3GPP TSG-RAN1 Meeting #19
Las Vegas, USA, 27 Feb – 2 March 01

Tdoc R1-01-0137

CR-Form-v3

CHANGE REQUEST

✍ **25.836**	**CR 001** ✍	rev **-** ✍	Current version:	**4.0.0** ✍

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ✍ symbols.*

Proposed change affects: ✍ (U)SIM [ ] ME/UE [ ] Radio Access Network [X] Core Network [ ]

Title: ✍	Additions to the node B synchronisation procedure		
Source: ✍	Siemens		
Work item code: ✍	RANimp-NBsync	***Date:*** ✍	20.02.2001
Category: ✍	**C**	***Release:*** ✍	REL-4
	Use one of the following categories: ***F*** *(essential correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(Addition of feature),* ***C*** *(Functional modification of feature)* ***D*** *(Editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *REL-4 (Release 4)* *REL-5 (Release 5)*

Reason for change: ✍	Support of frequency acquisition
Summary of change: ✍	An optional phase was added to the synchronisation procedure
Consequences if not approved: ✍	No support of low-cost node B implementations

Clauses affected: ✍	7.1, 7.2	
Other specs affected: ✍	[ ] Other core specifications [ ] Test specifications [ ] O&M Specifications	✍
Other comments: ✍		

How to create CRs using this form:

Comprehensive information and tips about how to create CRs can be found at: http://www.3gpp.org/3G_Specs/CRs.htm. Below is a brief summary:

1) Fill out the above form. The symbols above marked ✍ contain pop-up help information about the field that they are closest to.

2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under ftp://www.3gpp.org/specs/ For the latest version, look for the directory name with the latest date e.g. 2000-09 contains the specifications resulting from the September 2000 TSG meetings.

3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

7 Concept of Node B Synchronisation

7.1 General

In addition to proprietary means there are two ways to achieve cell synchronisation in a TDD system:

?? Synchronisation of nodes Bs to an external reference via the synchronisation port standardised for Rel. 99

?? Synchronisation of cells or Node Bs via the air interface described in this report for Rel. 4

The solution described in this report allows a mixture of both schemes, i. e. some cells may be synchronised over the air, some via the synchronisation port. In general, at least one time reference (e. g. GPS) is needed for each island of cells having connectivity to each other.

The RNC shall be the master of the synchronisation process, since the measurements either performed by a cell or by a UE, shall be signalled to and processed by the RNC.
A new procedure facilitates the transmission of measurements and commands between the RNC and the node B as well as allows the adjustment of the node B timing. Details of this procedure can be found in TR 25.838.
An optional phase may facilitate the frequency acquisition of node Bs at start-up prior to over-the-air synchronisation.

7.2 Synchronisation Procedure

The synchronisation procedure is based on using transmissions of cell synchronisation bursts in predetermined PRACH time slots based on an RNC schedule. Such soundings between neighbouring cells facilitate timing offset measurements by the cells. The timing offset measurements are reported back to the RNC for processing. The RNC generates cell timing updates that are transmitted to the Node Bs and cells for implementation. CEC sequences with multiple offsets are used as cell synchronisation bursts. The synchronisation procedure has two mandatory phases, the initial phase and the steady-state phase. Optionally, these phases may be preceded by a frequency acquisition phase. The procedure for late entrant cells is slightly different and is described separately. ~~The synchronisation procedure has two phases:~~

Frequency Acquisition Phase

The procedure for frequency acquisition is used to bring cells of an RNS area to within frequency limits prior to initial acquisition. This optional phase would allow cells to use low cost reference oscillators with accuracies in the order of several ppm. No traffic is supported during this phase:

1. The cell(s) containing the GPS receiver transmit continuously cell sync bursts specified by higher layers (i.e. one in every time slot).
2. Each cell shall listen for transmissions from other cells. Each cell shall perform frequency locking to any transmission received
3. When a cell has detected that it has locked its frequency to within 50 ppb of the received signal it will signal completion of frequency acquisition to the RNC and begin transmitting the specified code. The exact timing of the code phase is unimportant.
4. When the RNC has received completion of frequency acquisition signals from all cells the frequency acquisition phase is completed.

Initial Synchronisation

1. The RNC sends a request over the relevant Iub to the cell(s) with ~~GPS~~ reference clock for a timing signal. The RNC adjusts its clock appropriately, compensating for the known round trip Iub delay.
2. The RNC sends timing updates over the Iub to all the cells, apart from the one containing the reference clock~~GPS~~, instructing them to adjust their clocks towards its own timing. Each of the timing offsets is again adjusted by the Iub round trip delay for that cell.
3. At this point, none of the cells is supporting traffic so a large proportion of the time can be given over to achieving synchronisation. It is assumed that there is as yet no information available on which to base the generation of a re-use pattern for sync transmissions. Thus all cells are instructed to transmit their cell sync bursts in turn one after the other with *no re-use*, i. e. the same sync burst sequence and offset is used by all cells.

4. All cells listen for transmissions and those which successfully detect a cell sync burst report their timing and received S/(N+I) to the RNC over the relevant Iub. Knowing the schedule, the RNC is able to determine the cell which made the transmission and place a measurement entry in the relevant place in its measurement matrix. After all cells have made their transmissions, the RNC computes the set of updates which will bring the cells nominally into synchronisation.
5. Steps 3 and 4 are repeated several times (typically 10). This serves two purposes:-
    - ?? The rapid updates allow the correction of the clock frequencies as well as the clock timings to be adjusted in a short space of time. This rapidly brings the network into tight synchronisation.
    - ?? The S/(N+I) values are averaged over this period. This provides more accurate measurements (averaging over noise and fading) which can be used in the automatic generation of a re-use plan.
6. The S/(N+I) values are used, automatically, to plan a re-use pattern. This is performed as follows:-
    - ?? A matrix of minimal connectivity is computed on the basis of designating pairs of cells are minimal neighbours if either their estimated average S/(N+I) exceeds a threshold or if they have mutual neighbours.
    - ?? The set of cells is divided into partitions of cells. Each partition must satisfy the requirement that no pairs of cells within that partition are minimally connected. All cells within a partition transmit the same code offset in parallel.

Steady-State Phase

7. All of the cells in the same partition are arranged to transmit / receive in the same cell sync frames according to the above procedure and they transmit the same code offset in parallel. All cells report the reception times for all relevant code offsets back to the RNC.
8. At the end of each cycle, the RNC collates the information. In general there should always exist a path of bidirectional valid measurements that link every cell either directly or indirectly to the cell with UTC capability. However, the model is arranged such that only those cells which have such a path will be updated on any given occasion.
9. The process of partition transmissions and updating then continues indefinitely.

Late entrant Node Bs

The scheme for introducing new nodeBs into a synchronized RNS is as follows:

1. There is a specialised sync transmission scheduled by higher layers~~at regular intervals or event driven~~. A single common code (i.e. with the same, nominally zero, shift) is transmitted in parallel by *all* NodeBs addressed~~which are synchronised in the system~~. The late entrant NodeB will correlate against the specialised sync transmissions. The late entrant NodeB will take the earliest reception as the timing of the system.
2. Thus, at this point, the late entrant NodeB has obtained system time, subject to an unknown propagation delay between it and its nearest neighbour. The late entrant NodeB cannot, at this time, tell which of its neighbours *is* the nearest. However, this level of synchronisation is good enough that from then on the late entrant NodeB can distinguish the overlaid normal sync transmissions unambiguously for the various code shifts.
3. After this time the late entrant NodeB can measure the timings of sync transmissions received from specific NodeBs and report these to the RNC. In turn, the RNC can give the late entrant NodeB its own schedules for sync transmission and to use one or more of these. The RNC can then use the bi-directional sounding, which will then be available, to compute the true timing error and to instruct the NodeB to adjust its timing appropriately.

If the late entrant has an inaccurate clock the specialised cell sync burst transmission may be repeated often enough to allow full frequency searching.