TSG-RAN Working Group 1 meeting #19 **TSG R1-01-0275**

Las Vegas, USA
February 27th – March 2nd, 2001

Agenda item: 15 (Rel 5: Radio link performance enhancements)
Source: NEC
Title: Enhancement of SSDT for Release 5
Document for: Discussion and Decision

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1. Introduction

In Release 99 specifications, SSDT (Site Selection Diversity Transmit power control) is included in order to increase downlink capacity. Although the capacity gain of SSDT is somewhat reduced with the transmission of DPCCH from non-primary cells, the impact is small when the channel bit rate is high. This feature is desirable to introduce high-speed communication services in UTRAN.

However, the impact of DPCCH transmission is not small on low bit-rate channels because the transmit power ratio of DPCCH is not small. In order to improve the performance of SSDT, we propose to make a work item for the enhancement of SSDT for Release 5.

2. Impact of DPCCH transmitted from non-primary cells

The average transmit power per mobile station, i.e. the sum of average transmit power of all cells in the active set, is evaluated in multi-cell environment by means of computer simulation. The simulation assumptions are listed in the appendix in this contribution. The impact of the following parameters are investigated:

- P_{OFFSET} : Relative power offset between DPCCH and DPDCH
- R_{DPCCH} : Ratio of DPCCH bits in DPCH

Figure 1 shows the transmit power for the velocity of UE between 4 km/h and 80 km/h. Figure 1 shows that the gain of SSDT is negative regardless of the velocity when P_{OFFSET} is 3 dB and R_{DPCCH} is 0.2.

Figures 2 shows the transmit power with P_{OFFSET} of 0 dB and 3 dB for the ratio of R_{DPCCH} between 0 and 0.4. When P_{OFFSET} is 0 dB, the gain of SSDT is reduced by 1 dB at R_{DPCCH} of 0.2 compared with R_{DPCCH} of 0. When P_{OFFSET} is 3 dB, the gain of SSDT is reduced by 1.7 dB at

R_{DPCCH} of 0.2 compared with R_{DPCCH} of 0. This means that there is a significant room for improvement.

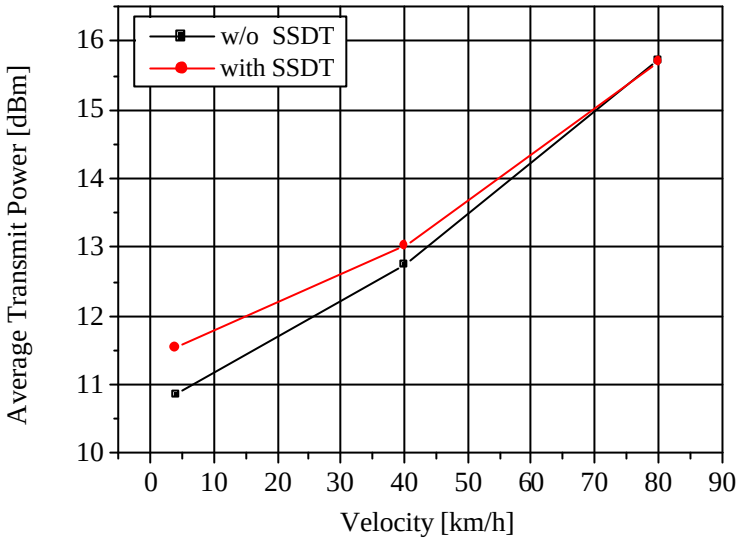

Fig.1 Transmit Power for the velocity of UE (P_{OFFSET} = 3 dB, R_{DPCCH} = 0.2)

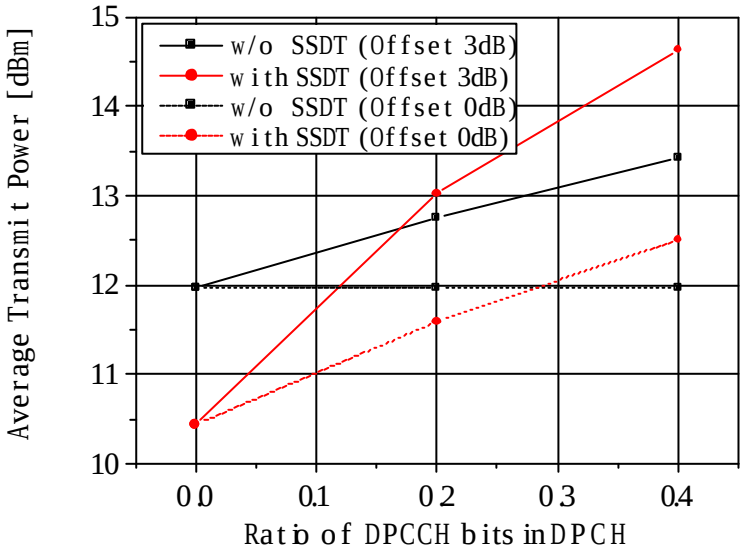

Fig.2 Transmit power for the ratio of DPCCH bits (Velocity = 40km/h)

3. Possible Solutions

Following solutions are identified:

(1) Modification of TPC procedures in non-primary cells
(2) Modification of primary cell selection

(1) Modification of TPC procedures in non-primary cells

In the first solution, DPCCH of non-primary cells is switched off. Impact on the uplink interference should be evaluated because non-primary cells suspend transmission of TPC commands.

(2) Modification of primary cell selection

In the second solution, more than one cell is selected as primary cells when the difference of CPICH RSCP between active cells is small. In addition, DPCCH of non-primary cells is switched off. Impact on UE and Node-B should be investigated because additional mechanism is required in UE and additional option is required in Node-B.

4. Conclusion

In this contribution, it is shown that there is a room for radio link performance improvement in SSDT, and possible solutions are identified. Considering the room for improvement, we propose to make a work item for the enhancement of SSDT for Release 5.

Appendix: Simulation assumptions

Simulation assumptions are as follows:

- 19 cells are arranged in a lap-around manner. Cell radius is 1.73 km
- Path loss exponent is 3.76, and standard deviation of shadowing is 8 dB.
- Vehicular-A model is used, and number of RAKE fingers is 6.
- Antenna diversity is not used.
- Processing Gain is 480 (26.8dB).
- Frame error is detected when the medium of received SIR is less than 2 dB.
- In soft handover, thresholds for addition and removal of active cells are 5 dB and 7 dB respectively. Maximum active set size is 3.
- Update delay of active sets is 250 msec.
- Inner loop is applied in downlink with the step size of 1 dB. The TPC bit error rate for the inner loop is 0.01 in the best branch. In other branches, the TPC bit errors are generated based on received SIR.
- Outer loop is applied in downlink with the target frame error rate of 0.01.

- Power balancing is applied with Adjustment Period of 1 frame, Adjustment Ratio of 0 and Maximum Adjustment Step of 2 slots for 1 dB adjustment.
- In SSDT, ID code length is 15 bits, and ID codes are transmitted once in every radio frame. Number of ID codes is 3. ID codes are used for primary cell selection regardless of the received SIR, i.e. the quality threshold for the ID codes is very low. Errors of ID codes are generated based on the received SIR.