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Agenda Item:

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Title: **Overview of the TDD harmonisation and the key features of TD-SCDMA**

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1. Introduction

The TD-SCDMA RTT, which was developed in China, has four key features (says the lower chip rate, uplink synchronization, smart antenna and baton handover) compared with the UTRA-TDD. Due to the high synergy potential of TD-SCDMA and UTRA-TDD, the harmonization of both RTTs was initiated at the beginning of this year. At the three harmonization meetings in Beijing, the participating companies (ARIB, CATT, DoCoMo, Ericsson, Nokia, Panasonic, RITT and Siemens) agreed on introducing and supporting the main key features of TD-SCDMA into UTRA-TDD, based on contribution of CATT (RP99248). This paper will give an overview of the 4 key features and their benefits.

2. Key Features in TD-SCDMA

2.1. Smart Antenna

Smart antenna is a widely accepted technology in IMT-2000 RTTs. A smart antenna system is composed of N antenna elements,N related feed cables and N coherent RF transceivers in the RF part. By using of the A/D converters or D/A converters in the analog baseband (ABB),the Rx and Tx analog signals are interfaced to the digital baseband(DBB) part over the high-speed data bus ,as described [1].The beamforming which points to a particular UE can be obtained through smart antenna. Due to the inherent robustness of CDMA and the space diversity realized by smart antenna, the interference for multipath propagation is greatly overcome, and the ISI can be greatly reduced. For downlink, beamforming can also reduce the interference to the other co-channel UEs. These performances can lead to the higher capacity of TD-SCDMA system. In addition, the baton handover supported by smart antenna can shorten the handover time, the algorithm complexity for joint detection can also be reduced by adopting smart antenna. [2].

2.2. Uplink Synchronization

One of requirements in 3rd mobile telecommunication system is the high system capacity. Synchronous CDMA (SCDMA) technology which implies the uplink channels always work synchronously, i.e. the UEs' spread signals arrive at the Node B at the same time can effectively simplify the demodulator in Node B, decease multiple-access-

interference (MAI) and increase the system capacity. Uplink synchronization procedure includes two stages, i.e. synchronization establishment and synchronization maintenance. The synchronization establishment is often associated with UE's access procedure, and the synchronization maintenance is often associated with the dedicated communication procedure between UE and network. Due to the multipath and shadow fading, however, the establishment and maintenance of the uplink synchronization between different UEs in a cell is difficult for the present mobile communications systems. The simple, effective and low-cost establishing and maintaining uplink synchronization solution will bring benefits to UTRA-TDD, following the harmonization with TD-SCDMA. The UL synchronization is equivalent to a very high precise timing advance according to the layer 1 specifications. Therefore, an extended TA option by means of a sub-chip granular operation was agreed on TSG RAN WG1 #6. The granularity of TA, in case of UL synchronization, is ±1/8 chips.

2.3. Low Chip Rate

The chip rate is one of the most important parameters in CDMA system. The choice of chip rate should base on the requirement of the service bearer capability of IMT-2000 RTT as well as the technical feasibility. According to ITU-T recommendation M.1225, IMT-2000 system should be able to support the bearer services vary from 1.2kbps to 2Mbps in different environments and to provide the performances such as high spectrum efficiency, low cost, worldwide roaming, and so on. It has been shown by CWTS that the above mentioned requirement can be satisfied at a much less chip rate compared with UTRA-TDD RTT if several novel technologies, such as smart antenna, uplink synchronization, is adopted. The other reason why low chip rate chosen is due to the DSP processor's capability. The low chiprate option was agreed on TSG RAN WG1 #6.

2.4. Baton Handover

The basic principle of baton handover is list as follow:

1. System knows the position of all UE;
2. System knows and determines the target cell for handover;
3. System informs mobile the information about the Node B in neighboring cells;
4. Mobile measurement helps the system to do the final decision;
5. After the cell search procedure, the mobile UT has already established synchronization to the Node B in target cell.

In the TD-SCDMA system, by using smart antenna the network can know all the UE accurate position in the cell (How to get the accurate position is for further description).The baton handover costs very shorter handover time period for both inside TD-SCDMA system and between difference systems than that of UTRA-TDD system; In the TD-SCDMA system the parameters that UE measure are not only the received signal power level and also their TX time offset and so on. Furthermore the frame structure of the TD-SCDMA RTT is different from that of the UTRA-TDD system ,so their data transmitted from their physical layer to upper layers have different format. The measure information which is used to handover procedure transmitted from L1 to L3 or network via MAC sublayer or the control information for handover transmitted from upper layer or network to L1 via MAC sublayer maybe influence the MAC sublayer, such as obstructing the transport channels, losting the synchronous information transmitted on the SCH channel (the concrete influence on MAC is FFS).

3. Conclusion

In this paper we have provide information about the four key features of TD-SCDMA, which are low chiprate, uplink synchronization, smart antenna and baton handover. These features were agreed to introduce to UTRA-TDD on the three TDD Harmonization meetings in Beijing (RP99248). Each of them will improve significantly the system performance, where the simultaneous usage of all the key feature gives further benefits. The smart antennas are capable of reducing interference in order to increase spectral efficiency. Also the UL synchronization lowers interference, which increases system capacity. The additional knowledge of UE's position, available through smart antennas and UL synchronization is used in the baton handover. Smart Antennas, UL synchronization and baton handover works best with the low chiprate, where relaxed hardware complexity lowers costs and eases software radio.
The provided information about the features and their benefits should ease the further harmonization process in WG2.

[1] TSGR1#5(99)623: "Smart Antenna Technology"
[2] TD-SCDMA Radio Transmission Technology For IMT-2000 Candidate Submission
[3] TSGR1#5(99)624: "Method and Principle of Uplink Synchronization"
[4] TSGR1#5(99)625: "Low Chiprate in UTRA-TDD"
[5] TS C102 v1.1.0: "Physical channels and mapping of tranport channels onto physical channels(TD-SCDMA)"
[6] S2.02: "Services provided by the Physical Layer (V0.3.0)"