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1. Introduction

The working assumption adopted at RAN1#47-bis that MCH-related transmissions should be time-division multiplexed (TDM) on a sub-frame basis with other physical channels (PDSCH and PDCCH etc.) provides an opportunity to formally clarify the assignment of CP lengths in the LTE downlink.

Further, the working assumption, again adopted at RAN1#47-bis, that all subframes of a cell/carrier are either hopping or not hopping and that in practice this implies that carriers with MCH/MBSFN subframes do not hop, can benefit from further discussion.

This contribution briefly discusses both issues and proposes clarifications on CP configuration and usable reference symbols (RS's) for initial and non-initial cell search.

2. Discussion

2.1. CP Length Configuration

RAN1#47-bis determined that the P-SCH and S-SCH are to be allocated to the same sub-frame of a radio frame. An example of the adopted radio frame structure, consistent with the RAN1#47-bis working assumption appears in Figure 1.

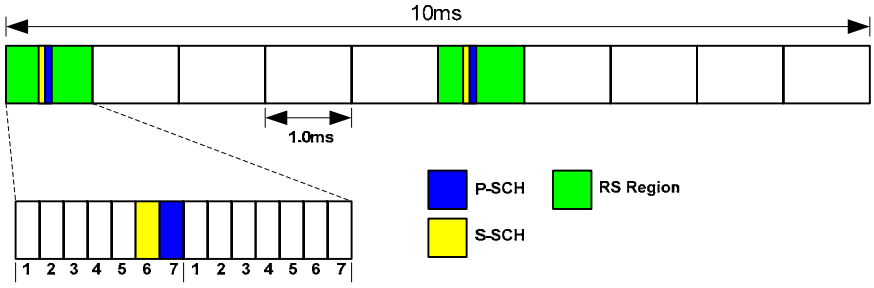

Figure 1 – Radio frame structure showing SCH and related content.

The working assumption that MBSFN/MCH transmission in MBMS-mixed mode be executed on a time-division multiplexed (TDM) basis suggests that – since the (P)-BCH occupies the centre 72 subcarriers of the SCH-associated subframe – MCH transmission is inapplicable to those subframes. Nevertheless, when processing the P/S-SCH and related reference symbols (RS) to determine the cell ID or execute a mobility measurement, the UE must resolve the ambiguity associated with the normal and extended CP lengths. since both CP lengths are applicable to unicast transmission. As discussed in [3], the current working

assumption of Figure 1 implies the UE executes blind CP length detection for subframes containing SCH symbols.

However, having determined the CP length applicable to the subframes containing the SCH symbols, the UE must still determine the CP length applicable to any subframes assigned to MCH use. This step can be simplified by requiring all sub-frames not associated with MCH use to be subject to the same CP length as the SCH-associated subframes. That is, once the CP length associated with the SCH-bearing subframes is identified by the UE, all subframes bearing only unicast physical channels can be safely assumed by the UE to use the same CP length. In the case the SCH-bearing subframes are using the extended CP length, the UE should then be free to assume MCH-associated subframes are also using the extended CP length.

2.2. Eligible Subframes for Mobility Related Measurements

The use of MBSFN-common RS's in a multi-cell MCH configuration, and the possible distinction of the RS time-frequency pattern applicable to those cells from the pattern applicable to unicast transmissions means that multi-cell MCH subframes would nominally be ineligible for mobility measurements.

In general, UE's configured to participate in a multi-cell MCH configuration would have some knowledge of the partitioning of a neighbour cell into MCH-associated and non-MCH-associated subframes (e.g. by participating in a common SFA) but would not of course be aware of all SFA's in which a neighbour cell might be participating. Recognising this, the UE could be required to execute measurements only on those subframes of neighbour cells known to be not associated with MCH transmissions. At present, this appears to be only the SCH- associated subframes.

This restriction is simple, but limits UE's to measure only 20% of neighbour cell subframes. Alternatively, proposals exist for TDM of control information for unicast operation within multi-cell MCH-associated subframes. If such TDM unicast fields were *guaranteed* to exist in all MCH-associated subframes, UE's would be able to execute mobility measurements on the RS's embedded with the first reference symbol on any subframe of a neighbour cell. This would make available a larger set of subframes for measurement purposes.

As a further extension of these observations, cells could provide (via S-SCH or (P-)BCH) indication of whether only the *SCH-associated* subframes or *all* subframes in the cell were eligible for measurement. This, of course, places further requirements on the S-SCH and (P-)BCH bit loading.

2.3. RS Hopping for MBSFN/MCH-Associated Carriers

RAN1#47-bis concluded that all subframes of a cell/carrier are either hopping or not hopping, and accordingly, in practice this could imply that carriers with MCH/MBSFN subframes do not hop at all. The potential restrictions to subframes eligible for mobility measurements above implies, however, that the hopping status of the non-MCH associated transmissions would be inconsequential. That is, either a) MCH subframes are not eligible to be measured, or b) unicast control symbols are present in all subframes and so permit a measurement to be executed in accordance with the normal unicast hopping state. If either a) or b) were adopted, an RS hopping restriction may not be required for MBMS-mixed carriers.

3. Conclusions

It is proposed that the following relatively minor, but still useful, clarifications on CP length allocation be embedded in TS 36.211, i.e. that

a) both subframes in a radio frame containing SCH symbols use the same CP length,

b) all subframes not bearing MCH transmissions[1] use the same CP length as that used by subframes containing SCH symbols, and

c) all subframes containing MCH transmissions use a CP length equal to or greater than that used by subframes containing SCH symbols.

It is further proposed that RAN1 consider the following issues relating to mobility measurements:

1. UE's may be statically or semi-statically configured to observe restrictions on the eligibility for measurement of specific subframes transmitted by neighbour cells. Alternatively, the UE may access a cell- or network-specific indication (delivered e.g. via S-SCH or P-BCH of a target cell or the serving cell) that there is restriction on the subframes of neighbour cells eligible for measurement.

2. When such a restriction is present, only subframes containing SCH symbols transmitted by a neighbour cell are eligible for mobility–related measurements.

3. When no restriction is present, the UE may at least assume that there are unicast fields in all MCH associated subframes i.e. UE may execute mobility measurements on the RS's embedded with the first reference symbol on any subframe of a neighbour cell.

Note that for both 2) and 3), RS hopping (including the constant RS shift sub-case) need not be suppressed for MBMS-mixed carriers.

4. References

[1] 3GPP TS 36.211, "Physical Channels and Modulation"

[2] 3GPP TS 36.300, "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2"

[3] R1-062990, "Outcome of Cell Search Drafting Session", Nokia, Ericsson, Siemens, TI, NTT DoCoMo, Motorola, Freescale, Institute for Infocomm Research, Panasonic, Mitsubishi Electronic, Toshiba, CATT, NEC, Nortel, Interdigital, TSG-RAN WG1 #46bis, Seoul, Korea, October 9 – 13, 2006

[1] *It may be useful to define a physical channel for MCH transmissions – e.g. PMCH.*