

Agenda Item:

Source: Lucent Technologies Inc.

Title: Further comments on transmit diversity schemes

Document for: Discussion and decision

Background

During WG1#15, it was agreed, for a variety of reasons [1], that TX diversity schemes with more than two antennas shall not be included under 3GPP Release 4.

In this paper, we re-affirm some of the points raised earlier by Ericsson [1] and note that many of the issues and comments are still relevant today. In addition to those issues from [1] which remain unanswered, we raise some new issues that affect the potential viability of enhanced transmit diversity schemes with more than 2 transmit antennas.

Work status

We note that many of the simulation results presented to date show considerable inconsistency of results. Even baseline cases for a single reference antenna have been reported with inconsistent E_c/I_o performance. The closed loop mode 1 curves, also used as a reference baseline for newly proposed schemes, show significant variations from one report to the next. It is likely that the simulation conditions are not sufficiently clear to allow meaningful comparisons between proposed schemes.

Performance Issues

In an operating system, the performance of closed loop schemes will be adversely affected beyond the error rates of the reverse link feedback. In soft handoff zones, it is well known that much of the time, the reverse link is effectively broken since the mobile only transmits enough power to reach the nearest base station. The other cells in the active set will be running extremely high FER on their reverse links and the impact of this on closed loop diversity schemes has not yet been evaluated. With more than two transmit antennas, we anticipate that the problem would be worsened, since the additional antennas would be allowing the UE to operate under even harsher conditions.

Another performance issue that comes up in the context of soft handoff is the problem of using the feedback signals to support multiple antennas across multiple base stations. With closed loop mode 1 and a UE in 3-way soft handoff, the UE would be sending back one pair of antenna coefficients that would be applied to 3 different antennas in 3 different base stations. This will clearly degrade the performance of the closed loop system since the antenna coefficients chosen must be a compromise across all the cells in the active set. Once again, we would expect this problem to be exacerbated by the extension to more transmit antennas.

It is well understood that the majority of the improvement in diversity systems arises from adding the first diversity antenna, and that adding subsequent antennas will have diminishing returns. Since the incremental improvements relative to 2 antenna transmit diversity are not large, it is possible that they may in fact be cancelled out by the system level degradations discussed in this section.

Complexity and Backwards Compatibility

As discussed in [1], a number of complexity issues exist, particularly related to backwards compatibility and the impact on Release99 UE.

In addition to those cited in [1], we believe there are additional complexity issues associated with soft handoff. Extensions to the signalling for the reverse link have been proposed to accommodate more than two transmit antennas. In the previous section, we identify potential performance degradations in soft handoff that impact the viability of the enhanced transmit diversity schemes. An open question is the management of the reverse signalling for transmit diversity when in soft handoff between cells with different numbers of transmit antennas. Unless we are willing to assume that all base stations would have, for example, 4 transmit antennas, a method would be needed to support handoff between cells with differing numbers of antennas and the dynamic combinations possible while moving through a system. A method of supporting closed loop feedback in soft handoff with differing numbers of antennas appears to require either an increase in the reverse link signalling rate or, keeping the reverse link signalling rate constant, a degradation of performance.

Conclusion

In conclusion, we re-affirm the significant points raised in [1] and identify a number of new issues related to the performance and complexity of the enhanced transmit diversity schemes while in soft handoff. We also note that, as stated in [1], alternative solutions (e.g. adaptive antennas) are available which yield performance gains without the need for increases in UE complexity or significant rework in the standards.

Consequently, we recommend that RAN WG1 and TSG RAN a) not continue work on this work item and b) not include any new TX diversity schemes into release 5 specifications.

Reference

- [1] R1-00-1054, "Comments on transmit diversity schemes with more than two antennas", Ericsson, 3GPP RAN WG1#15.