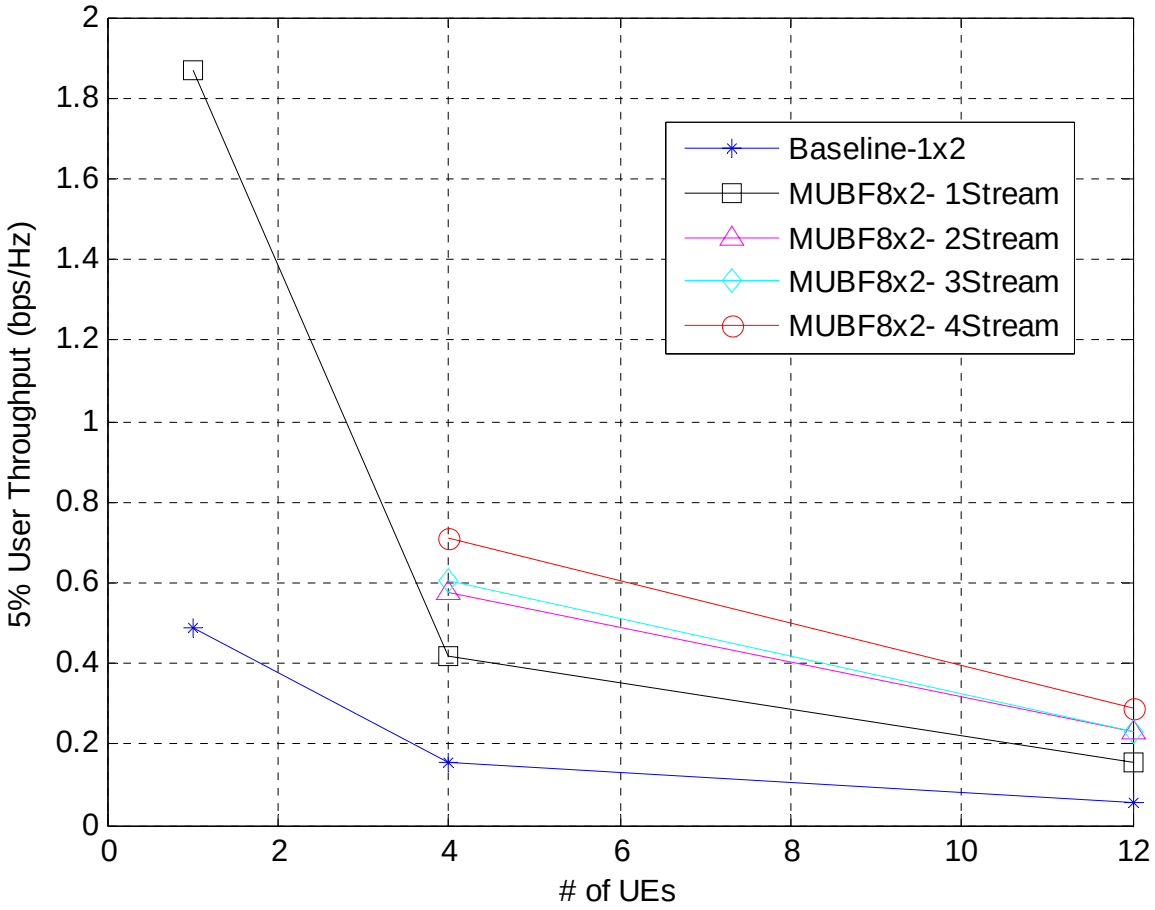
3-sector Antenna



SCM-Urban Macro- #of Beam Isolation=2



SCM-Urban Macro- #of Beam Isolation=2



SU CL MIMO

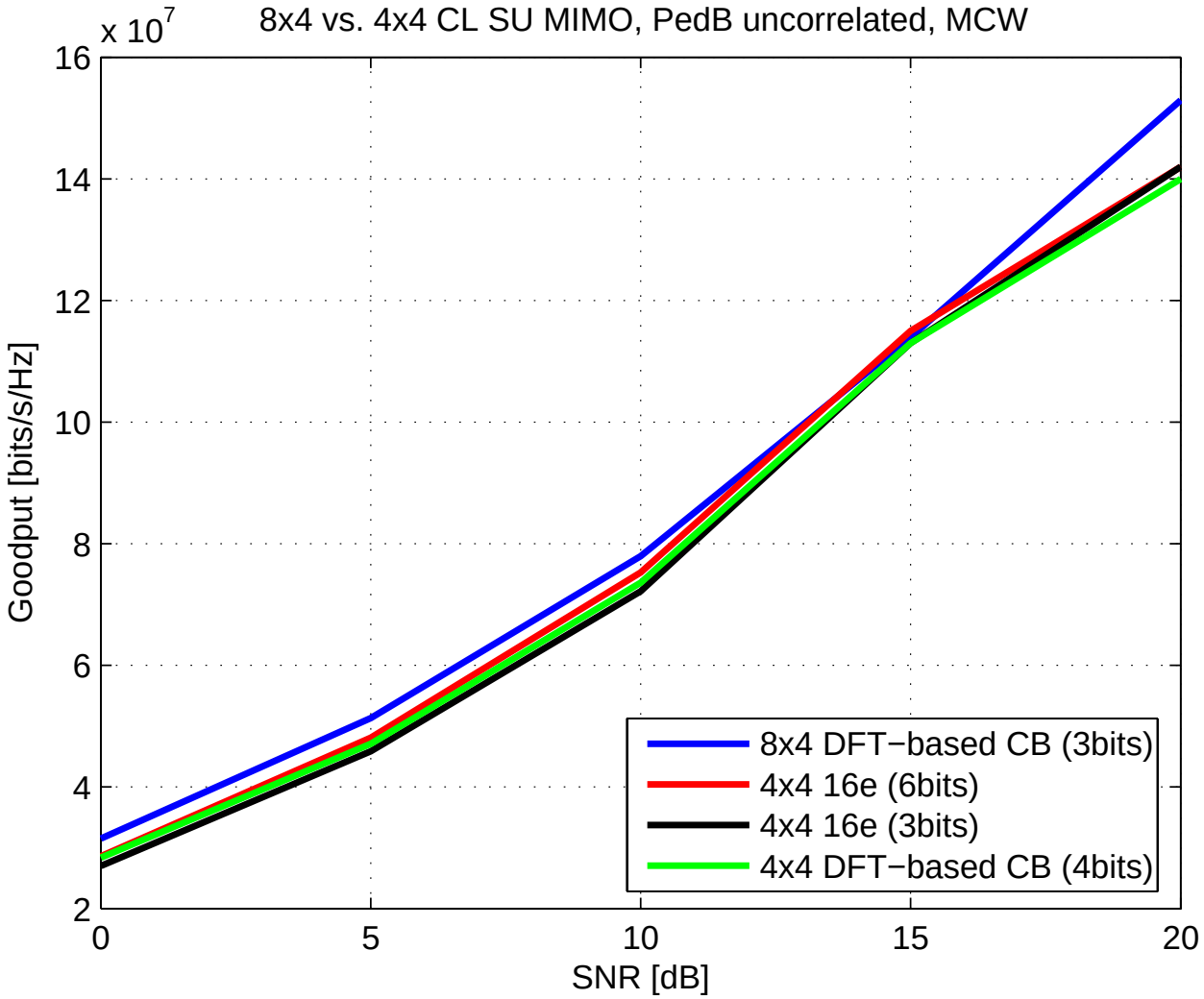
- 8 Tx at the BS leverages the benefits of high rank transmissions (up to 4) with a much higher occurrence than with 4 Tx.

- The transmission format for rank 4 will be defined in 16m: we might as well exploit it properly on the DL.

Simulation Conditions - SU MIMO

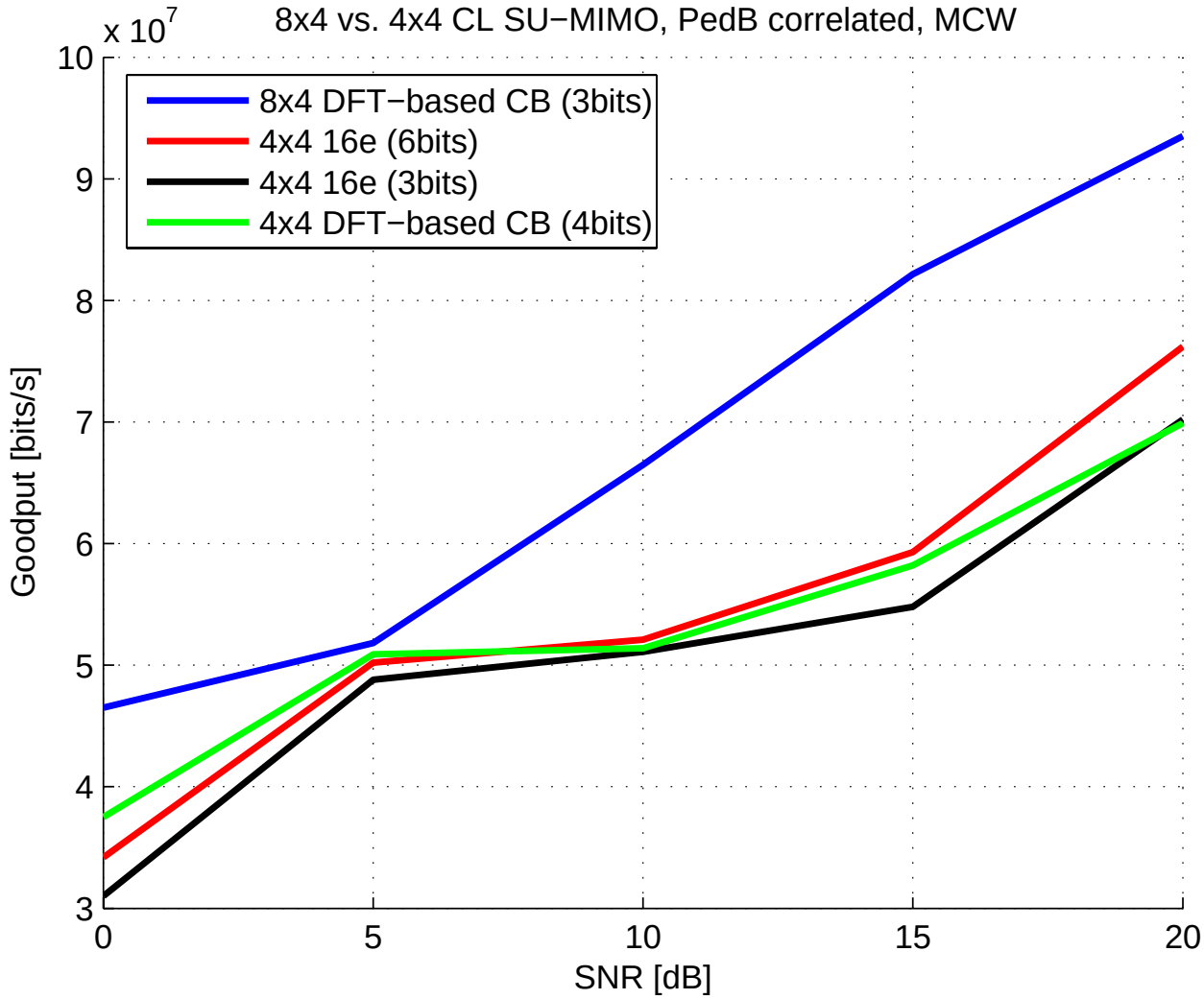
Transmission bandwidth	20 MHz
Centre frequency	2.5 GHz
Subframe duration	0.6171 ms
Subcarrier spacing	10. 938 kHz
FFT size	1024
Number of occupied subcarriers	1008
Number of OFDM symbols per subframe	6
Number of subcarriers per Resource Unit	18
Spatial channel environment	Modified PedB channel, 3 km.h, uncorrelated at MS - Uncorrelated case: 4 wavelengths spacing and 15 degree angular spread at the base - Correlated case: ½ wavelength spacing and 3 degree angular spread at the base - Dual polarized case: +/-45 → V-H, ½ wavelength spacing and 3 degree angular spread at the base
CQI feedback	6 subframes delay, error-free
Uplink sounding	18 dB power difference between DL and UL
Feedback load	Full feedback (for every resource unit), 10 users
Downlink pilot overhead	2 Tx: 11.11%, 4 Tx: 22.22%
Channel estimation	Ideal
MIMO detection method	Linear MMSE
Modulation and coding	10 MCS levels
HARQ	Chase Combining, non-adaptive, 8 subframes retransmission delay, maximum 4 retransmissions

CL SU MIMO 8x4 vs. 4x4
PedB uncorrelated, MCW



(DFT_8x4-16e_4x4_3bits)/16e_4x4_3bits=16.6577 11.8568 7.9602 0.8347 7.6875

CL SU MIMO 8x4 vs. 4x4
PedB correlated, MCW



(DFT_8x4-16e_4x4_3bits)/16e_4x4_3bits=50.0323 6.2152 30.0978 49.9343 33.2179

Conclusion

- 8×4 antenna configuration significant increases average and cell-edge spectral efficiency
- Proposed SDD text
  - In section 11.x.1.1. Antenna Configuration
  - "The BS employs a minimum of two transmit antennas. The MS employs a minimum of two receive antennas. The antenna configurations are (N_T, N_R) = (2, 2), (4, 2), (4, 4), (8, 2), and (8, 4), where N_T denotes the number of BS transmit antennas and N_R denotes the number of MS receive antennas. "
  - In section 11.x.1.2. Codeword to Layer Mapping
  - "The number of spatial streams, M, for SU-MIMO is $M \leq \min(N_T, N_R)$, where M is no more than 4. MU-MIMO can have up to 2 streams with 2 Tx antennas, and up to 4 streams for 4 Tx and 8 Tx antennas."