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Title	**Performance evaluation of 8Tx codebooks**	
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Re:	Category: AWD comments / Area: Chapter 15.3.7 (DL-MIMO) "Comments on AWD 15.3.7 DL-MIMO"	
Abstract	The contribution evaluates performance of various 8Tx codebooks	
Purpose	To be discussed and adopted by TGm for the 802.16m amendment.	
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1

Performance evaluation of 8Tx codebooks

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1. Introduction

Some contributions raised some issues regarding the 8Tx codebook currently accepted in the AWD. Contribution C80216m-09_0941 proposes a new 6-bit codebook for 8Tx. Contribution C80216m-09_0924 claims that a 8Tx codebook previously submitted in the contribution C80216m-09_038r1 outperforms the current AWD codebook. We evaluate the performance of the 6bits codebook of C80216m-09_0941 and the 4bits codebook of C80216m-09_038r1 and compare with performance of current AWD codebook.

2. CL SU MIMO

Figures 1 to 3 evaluates performance of C80216m-09_0941 and AWD codebooks in uncorrelated, correlated and dual-polarized channels. As we can see from those figures, the 6bit codebook proposed in C80216m-09_0941 doesn't provide any significant gain over the current AWD 4bit codebook. There is a slight gain only in uncorrelated at around 10dB where the gain rises up to 4.6%. However there is no gain in dual-polarized and correlated channels, which are primary deployments for 8Tx. The complexity in codebook search of a 6bits codebook is significantly larger than the 4bit AWD codebook.
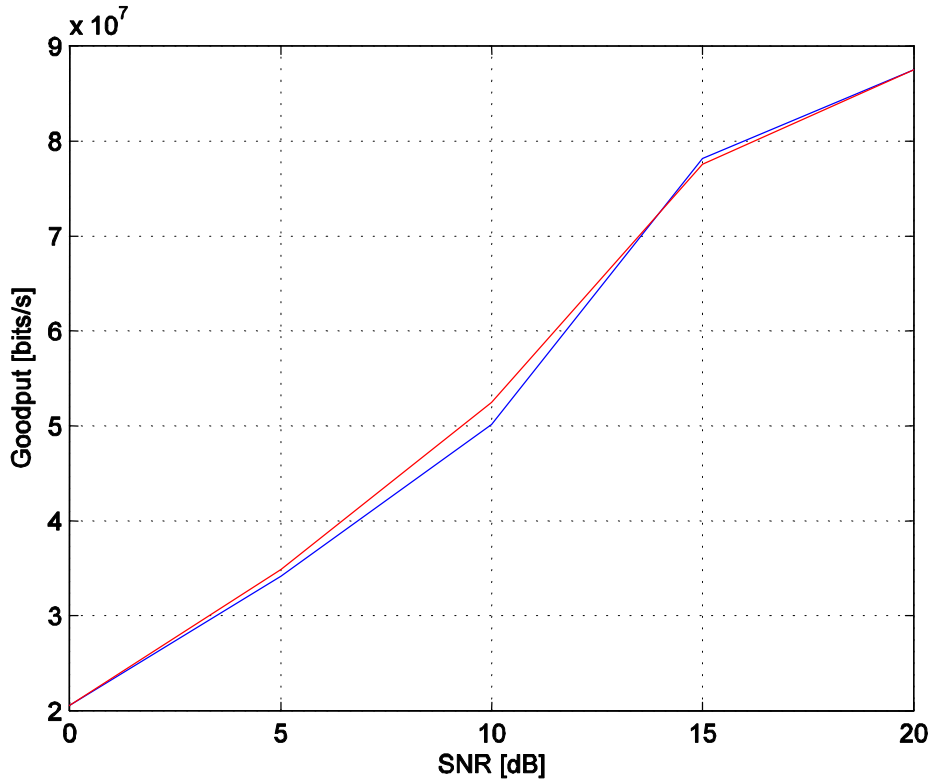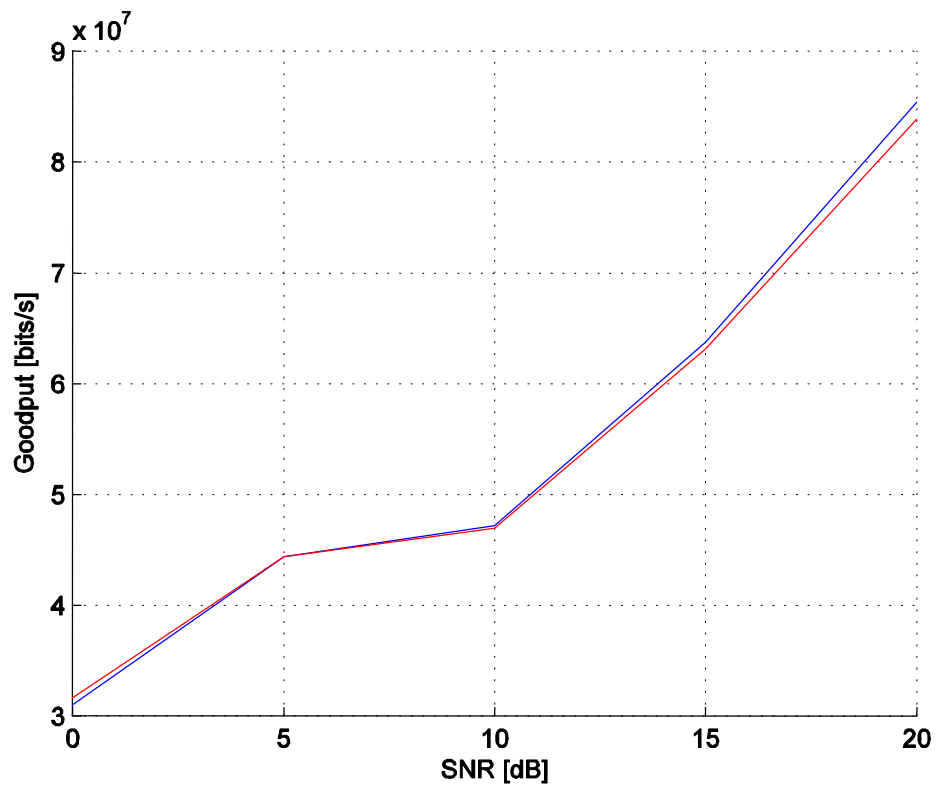

Figure 1. Performance of C80216m-09_0941 6bits (red) and AWD 4bits (blue) codebooks in 8x2 CL SU MIMO over uncorrelated (4 lambda spacing and 15 degrees angle spread) channels

Table 1: Gain of C80216m-09_0941 6bits over AWD 4bit in 8x2 CL SU MIMO over uncorrelated (4 lambda spacing and 15 degrees angle spread) channels

0dB	5dB	10dB	15dB	20dB
-0.2 %	2.0 %	4.6 %	-0.7 %	0.0 %

Figure 2. Performance of C80216m-09_0941 6bits (red) and AWD 4bits (blue) codebooks in 8x2 CL SU MIMO over correlated (0.5 lambda spacing and 3 degrees angle spread) channels
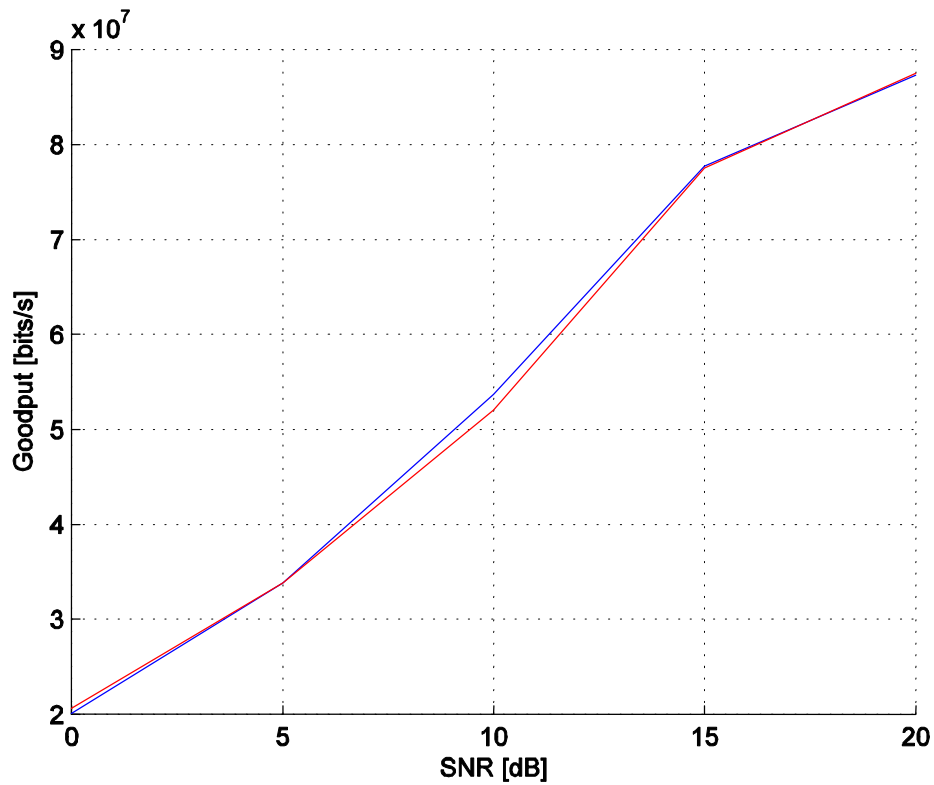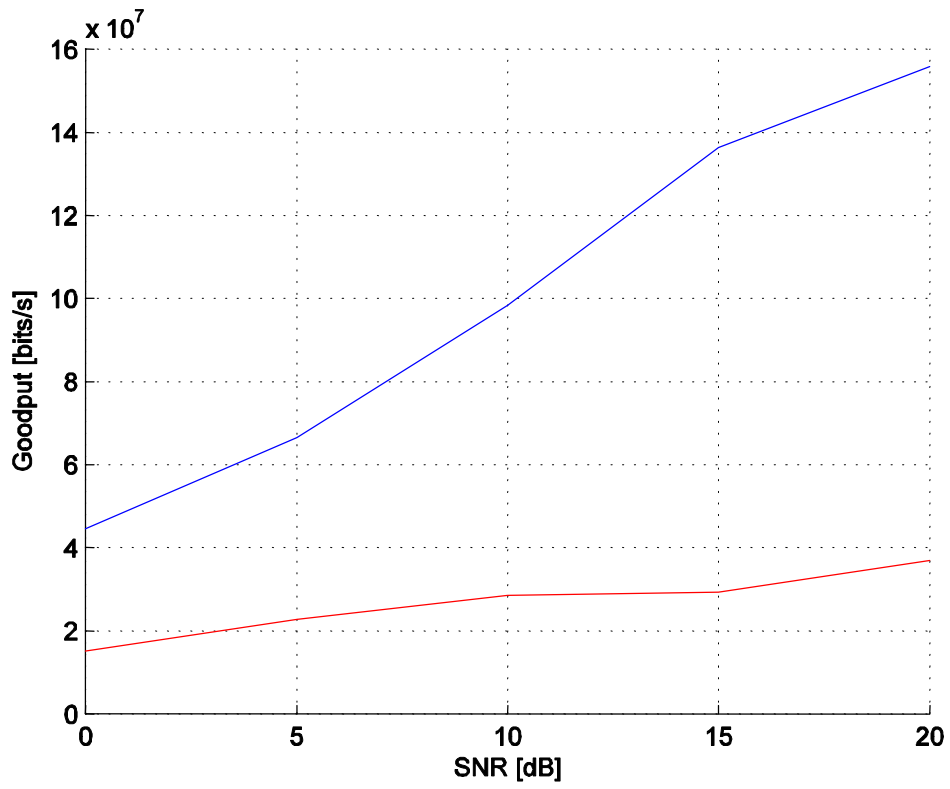
Figure 3. Performance of C80216m-09_0941 6bits (red) and AWD 4bits (blue) codebooks in 8x2 CL SU MIMO over correlated (0.5 lambda spacing and 3 degrees angle spread) dual-polarized 45-VH (8dB XPD) channels

3. CL MU MIMO

Figures 4 and 5 evaluates the performance of C80216m-09_038r1 and AWD codebook in correlated channels (0.5 and 0.7 lambda spacing) in 8x2 CL MU-MIMO transmissions with maximum 4 scheduled users. Those simulations confirm that the current AWD 4bit codebook provides significant gain over C80216m-09_038r1 in MU-MIMO.

Figure 4. Performance of C80216m-09_038r1 4bits (red) and AWD 4bits (blue) codebooks in 8x2 CL MU MIMO over correlated (0.5 lambda spacing and 3 degrees angle spread) channels
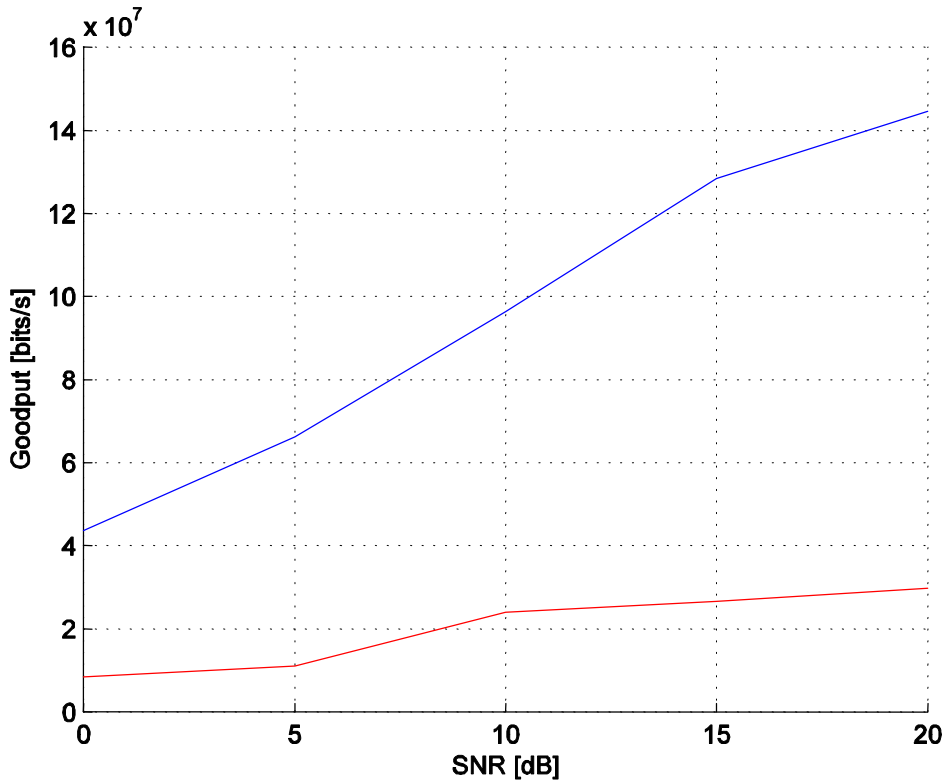
Figure 5. Performance of C80216m-09_038r1 4bits (red) and AWD 4bits (blue) codebooks in 8x2 CL MU MIMO over correlated (0.7 lambda spacing and 3 degrees angle spread) channels

4. Conclusions

The AWD codebook has been shown to provide the best performance. Hence the AWD 8Tx codebook shouldn't be changed.

5. Appendix: Simulation Assumptions

- Channel model: Pedestrian B channel model, 3km/h, linear array
    - Uncorrelated: AS= 15, d/λ=4
    - Correlated: AS= 3, d/λ=0.5 and d/λ=0.7
    - Dual-pol: 45->VH with 8dB XPD
- 10 MHz
- 10 active users
- HARQ (Chase Combining, non-adaptive) with 3 retransmissions
    - Delay first transmission: 8 subframes
    - Delay between re-transmissions: 1 frame (8 subframes)
- CQI, PMI feedback period: every frame (5 ms)
- Link Adaptation (PHY abstraction): QPSK 1/2 with repetition 1/2/4/6, QPSK 3/4, 16QAM 1/2, 16QAM 3/4, 64QAM 1/2, 64QAM 2/3, 64QAM 3/4, 64QAM 5/6
- Ideal channel estimation
- MMSE receiver
- No CQI transmission errors
- ZFBF and SCW CL SU MIMO with rank adaptation
- LLRU (4 PRUs)

1   •   Ideal antenna calibration
2   •   No constraint on PAPR