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**Source:** Infineon Technologies  
**Title:** Rank adaptation in open loop MIMO  
**Agenda Item:** 6.3.4  
**Document for:** Discussion and Decision

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## I INTRODUCTION

Operation of the large delay CDD mode in open loop scenarios (corresponding to high Doppler) has been proposed in [1]:

- No PMI feedback due to channel aging.
- No spatial differential CQI feedback due to intrinsic inaccuracy of channel estimation at high Doppler.
- For rank = 1 transmission, use TxD (SFBC for 2x2, and SFBC-FSTD for 4x2 and 4x4).
- For rank > 1 with 4 Tx, use WcDU, whereby the pre-coding matrices (specified in [1]) are cycled every  $\gamma$  subcarriers, where  $\gamma$  = rank of the transmission.
- For rank = 2 with 2 Tx, use WDU with a fixed precoding matrix (as specified in [1]).
- Support dynamic rank adaptation.

In this contribution, we study dynamic rank adaptation between rank-1 and rank-2 transmissions in a 4x2 configuration for the large delay CDD mode as proposed in [1]. Our study shows that rank adaptation should be performed based on SINR and receiver type, rather than on SINR only.

## II RANK ADAPTATION

The motivation for rank adaptation is to match transmission rate to varying channel conditions to increase network capacity. When channel conditions are favorable, the desire would be transmit higher data rate, and vice versa. High data rate can be achieved by one of two ways:

1. use a higher MCS at a lower rank, or
2. use a lower MCS at a higher rank.

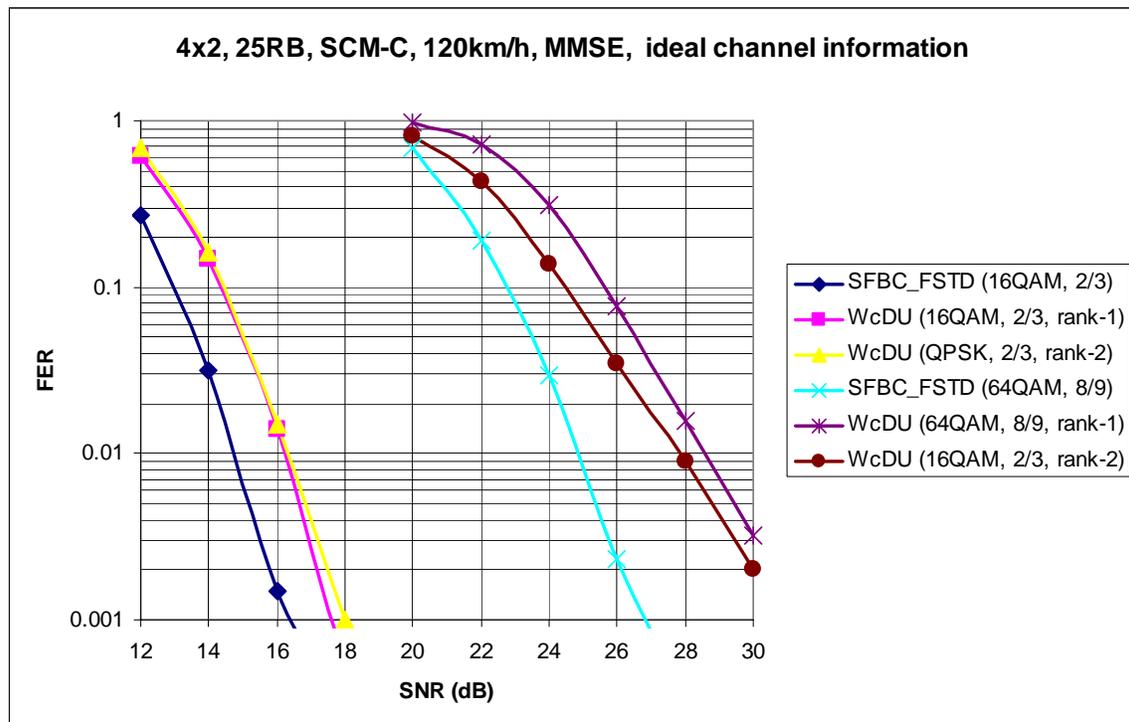
More specifically, we compare rank-1 and rank-2 transmission modes in this contribution. For 4x2 configuration, rank-1 corresponds to SFBC-FSTD, and rank-2 corresponds to WcDU (per [1]). And to make an equitable comparison, we fix the data rate across rank-1 and rank-2, and compare the BLER performance of the two transmission formats. For example, in our study, we chose two data rates, one low and one high. For the low data rate, we have:

- For rank-1 SFBC-FSTD, MCS for CW1 = 2/3 16QAM
- For rank-2 WcDU, MCS for CW1 and CW2 = 2/3 QPSK

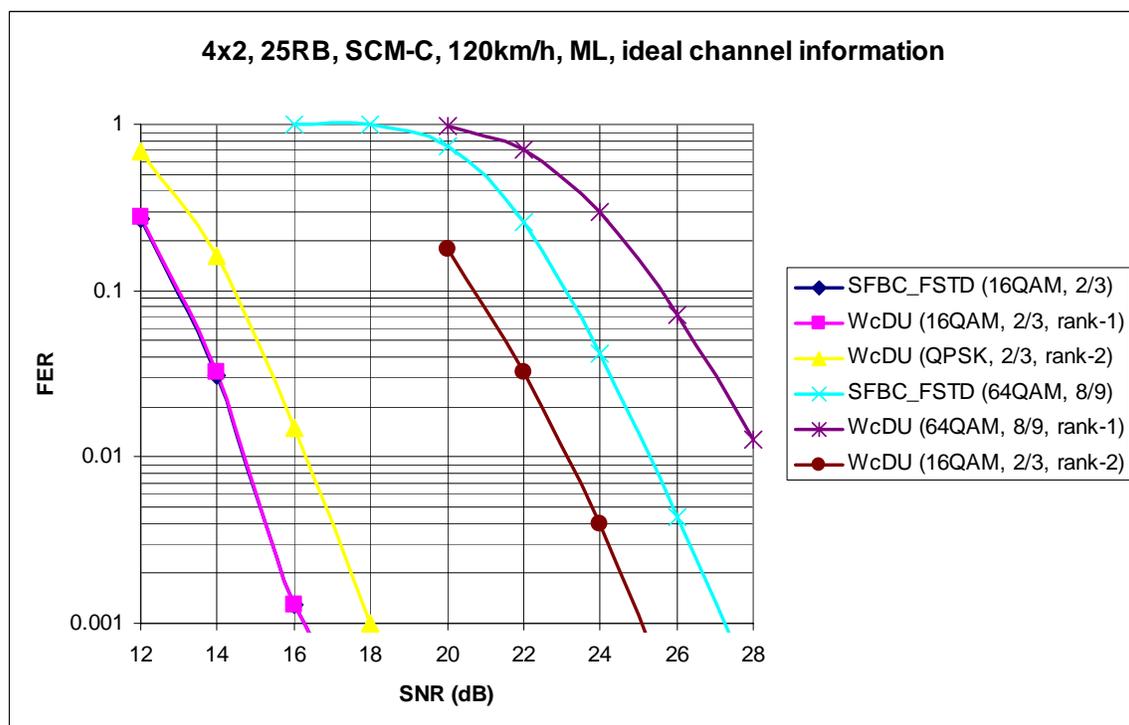
For the high data rate, we have:

- For rank-1 SFBC-FSTD, MCS for CW1 = 8/9 64QAM
- For rank-2 WcDU, MCS for CW1 and CW2 = 2/3 16QAM

We compared the BLER performance of rank-1 and rank-2 schemes for 25RB, in an SCM-C channel, at 120km/hr for both an MMSE receiver and a Maximum Likelihood (ML) receiver.



**Figure 1: BLER performance of rank-1 and rank-2 transmission modes with an MMSE receiver**



**Figure 2: BLER performance of rank-1 and rank-2 transmission modes with an ML receiver**

### III DISCUSSION OF SIMULATION RESULTS

Figure 1 shows the simulation results with an MMSE receiver. At the lower data rate, we observe that SFBC-FSTD performs better than WcDU. Also, both rank-1 WcDU and rank-2 WcDU exhibit comparable performance.

At the higher data rate (corresponding to higher SNR), we observe from Figure 1 that SFBC-FSTD again performs better than WcDU. And, rank-2 WcDU performs better than rank-1 WcDU.

Therefore, we conclude that with an MMSE receiver, regardless of SNR, we would stay with rank-1 SFBC-FSTD rather than switch to rank-2 WcDU.

Figure 2 shows the simulation results with an ML receiver. At the lower data rate, we observe that rank-1 SFBC-FSTD performs better than rank-2 WcDU. However, at the higher data rate (corresponding to higher SNR), rank-2 WcDU performs better than rank-1 SFBC-FSTD.

Therefore, we conclude that with an ML receiver, we would operate with rank-1 SFBC-FSTD at lower SNR, and operate with rank-2 WcDU at higher SNR.

### IV CONCLUSION

Our investigation shows that dynamic rank adaptation during open loop operation using the large delay CDD mode (as proposed in [1]) depends on SINR as well as receiver type. Rank recommendation will be signaled from the UE to eNodeB. And naturally, the UE will select the preferred rank based on its receiver capability as well the SINR. However, if eNodeB chooses to override the rank recommendation from the UE, eNodeB should be aware of the UE's receiver type.

### V REFERENCES

- [1] R1-080579, "Further details on large delay CDD for E-UTRA," AT&T et. al., RAN 1 #51bis, Sevilla, Spain, Jan 2008.