

Source: Motorola
Title: MIMO RS Structure for Unicast/MBMS-Mixed Scenarios
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1. Introduction

During the RAN1#48 meeting in St. Louis, it was agreed that either a) the first or b) the first and second OFDM symbols in an MBSFN subframe would contain unicast control information. If only the first symbol is required for unicast control channel (PDCCH) purposes, then since the first symbol does not contain transmitted RS's for any 3rd and 4th eNB antennas present (i.e. RS_2 and RS_3 could not be transmitted using the RS locations defined in Section 5.6.1.2 of TS 36.211), it is not immediately obvious that CQI measurements (more generally, MIMO rank adaptation and precoding vector optimisation) can be executed for those antennae during MBSFN subframe transmission.

This contribution therefore outlines some options for enabling MIMO CQI measurements of the 3rd and 4th antenna.

2. Discussion

Option 1: If only the first OFDM symbol is assigned for PDCCH purposes in MBSFN sub-frames, then TS 36.211 specifies unicast RS locations for RS_0 and RS_1 . One approach to making available observations of RS_2 and RS_3 would then be to rotate (or generally re-map) the association of RS's with antenna ports in each MBSFN-allocated subframe. For example, in subframe n antenna ports 0 and 1 are respectively associated with RS_0 and RS_1 , while in subframe $n+1$ antenna ports 0 and 1 are respectively associated with RS_2 and RS_3 , and so on.

Option 2: A second approach would require unicast transmission of the second OFDM symbol in an MBSFN subframe or sequence of MBSFN subframes before the first subframe containing a MIMO-enabled unicast transmission. This would permit observation of RS_2 and RS_3 in the currently specified locations in OFDM symbols {0,1} in the first slot of the subframe. However, this approach would place some further constraints on system operation. Specifically, all cells participating in the SFA would need to transmit two unicast control symbols in the specified MBSFN subframes. Nevertheless, this functionality of delivering time-varying PDCCH allocations could certainly be embedded in the semi-statically configured MBSFN subframe sequence, and incorporated by the MCE in transport block dimensioning for delivery over each SFA. Here, the impact of the additional unicast control overhead on the system operation could be minimized if MBSFN subframes were clustered together.

Option 3: A third approach would be to 'puncture' into one or more MBSFN-allocated subframes those reference symbols associated with antenna ports unobservable during the PDCCH transmission interval. For example, if only the first OFDM symbol in an MBSFN subframe were allocated for PDCCH transmission, and therefore only RS_0 and RS_1 were available for processing at the UE, RS_2 and RS_3 would be punctured into the MBSFN portion of the subframe. In this particular approach, if the existing RS_2 and RS_3 locations were used for transmission in OFDM symbol 1 (generic frame structure, and extended CP), the working assumption on MBSFN RS locations (Figure 9 of TS 36.211) means that MBSFN data symbols rather than reference symbols would be punctured. Frequency-adjacent MBSFN data

symbols and unicast reference symbols would be subject to different channel impulse responses, however, with some resulting possibility of MIMO RS SINR reduction. Again, the impact of such RS puncturing on the system could be minimized if MBSFN subframes were clustered together.

Option 4: Another approach would be to enforce the first unicast subframe after an MBSFN subframe to be guaranteed to contain reference symbols for antennae not observable in MBSFN subframes. However, full MIMO link adaptation could not commence earlier than a second unicast subframe. Although this places some constraints on the system, the constraint is cell-specific and its effect can be mitigated again if MBSFN subframes are clustered together.

Option 5: A final approach would be to interlace MBSFN and unicast subframes such that link adaptation of antennas on unicast subframes remains valid for the immediately subsequent unicast subframes. Although this again places some constraints on the system, it does not require modification of the MBSFN structure.

3. Conclusions

In this contribution several approaches were discussed for enabling observation of RS_2 and RS_3 when a multi-antenna eNB is configured to transmit a carrier frequency or frequency layer in a unicast/MBMS-mixed configuration. It is proposed that RAN1 further consider whether RS provisioning in multi-antenna eNB scenarios for unicast/MBMS-mixed configurations needs further adjustment.