

Standardisation updates on HSPA Evolution

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Summary

This newsletter provides an update concerning the latest progress of HSPA standardisation in 3GPP to complete the work for Release 8 on Dual-Cell HSDPA and gives some outlook on what is planned for Release 9. After a study that confirmed the potential gain for various multi-carrier technologies, 3GPP RAN decided for a set of new work items for Release 9. Additional gains can be expected in terms of peak data rates by the combination of Dual-Carrier HSDPA with MIMO and by introducing the concept of Dual-Carrier in the Uplink as well. Furthermore, additional flexibility will be added by supporting new carrier combinations in different spectrum allocations. The work items which are lead by Nokia Siemens Networks and Ericsson are expected to be completed by December 2009 and will ensure the continued evolution and competitiveness of HSPA even in Release 9 and beyond.

Background on HSPA Evolution Release 8

A detailed introduction into HSPA Evolution was given in the Nomor Research white paper *Dual-Cell HSDPA and its Future Evolution* available at <http://www.nomor.de>.

The work item Dual-Cell HSDPA operation on adjacent carriers was completed at RAN#42 in December 2008. The 3GPP 25-series specification has been updated accordingly.

Latest decision within the working groups included the following [1]:

- RAN1 discussed the uplink coverage degradation of the previously agreed uplink control channel structure and agreed to map the HSDPA related feedback information to a single HS-DPCCH instead of two.
- RAN2 concluded that a set of cell-specific parameters is needed for the secondary cell. RAN2 also agreed to introduce 4 new UE categories (21-24) and concluded that there should be a method for UEs to indicate support of dual cell and MIMO capability (but

not simultaneously).

- RAN3 agreed on a principle structure for the necessary additions in the tabular format. It was also agreed to make it possible to establish secondary cells with the Radio Link Reconfiguration procedures.

Study item: UTRA Multi-Carrier Evolution

Dual Cell HSDPA operation has been studied for another meeting cycle in 3GPP RAN and was now closed at RAN #43 in March 2009. As outcome an in-depth analysis by RAN1 was presented mainly looking at the potential gain and complexity of this technology.

The study can be categorised into:

- Dual Cell HSDPA on two separate frequency bands.
- Dual Cell HSDPA together with MIMO in a single frequency band.
- Three and four carrier HSDPA for both single, as well as two separate frequency bands.
- Dual Carrier HSUPA on adjacent carriers.

The following RAN WG1 findings have been reported to RAN plenary [2]:

- The peak rate improvements of all the features are as expected.
- MC-HSDPA and DC-HSUPA provide substantial gains over the combination of single carrier and/or DC-HSDPA operation with the same number of carriers in downlink and dual single carrier HSUPA operation in uplink.
- For the studied highly loaded systems (larger number of users) with full buffer traffic source models, MC-HSDPA and DC-HSUPA provide gains that are smaller.
- In the environments where both the DC-HSDPA and single carrier MIMO benefits manifest themselves, both gains are obtainable simultaneously with MIMO + DC-HSDPA combination.
- MC-HSDPA gains on two separate frequency bands are similar to MC-HSDPA in a single

frequency band.

- Designing the physical layer control channel support for the features does not cause any significant problems and can be considered to be the same for both single, as well as two separate frequency band cases.
- Implementation complexity of the base-band processing is expected to increase linearly with the peak rate.
- The number of new UE categories needed would depend on the number of allowed combinations of the different features and allowed band combinations.

Main contributors to this study items so far were Qualcomm, Ericsson, Nokia/Nokia Siemens Networks, and Huawei.

Release 9 works on HSPA Evolution

Based on the findings of the study item as described before, three new work items were approved by RAN#43 in March 2009 [3]. All of the study items are expected to be completed in December 2009 and will generate quite some work load in the working groups, particularly in RAN4 dealing with the RF requirements and specifications.

1.Support for different bands for Dual-Cell HSDPA [4]

In Release 8 DC-HSDPA can only operate on adjacent carriers. This work item will allow that the paired cells can operate on two different frequency bands. The physical layer operation is unchanged from the Release 8 DC-HSDPA operation. Thus, no RAN1 work is anticipated for this DB-HSDPA work. The two cells will belong to the same Node-B and the mobility is based on one of the carriers only (anchor carrier). Only a set of band combinations will be standardized in order to keep the UE RF implementation feasible. Once the band combinations are agreed, RAN4 will provide this information to RAN2 so that RAN2 can do the necessary updates to the L2/L3 specifications.

2. Combination of DC-HSDPA with MIMO [5]

This work item addresses only a limited set of scenarios. The carriers have to belong to the same Node-B and have to be on adjacent carriers. Furthermore, dual carrier transmission will only apply to HSDPA physical channels. It can be assumed that most of the functionality currently defined for DC-HSDPA and for MIMO will be reused. The basic concepts of DC-HSDPA+MIMO will already be presented in June 2009 prior to RAN#44 followed by the work on the RF requirements and specification. The support of MIMO in combination with DC-HSDPA

will allow operators deploying Release 7 MIMO to benefit from the DC-HSDPA functionality as defined in Release 8. Still it needs to be seen which manufacturers are providing MIMO equipment and which operators are actually deploying MIMO release 7.

3.Dual Cell-HSUPA [6]

This work item addresses also a limited set of scenarios. The carriers belong to the same Node-B and have to be on adjacent carriers. Furthermore, it is assumed that at least 2 carriers are configured simultaneously in the downlink and have the same duplex distance to the uplink. The dual carrier transmission will only be applied to HSUPA UL physical channels and DPCH.

Modifications concerning the specification should mainly affect the following functionality:

- UL and DL control channel structure.
- L2/L3 protocols and procedures
- UTRAN network interfaces
- UE RF and performance requirements
- BS RF and performance requirements
- RRM requirements

The work item rapporteurs of the first two work items are from Nokia Siemens Networks, while the latter work item is lead by Ericsson.

Regarding the work on HSDPA with more than 2 carriers (e.g. up to 4 carriers to support 20 MHz similar to LTE), no additional work item was agreed for Release 9. Nevertheless, it could be foreseen that proposals for such work are made for Release 10 once the previously defined work has been completed.

References

- [1] RP-080814, "Status Report for WI to TSG"
- [2] RP-090318, "RAN1 findings of the UTRA Multi-Carrier Evolution study", Qualcomm
- [3] RP-090xxx Draft Report on RAN Plenary 43, Stefania Sesia
- [4] RP-090015, Work item description "Dual-band HSDPA", Nokia Siemens Networks
- [5] RP-090014 Work item description "Dual-Cell HSUPA", Nokia Siemens Networks
- [6] RP-090332 Work item description "Combination of DC-HSDPA and MIMO", Ericsson

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