3GPP TSG RAN WG1#19 ***TSGR1#19 R1-01-0335***
Las Vegas, United States, February 27 – March 2

Agenda item: **Ad Hoc: Tx diversity**

Source: **Nokia**

Title: **Backward Compatibility with Tx-Diversity Extensions**

Document for: **Discussion**

Introduction

In the context of Rel-5 Tx diversity study item several diversity extensions for 4 Tx-antennas have been introduced in 3GPP. Both closed loop and open loop schemes have been considered, such as Siemens' eigenbeamformer [1], Siemens' STTD extension for PICH [2], Motorola's OTD+STTD [3], Nokia's mode 1 extensions for 4-Tx-antennas [4], Motorola's proposal [5] and Samsung's proposal [6]. In order to estimate the required two additional channels there are two discussion proposals for CPiCH extensions, namely symbol level extension concept by Siemens [7] and sum channel proposal by Samsung [8]. Also, Fujitsu's proposal [9] treats pilot extension, as well as documents [10], [11].

4-antenna Tx diversity schemes require a separation of the four channels. It has been proposed that this could be achieved by utilizing both primary and secondary CPiCH. In simulations this far it has typically been assumed that –10dB of the total energy of Node B is used on common pilots. Basically, there are a couple of possibilities in extending the 2-antenna Tx diversity pilots for 4 antennas. One can double or at least reasonably increase the total CPiCH energy in order to quarantee channel estimation performance (e.g. –7 dB), or one can share the –10dB pilot energy among four channels. The latter approach has been employed up to now; otherwise the power increment should be decreased from the achieved diversity gain and the corresponding comparisons with 2-antenna Tx schemes should be generated. In this document, we assume that the total CPiCH energy is kept unchanged at –10 dB.

Rel'99 backward compatibility is naturally the key criteria in examining diversity extensions; full functionality of Rel'99 UE's should be quaranteed in a UTRAN of later release. This document points out three specific UE measurements that seem likely to cause serious problems when extending TX diversity to 4 antennas through sharing CPiCH energy with primary and secondary channelization codes.

Three measurement problems

When looking into the proposed 4-antenna Tx diversity schemes, four strong symmetric (i.e., equal power) common pilots for channel estimation seem very important in order to guarantee the claimed performance. The proposed 4-antenna Tx diversity simulation results appear to be generated assuming symmetry. Hence the common pilot energy of –10dB has been divided equally among P-CPiCH and S-CPiCH which means that only 50% of P-CPiCH energy as specified in Rel'99 for 2-antenna Tx diversity concept is available for Rel'99 terminals in a Node B employing this kind of 4-antenna scheme.

On the other hand, there are several critical UE measurements that are required to be calculated from P-CPiCH only (according Rel'99 specification), e.g. measurements for

1) SHO evaluation,

2) Idle mode cell re-selection,

3) Cell synchronization.

Problem 1) could be solved in principle by adding a 3 dB offset at Node B for UE CPiCH measurements. However, measurements 2) & 3) would cause blind areas for rel'99 terminals or they would force UTRAN to reduce downlink cell size; in case only P-CPiCH would be transmitted with –10dB (i.e. 2-antenna Tx diversity case), the corresponding cell radius in forward link is larger due to greater (3dB) received pilot energy! Hence, when utilizing S-CPiCH the diversity gain is obtained partly with the cost of cell coverage.

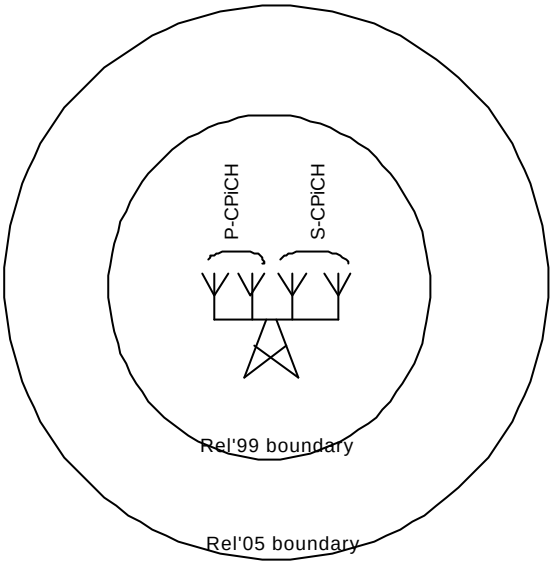

Figure 1. Change in the effective area of Node B when pilot energy is distributed to P-CPICH and S-CPICH

Conclusion

In order to extend the Tx-diversity functionality for 4 antennas, Rel'99 backward compatibility problems concerning common pilots should be solved. Furthermore, if the common pilot energy of Node B using 4-antenna Tx diversity increases compared to 2-antenna Node B, this gain should be taken into account when evaluating the performance of 4-antenna Tx diversity over the Rel'99 2-antenna method.

References

[1] Siemens, "Advanced closed loop Tx diversity concept (eigenbeamformer)", (TSGR1#14(00)0853) 3GPP TSG RAN WG 1, Meeting #14, 4-7th, July, 2000 Oulu, Finland.

[2] Siemens, "STTD coding method using up to four antennas to improve the performance of Indicator Channels (PICH)", 3GPP TSG RAN WG1#14, *TSGR1#14, R1-00-0852*, Oulu, Finland, July 4 – 7, 2000.

[3] Motorola, "Extended sttd with switching for open loop transmit diversity for more than 2 antennas", 3GPP RAN TSG WG1 meeting, Yokohama, Japan, February 22 1999.

[4] Nokia, "Proposal for extended closed loop mode 1 concept to T_x diversity TR", (TSGR1#13(00)0712) 3GPP TSG RAN WG1, Meeting #15, 22-25th, August, 2000,Berlin, Germany.

[5] Motorola, "Closed loop transmit diversity mode 2 with reduced states for 4 elements", 3GPP TSG RAN WG1, TSGR1#15(00)1132, Meeting #15, 22-26th, August, 2000, Berlin, Germany.

[6] Samsung and Seoul National University, "Proposal for the use of closed loop Tx diversity with more than 2 Tx Antennas", TSG-R WG1 document, TSGR1#12(00)0506, 10-13th, April, 2000, Seoul, Korea.

[7] Siemens, "Possible Enhanced Transmit Diversity Pilot Patterns", TSG-RAN Working Group 1 meeting #15, *TSGR1#15(00)1117*, Berlin, Germany 22 – 25 August, 2000.

[8] Samsung, "New CPICH Transmission scheme for 4-antenna transmit diversity", TSG-RAN Working Group 1 meeting #15, *TSGR1#15(00)1072*, Berlin, Germany, August 22 - August 25, 2000.

[9] Fujitsu, "Enhance the Beamfoming Feature of the Multiple Antenna Tx Diversity Enhance the Beamfoming Feature of the Multiple Antenna Tx Diversity", TSG-RAN Working Group 1 meeting No. 15, TSGR1#15(00)-1065, August 22– 25, Berlin, Germany.

[10] Siemens, "Text proposal for RAN WG1 report on Tx diversity solutions for multiple antennas", 3GPP TSG RAN WG 1, *TSGR1#15 R1-00-1126*, Berlin, Germany, August 22-25, 2000.

[11] Siemens, "Simulation parameters for Tx diversity simulations using correlated antennas", 3GPP TSG RAN WG 1, *TSGR1#16 R1-00-1180*, Pusan, Korea, October 10-13, 2000.