3GPP TSG RAN2#59 **R2-073532**
Athens, Greece
20-24 August, 2007

Agenda item: **4.8**
Source: **Motorola**
Title: **UE Capability and MBSFN**
Document for: **Discussion**

1. Introduction

In a companion contribution [1], UE capabilities were discussed with emphasis on DL-SCH reception. This contribution briefly discusses UE capabilities in association with MCH and MBSFN operation.

2. UE MBMS Categories

For point-to-multipoint (ptp) MBMS modes supported over DL-SCH, it seems reasonable to bundle related UE capabilities targeted with the DL-SCH categories outlined in [1]. No MBMS-specific categories appear to be required in this case.

The corresponding task of specifying UE capabilities for MCH MBSFN operation is simplified by the adopted mechanism of time-division multiplexing (TDM) between DL-SCH and MCH-associated (MBSFN subframes) subframes. That is, RAN1 and RAN2 have adopted the approach that the UE is not required to process both types of transport channel in a single subframe. Additional potentially simplifying factors for MBMS delivery via MCH MBSFN include the absence of H-ARQ re-transmission and spatial multi-stream operation.

The absence of MCH H-ARQ acknowledgement means that MCH transport blocks need not obey the same timing constraints for decoding as DL-SCH transport blocks [2]. At the same time, given the time-division multiplexing of MBSFN-allocated subframes and the RAN2-adopted use MCH allocation patterns, it is possible to control the rate of reception of MBSFN-allocated subframes by individual UE's. That is, in a fashion similar to well-established mechanisms for limiting UE data rates in Rel-99 to Rel-7, the network can limit the number of MBSFN allocated subframes per unit time that a UE is required to decode, where the applicable "unit time" is some as-yet-unspecified time interval or window of subframes.

For example, the network can configure the MCH configuration to which a UE is subscribed to avoid requiring UE's to *continuously* receive a sequence of MCH-associated subframes (recognising that in any case at least subframes 0 and 5 will not be MCH-allocated).

From the perspective of defining a maximum MBSFN MCH data rate however, it seems reasonable to align the maximum data rate capabilities of the MBMS categories to the unicast categories outlined in [1]. A set of such MBMS categories appears in Table 1.

Taking the example of Table 1, the absence of dynamic scheduling for MBSFN MCH permits the maximum number of RB's allocable per subframe to scale according to an activity factor captured by parameter n. In the table, n is defined so that if the UE is required to decode an MCH in every MBSFN-allocable subframe, then $n = 1$. If 1 out of every 2 subframes then $n = 2$, while for 1 out of every 3 subframes $n = 3$ and so on. Of course, this assumes a simple, periodic MBSFN subframe allocation pattern, and other slightly more complex patterns may be feasible. Table 1 is therefore intended as a simple example.

MBMS Category	Max. # MBMS MIMO Streams	Max. # RB's	Peak Data Rate (Mbps)
1	1	25*n*	15.5
2	1	50*n*	31.0
3	1	100*n*	62.1

Table 1 – Example MCH MBSFN UE capabilities.

Note finally that, notwithstanding the time division multiplexing of unicast and MBSFN MCH transmissions, potential differences between ACK/NACK timing for DL-SCH and decoding latencies for MBSFN MCH transmission will make essential an assessment of joint decoding limitations of DL-SCH and MCH.

3. UE MBMS Categories and SFN Tracking

Table 1 outlines example MBMS MBSFN capabilities based on an MBSFN subframe allocation pattern transmitted by any source SFN which the UE is accessing in order to receive a specific set of MBMS services. It is worth noting, however, that the single frequency network concept underlying MBSFN use implies that the channel estimation, synchronization and timing tracking, and frequency correction functions and associated UE state variables applicable to each SFN are likely to be mutually distinct, and also distinct from those applicable to unicast reception from the selected serving cell.

Accordingly, a further mechanism to control UE complexity would be to limit the maximum number of distinct MBSFN's that the UE is required to support, regardless of the MBSFN subframe activity pattern applicable to component SFN's. As a specific example, a UE could be required to support access to the unicast serving cell, and additionally a maximum of two (2) MBSFN's.

4. Conclusions

It is proposed that:

a) MBMS UE capability categories applicable to MBMS services delivered in single-cell DL-SCH mode should conform to unicast DL-SCH categories and need not be specified separately.

b) MBMS UE capability categories for MBSFN operation should be specified according the number of MBSFN-allocated subframes receivable by the UE within a specific sequence or "window" of subframes.

    a. The formal definition of the "subframe window" is FFS, and an "MBSFN-allocated subframe" includes any MBSFN-allocated subframe associated with an SFN bearing MBMS services to which the UE is subscribed.

c) Regardless of the data rate delivered by the associated MBSFN's, at any instant in time, a UE is not required to receive transport blocks delivered over more than i) a unicast serving cell and ii) two (2) distinct MBSFN's.

Finally, further evaluation of the interaction of DL-SCH and MBSFN MCH reception is required.

5. References

[1] R1-073531, Motorola, "UE Capability", RAN2#59, Athens, Greece, 20-24 August 2007

[2] R1-073366, Motorola, "HARQ Timing", RAN1#50, Athens, Greece, 20-24 August 2007