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Title:	Accuracy Requirements for Node B Synchronization Correction to R1-00-0472
Document for:	Discussion

1   Introduction

TDD Node B Synchronization has been approved as a Work Item for R2000. (Reference [1]). TSG RAN WG4 is responsible for selecting performance requirements, but the required accuracy for TDD Node B Synchronization is currently an open item. In order to perform design studies and tradeoffs it is necessary to have performance goals in mind.

This contribution proposes a preliminary performance target of 2.5 microseconds for Macro Cells for synchronization of Node B time references to one another. It also sugests that the requirement for Pico Cells should be less strict.

2   Background

The primary motivation to maintain time synchronization between TDD Cells is to ensure that the uplink transmissions of a UE assigned to one Cell does not interfere with reception by a neighboring UE assigned to a different cell.

Ideally, when Cells transmit they should start their time slots at precisely the same time and their frames should also be alligned. We define the timing error between two Cells (or Node Bs) as the difference between their reference clocks, from which each would derive its slot and frame boundaries.

Error sources which impact this process include:
- Time misalignment between Nodes
- Propagation Time for the downlink transmission due to Range
- (Intentional)Timing advance of the UE transmission
- Multipath spread.
- Non-zero time for power-down after transmission.

Taking these items into consideration, WG4 has considered several proposals. See reference [2]. It appears that the tightest proposed error has been 5 microseconds, derived considering the propagation delays associated for a Macro cell. It has been proposed that Micro and Pico Cells, with smaller propagation uncertainty, can coexist with larger errors.

There appears to be no sentiment for tolerances less than 5 microseconds. Furthermore, Base Station Classification has also been approved as a work item, with one of its goals to assign performance requirements to base stations as needed; e.g. different accuracy for Pico Cells than for Macro Cells. See reference [3].

3 Recommendation

3.1 Macro Cells

Recognizing that WG4 has the responsibility to make the final decision, it is proposed to select one half of the current lower bound for Macro Cells (i.e. 5.0/2 = 2.5 microseconds) as an initial for the error budget for the over-the-air synchronization function. This allows both for margin and for other error sources that might be outside of the control of the over-the-air synchronization process.

As we better understand both the technical difficulties and the underlying requirements, we can adjust this target value.

3.2 Pico Cells

More liberal limits may be appropriate for Pico Cells. There is no need to account for propagation guard time. The exact value should be determined as a result of study efforts within both WGs 1 and 4.

[1] RP-000055   Proposed work item "NodeB Synchronisation for TDD" (Siemens)
TSG RAN#7, Madrid Spain, 12-15 March 2000.

[2] TSGR4#7(99)459 – TDD BS synchronisation, Siemens, Makuhari, Japan, 7-10 September 1999

[3] RP-000185   Proposed work item "TDD Base stations classification", InterDigital,work task, TSG RAN#7, Madrid Spain, 12-15 March 2000.