Agenda item:	AH24 : High Speed Downlink Packet Data Access
Source:	Lucent Technologies
Title:	Complexity of Node B for MIMO architectures
Document for:	Proposed text contribution for TR

1. INTRODUCTION

We propose text for a new section 7.4.3 on MIMO Node B complexity in the Technical Report [1]. This text is based on a previous contribution [2].

2. PROPOSED TEXT

The block diagram for M antenna MIMO HSDPA transmission is shown in Figure 3 in Section 5.4. A single antenna transmitter demultiplexes the high speed data stream into N lower rate substreams (N is the number of Walsh spreading codes) whereas the MIMO transmitter demultiplexes the stream into MN lower rate substreams. In terms of baseband processing, the MIMO demultiplexers require minimal additional complexity over the single antenna demultiplexers. For backwards compatibility, non-MIMO transmission on other dedicated channels are transmitted over antenna 1. The MIMO and non-MIMO signals will not interfere with each other since the Walsh codes used are mutually orthogonal. Orthogonal pilot sequences are also transmitted from each antenna to allow for timing acquisition, synchronization, and/or channel estimation.

The power of the MIMO transmissions are normalized so that for the DSCH so the total transmit power summed across the M antennas is the same as for the single antenna transmission. Hence while multiple power amplifiers are required for MIMO transmission, (typically one per transmit antenna), the loading on any of these amplifiers will be reduced compared to the power amplifier in a single antenna system. Furthermore, because MIMO transmission uses smaller data constellations, the peak-to-average power ratio is also reduced

In the same way that transmit diversity techniques rely on uncorrelated fading among pairs of transmitter and receiver antennas, high spectral efficiencies of the MIMO system also rely on uncorrelated fading. The correlation depends on the spacing between antennas and height of the antennas with respect to the local scatterers. For outdoor base stations where the antennas are significantly higher than the scatterers, totally uncorrelated fading is achieved using a separation of 10 wavelengths between nearest neighbors in a linear base array of dual-polarized antennas [3]. It is also shown that an antenna separation of only 4 wavelengths is sufficient to achieve 80% of the capacity. With a 2GHz carrier frequency, the wavelength is 15cm. Hence an array of 4 antennas with 10 wavelength spacing is 4.5m long and with 4 wavelength spacing is 1.8m. Using dual-polarized antennas, four antennas can effectively fit in the space of two unpolarized antennas so that the array lengths are only 1.5m and 0.6m respectively for 10 and 4 wavelength separation. These values are all within the range of current base station antenna configurations and are comparable with separations required for transmit diversity. For indoor base stations, or in situations where the antennas are at the same height as the local scatterers, the scatterers will cause more decoupling of the signals at the antennas. Hence the required antenna separation for a given level of correlation will be even less.

3. REFERENCES

[1] 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Physical Layer Aspects of UTRA High Speed Downlink Packet Access; (Release 2000), (3G Technical Report (TR) 25.848, version 0.2.1), Tdoc R1-00-1480, TSG-RAN WG1; January 15th-18th, 2001, Boston, USA.
[2] Lucent. Complexity of Node B for MIMO architectures. TSG_R WG1 document TSGR1#18(01)0130, , 15-18th, January 2001, Boston, USA.
[3] D. Chizhik, F. Rashid-Farrokhi, J. Ling, A. Lozano, "Effect of antenna separation on the capacity of BLAST in correlated channels," to appear in *IEEE Communications Letters*.