3GPP TSG RAN Meeting#18 **RP-020888**
New Orleans, USA 3rd –6th of December 2002

Agenda item: **8.4 High Speed Downlink Packet Access**

Source: **Nokia, Vodafone Group,**

Title: **Applicability of TxAA Mode 2 in HSDPA Channels.**

Document for: **Discussion & decision**

1. Introduction

In this document we address the current TSG RAN WG1 status of TxAA mode 2/HSDPA analysis. TSG RAN WG1 has discussed the applicability of Rel'99 Tx-diversity methods for HSDPA at length. Currently, STTD and TxAA mode 1 have been agreed for use with HSDPA, but TxAA mode 2 is still in "For Further Study"-status.

In line with fundamental decision-making process RAN WG1 expects a full elaboration of possible benefits and drawbacks, including complexity aspects, before concluding whether to include TxAA Mode 2 for use with HSDPA. We further believe that there should be a clear and agreed gain over the existing methods. Unfortunately, the issue has turned out to be non-trivial. Analysis of TxAA mode 2 performance is still far from complete, especially the performance with real antenna verification is questionable. There is clear evidence that TxAA mode 2 is not having any *real* benefit even over single antenna transmission, whereas RAN WG1 already agreed that TxAA mode 1 does show a benefit over single antenna transmission in HSDPA.

2. Status of TxAA/HSDPA analysis

2.1 General aspects

There is a clear need for separate HSDPA analysis of Tx-diversity methods because of different (from DCH) Link Adaptation methods being employed (16-QAM, no PC, HARQ, AMC + schedulers). It is well known that Closed Loop methods are suffering due to many practical issues. For example, real antenna verification has been considered, in addition to which we have also some general multiantenna imperfection effects (as power unbalance at Node B & chip synchronization error), and variations of environment (multipath, velocity, feedback errors & feedback delays etc.). Thus, instead of evaluating TxAA based only on ideal performance results, we are interested in the end performance with major imperfections considered: Is there any real benefit from the technique and what is the required complexity for achieving it?

2.2 TxAA mode 1

In RAN WG1, the decision of including TxAA mode 1 for use with HSDPA channels was based on wide support of both manufacturers and operators – at the end, no objections against mode 1 were proposed. Also, there weren't any essential objections against the analysis and results of mode 1 presented in TSG RAN WG1 – active discussion in the issue has been open. One should bear in mind that RAN WG1 has been faced with the same practical issues in the analysis of both TxAA modes 1 and 2. Antenna verification results have been one of the important topics - there is quite an exact and well known verification algorithm for mode 1 described in the annex of Rel'99/'4 specification. Hence it can be seen that *the decision for TxAA mode 1 was based on the full understanding (together with the required analysis) about the applicability of mode 1 for HSDPA, in addition to wide and active support by several companies.*

2.3 TxAA mode 2

There are several serious problems in the applicability of mode 2 for HSDPA, which has been pointed out in RAN WG1, with demonstrations by corresponding simulation curves (see e.g. [1], [2] and [14]). We see that there is still a

lack of understanding on a fundamental level between the results of different companies – e.g. in the results with real antenna verification and 16-QAM. Furthermore, there are some conceptual problems with HSDPA, such as power unbalance and 16-QAM-constellation estimation, which are still without any concrete solution. It should be noted that there has been only one company actively supporting TxAA mode 2 for HSDPA, and there is a lack of interested companies to provide impartial analysis.

The following list summarizes the current status at RAN WG1:

- Problem with TxAA mode 2 over HSDPA: Antenna verification is having a key role in performance (a significant difference between the ideal & no verification results): How far are we really from the ideal results utilizing real antenna verification?
    - Difference from DCH is now that the power of HS-DSCH may be remarkably higher and the verification is done based on DCH pilots.
- It is our experience that there is no real gain over the existing modes if utilizing TxAA mode 2.
    - Also, it's quite questionable what would be the real network level coverage/outage of TxAA mode 2 because of rather narrow application area even with ideal assumptions.
    - Nokia results depict the average performance seen by the network [1], [2], [14].
- The discussion in TSG RAN WG1 has not been open in the area of reference antenna verification algorithm for TxAA mode 2.
    - No clear and exact reference algorithm (verification) is available in order to calibrate the performance results resulting in unclear performance and complexity assessment.
- A lot of time has been available for completing the analysis (~ one year), and we are still at the very beginning with TxAA mode 2 (e.g. trying to agree BLER curves with real antenna verification to synchronize understanding among companies). Therefore, it is questionable whether more time would help.
    - Problems have been pointed out early enough.
    - No progress really made in fundamental questions.
    - Other companies have shown little interest, so not really felt as an important feature?
- There are some other issues concerning Mode 2 that are still without any solution:
    - Power unbalance between Tx-antennas when utilizing TxAA mode 2 with HS-DSCH: Since of high power and few UE's the characteristic power unbalance of Mode 2 (6 dB between the Tx-antennas) is causing Power Amplifier problems in node B, and may impact coverage behaviour during the operation.
    - In order to guarantee the performance of TxAA mode 2 there seems to be a need for setting tighter RF requirements already for rel'99 and rel'4 for BS TX power measurements and accuracy (see [15]). This is indicating that TxAA mode2 does not match to the existing power accuracy schemes in BS defined for rel-99 and –4 and deployed in the market already. Both STTD and TxAA mode 1 seem quite robust to power unbalance at Node B, i.e.There is no need to set any further requirements for STTD and TXAA mode 1.

3. Conclusion

In this document we summarized the current TSG RAN WG1 status of TxAA/HSDPA analysis. As a conclusion we can see that there is no common agreement in WG1 on the applicability of mode 2 for HSDPA. We also think that in RAN WG1 there has been enough time (~one year) to complete the analysis if companies were to consider TxAA mode 2 as an important feature of HSDPA. Based on technical arguments presented above, Nokia cannot agree on specifying TxAA mode 2 for HSDPA channels.

4. References

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[15] R4-02-1188, "Proposal to correct transmit diversity in 25.104", TSG-RAN WG4#24, Helsinki, Finland, August 12-16, 2002.

[16] R1-02-1078, "Inclusion of closed loop mode transmit diversity for HSDPA", TSG-RAN WG1#28, Seattle, USA, August 19-22, 2002.