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Agenda Item: Plenary

Source: Nokia, Siemens

Title: Clarifications on the Out-of-sync handling for UTRA TDD

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Berlin, Germany, 22 AUG 2000 - 25 AUG 2000

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CHANGE REQUEST

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25.224 CR 033 Current Version: V3.3.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to:	TSG RAN #9	For approval	X	strategic	*(for SMG*
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Proposed change affects: *(at least one should be marked with an X)*	(U)SIM		ME	X	UTRAN / Radio	X	Core Network

Source: Nokia, Siemens **Date:** 22.08.2000

Subject: Clarifications on the Out-of-sync handling for UTRA TDD

Work item: TS25.224

Category:				**Release:**		
	F	Correction	X		Phase 2	
	A	Corresponds to a correction in an earlier release			Release 96	
(only one category	B	Addition of feature			Release 97	
shall be marked	C	Functional modification of feature			Release 98	
with an X)	D	Editorial modification			Release 99	X
					Release 00	

Reason for change: Some clarifications/corrections required for the out-of-sync scheme

Clauses affected: 4.2.2.3.1, 4.4.2.1.2, 4.4.2.2.2, 4.5

Other specs affected:				
	Other 3G core specifications		→ List of CRs:	
	Other GSM core specifications		→ List of CRs:	
	MS test specifications		→ List of CRs:	
	BSS test specifications		→ List of CRs:	
	O&M specifications		→ List of CRs:	

Other comments:

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4.2.2 Uplink Control

4.2.2.1 General Limits

By means of higher layer signalling, the Maximum_Allowed_UL_TX_ power for uplink may be set to a value lower than what the terminal power class is capable of. The total transmit power shall not exceed the allowed maximum. If this would be the case, then the transmit power of all uplink physical channels in a timeslot is reduced by the same amount in dB.

4.2.2.2 PRACH

The transmit power for the PRACH is set by higher layers based on open loop power control as described in TS 25.331.

4.2.2.3 DPCH, PUSCH

After the synchronisation between UTRAN and UE is established, the UE transits into open-loop transmitter power control (TPC).

The transmitter power of UE shall be calculated by the following equation:

$$P_{UE} = \alpha L_{P-CCPCH} + (1-\alpha) L_0 + I_{BTS} + SIR_{TARGET} + \text{Constant value}$$

where

P_{UE}: Transmitter power level in dBm.

$L_{P-CCPCH}$: Measure representing path loss in dB (reference transmit power is broadcast on BCH).

L_0: Long term average of path loss in dB.

I_{BTS}: Interference signal power level at cell's receiver in dBm, which is broadcast on BCH.

α: α is a weighting parameter which represents the quality of path loss measurements. α may be a function of the time delay between the uplink time slot and the most recent down link time slot containing a physical channel that provides the beacon function, see [8]. α is calculated at the UE. An example for calculating α as a function of the time delay is given in annex A.1.

SIR_{TARGET}: Target SNR in dB. A higher layer outer loop adjusts the target SIR.

Constant value: This value shall be set by higher Layer (operator matter). and is broadcast on BCH.

If the midamble is used in the evaluation of $L_{P-CCPCH}$ and L_0, and the Tx diversity scheme used for the P-CCPCH involves the transmission of different midambles from the diversity antennas, the received power of the different midambles from the different antennas shall be combined prior to evaluation of these variables.

4.2.2.3.1 Out of synchronisation handling

UE shall shut off the uplink transmission if the following criteria is fulfilled:

- Tthe UE estimates the received dedicated channel burst quality over the last [160] ms period to be worse than a threshold Q_{out}. This criterion is never fulfilled during the first [160] ms of the dedicated channel's existence. Q_{out} is defined implicitly by the relevant tests in TS 25.102;

UE shall resume the uplink transmission if the follwowing criteria is fulfilled:

- Tthe UE estimates the burst reception quality over the last [160] ms period to be better than a threshold Q_{in}. This criterion is always fulfilled during the first [160] ms of the dedicated channel's existence. Q_{in} is defined implicitly by the relevant tests in TS 25.102.

- If the UE detects the beacon channel reception level [10 dB] above the handover triggering level, then the UE shall be allowed to use a further [320] ms estimation period for the burst quality evaluation.

4.2.3 Downlink Control

4.2.3.1 P-CCPCH, PICH

The Primary CCPCH transmit power is set by higher layer signalling and can be changed based on network determination on a slow basis. The reference transmit power of the P-CCPCH is signalled on the BCH. The PICH is transmitted with the same power as the P-CCPCH.

4.2.3.2 S-CCPCH

The relative transmit power of the Secondary CCPCH compared to the P-CCPCH transmit power is set by higher layer signalling.

4.2.3.3 Dedicated Physical Channel, PDSCH

The initial transmission power of the downlink Dedicated Physical Channel and the PDSCH is set by the network. After the initial transmission, the UTRAN transits into SIR-based inner loop power control.

The UE shall generate TPC commands to control the network transmit power and send them in the TPC field of the uplink DPCH and PUSCH. An example on how to derive the TPC commands in given in Annex A.2

As a response to the received TPC command, UTRAN may adjust the transmit power of all downlink DPCHs and PDSCHs of this radio link. When the TPC command is judged as "down", the transmission power may be reduced by one step, whereas if judged as "up", the transmission power may be raised by one step. The UTRAN may apply an individual offset to the transmission power in each timeslot according to the downlink interference level at the UE. The transmission power of one DPCH or PDSCH shall not exceed the limits set by higher layer signalling by means of Maximum_DL_Power (dB) and Minimum_DL_Power (dB). The transmission power is defined as the average power of the complex QPSK symbols of a single DPCH before spreading.

During a downlink transmission pause, the UTRAN may accumulated the TPC commands received. The initial UTRAN transmission power for the first data transmission after the pause may then be set to the sum of transmission power before the pause and a power offset according to the accumulated TPC commands. Additionally this sum may include a constant set by the operator and a correction term due to uncertainties in the reception of the TPC bits.

The total downlink transmission power at the nodeB within one timeslot shall not exceed Maximum Transmission Power set by higher layer signalling. In case the total power of the sum of all transmissions would exceed this limit, then the transmission power of all downlink DPCHs is reduced by the amount that allows fulfilling the requirement. The same amount of power reduction is applied to all DPCHs.

A higher layer outer loop adjusts the target SIR.

4.2.3.3.1 Out of synchronisation handling

When the dedicated physical channel out of sync criteria based on the received burst quality is as given in the subclause 4.4.2 then the UE shall set the uplink TPC command = "up". The CRC based criteria shall not be taken into account in TPC bit value setting.

4.3 Timing Advance

UTRAN may adjust the UE transmission timing with timing advance. The initial value for timing advance will be determined in the UTRAN by measurement of the timing of the PRACH. The required timing advance will be represented as an 6 bit number (0-63) being the multiple of 4 chips which is nearest to the required timing advance.

When Timing Advance is used the UTRAN will continuously measure the timing of a transmission from the UE and send the necessary timing advance value. On receipt of this value the UE shall adjust the timing of its transmissions accordingly in steps of ±4chips. The transmission of TA values is done by means of higher layer messages. Upon receiving the TA command the UE shall adjust its transmission timing according to the timing advance command at the beginning of the next frame that fulfils the SFN Mod 20 = 0 criteria and which does not occur sooner than 10 frames after the TTI period for the DCCH carrying the timing advance command ended.

When TDD to TDD handover takes place the UE shall transmit in the new cell with timing advance TA adjusted by the relative timing difference Δt between the new and the old cell:

$$TA_{new} = TA_{old} + 2\Delta t$$

4.3.1 Timing advance with UL Synchronization

If UL Synchronization is used, the timing advance is sub-chip granular and with high accuracy in order to enable synchronous CDMA in the UL. The required timing advance will be represented as a multiple of 1/4 chips.

The UTRAN will continuously measure the timing of a transmission from the UE and send the necessary timing advance value. On receipt of this value the UE will adjust the timing of its transmissions accordingly in steps of ±1/4 chips.

Support of UL synchronisation is optional for the UE.

4.4 Synchronisation and Cell Search Procedures

4.4.1 Cell Search

During the initial cell search, the UE searches for a cell. It then determines the midamble, the downlink scrambling code and frame synchronisation of that cell. The initial cell search uses the Synchronisation Channel (SCH) described in [8]. The generation of synchronisation codes is described in [10].

This initial cell search is carried out in three steps:

Step 1: Slot synchronisation

During the first step of the initial cell search procedure the UE uses the primary synchronisation code c_p to acquire slot synchronisation to the strongest cell. Furthermore, frame synchronisation with the uncertainty of 1 out of 2 is obtained in this step. A single matched filter (or any similar device) is used for this purpose, that is matched to the primary synchronisation code which is common to all cells.

Step 2: Frame synchronisation and code-group identification

During the second step of the initial cell search procedure, the UE uses the modulated Secondary Synchronisation Codes to find frame synchronisation and identify one out of 32 code groups. Each code group is linked to a specific t_{Offset}, thus to a specific frame timing, and is containing 4 specific scrambling codes. Each scrambling code is associated with a specific short and long basic midamble code.

In Case 2 it is required to detect the position of the next synchronization slots. To detect the position of the next synchronization slots, the primary synchronization code is correlated with the received signal at offsets of 7 and 8 time slots from the position of the primary code that was detected in Step 1.

Then, the received signal at the positions of the synchronization codes is correlated with the primary synchronization Code C_p and the secondary synchronization codes $\{C_0,\ldots,C_{15}\}$. Note that the correlations can be performed coherently over M time slots, where at each slot a phase correction is provided by the correlation with the primary code. The minimal number of time slots is M=1, and the performance improves with increasing M.

Step 3: Scrambling code identification

During the third and last step of the initial cell-search procedure, the UE determines the exact basic midamble code and the accompanying scrambling code used by the found cell. They are identified through correlation over the P-CCPCH with all four midambles of the code group identified in the second step . Thus the third step is a one out of four decision. This step is taking into account that the P-CCPCH containing the BCH is transmitted using the first channelization code ($c_{Q=16}^{(h=1)}$ in [10]) and using the first midamble $\mathbf{m}^{(1)}$ (derived from basic midamble code $\mathbf{m}_P$ in [8]). Thus P-CCPCH code and midamble can be immediately derived when knowing scrambling code and basic midamble code.

NOTE: The cell parameters change from frame to frame, cf. "Table 7 Alignment of cell parameter cycling and SFN" in [10].

4.4.2 Dedicated channel synchronisation

4.4.2.1 Synchronisation primitives

4.4.2.1.1 General

For the dedicated channels, synchronisation primitives are used to indicate the synchronisation status of radio links, both in uplink and downlink. The definition of the primitives is given in the following subclauses.

4.4.2.1.2 Downlink synchronisation primitives

Layer 1 in the UE shall every radio frame check synchronisation status of the downlink dedicated channels. Synchronisation status is indicated to higher layers, using the CPHY-Sync-IND or CPHY-Out-of-Sync-IND primitives.

Out-of-sync shall be reported using the CPHY-Out-of-Sync-IND primitive if either of the following criteria is fulfilled:

- the UE estimates the received dedicated channel burst quality over the last [160] ms period to be worse than a threshold Q_{out}. This criterion is never fulfilled during the first [160] ms of the dedicated channel's existence. Q_{out} is defined implicitly by the relevant tests in TS 25.102;
- if the UE detect the beacon channel reception level [10 dBm] above the handover triggering level, the UE uses [320] ms estimation period for the burst quality evaluation;
- the last [16] transport blocks, as observed on all TrCHs using CRC, are received with incorrect CRC and in. In addition, over the last [160] ms, no transport block has been received with correct CRC. In case the beacon channel reception criteria is fulfilled the values are [32] transport blocks and [320] ms respectively.

In-sync shall be reported using the CPHY-Sync-IND primitive if both of the following criteria are fulfilled:

- the UE estimates the burst reception quality over the last [160] ms period to be better than a threshold Q_{in}. This criterion is always fulfilled during the first [160] ms of the dedicated channel's existence. Q_{in} is defined implicitly by the relevant tests in TS 25.104;
- at least one transport block, as observed on all TrCHs using CRC, is received with correct CRC. If there is no TrCH using CRC, this criterion is always fullfilled.

In-sync shall be reported using the CPHY-Sync-IND primitive in case of DTX if the following criterion is fulfilled:

- The UE receives a special burst in case of DTX and estimates its burst reception quality to be better than a threshold Q_{in}.

How the primitives are used by higher layers is described in TS 25.331.

4.4.2.1.3 Uplink synchronisation primitives

Layer 1 in the Node B shall every radio frame check synchronisation status of the radio link. Synchronisation status is indicated to the RL Failure/Restored triggering function using either the CPHY-Sync-IND or CPHY-Out-of-Sync-IND primitive.

The exact criteria for indicating in-sync/out-of-sync is not subject to specification, but could e.g. be based on received burst quality or CRC checks. One example would be to have the same criteria as for the downlink synchronisation status primitives.

4.4.2.2 Radio link monitoring

4.4.2.2.1 Downlink radio link failure

The downlink radio links are monitored by the UE, to trigger radio link failure procedures. The downlink radio link failure criteria is specified in TS 25.331, and is based on the synchronisation status primitives CPHY-Sync-IND and CPHY-Out-of-Sync-IND, indicating in-sync and out-of-sync respectively.

4.4.2.2.2 Uplink radio link failure/restore

The uplink radio links are monitored by the Node B, to trigger radio link failure/restore procedures. Once the radio links have been established, they will be in the in-sync or out-of-sync states as shown in figure 1 in subclause 4.3.2.1. Transitions between those two states are described below.

The uplink radio link failure/restore criteria is based on the synchronisation status primitives CPHY-Sync-IND and CPHY-Out-of-Sync-IND, indicating in-sync and out-of-sync respectively.

When the radio links is are in the in-sync state, Node B shall start timer T_RLFAILURE after receiving N_OUTSYNC_IND consecutive out-of-sync indications. Node B shall stop and reset timer T_RLFAILURE upon receiving successive N_INSYNC_IND in-sync indications. If T_RLFAILURE expires, Node B shall trigger the RL Failure procedure and indicate which radio links are out-of-sync. When the RL Failure procedure is triggered, the radio links' state changes to the out-of-sync state.

When the radio links are in the out-of-sync state, after receiving N_INSYNC_IND successive in-sync indications Node B shall trigger the RL Restore procedure and indicate which radio links have re-established synchronisation. When the RL Restore procedure is triggered, the radio links' state changes to the in-sync state.

The specific parameter settings (values of T_RLFAILURE, N_OUTSYNC_IND, and N_INSYNC_IND) are configurable, see TS 25.433.

4.5 Discontinuous transmission (DTX) of Radio Frames

Discontinuous transmission (DTX) is applied in up- and downlink when the total bit rate after transport channel multiplexing differs from the total channel bit rate of the allocated dedicated physical channels.

Rate matching is used in order to fill resource units completely, that are only partially filled with data. In the case that after rate matching and multiplexing no data at all is to be transmitted in a resource unit the complete resource unit is discarded from transmission. This applies also to the case where only one resource unit is allocated and no data has to be transmitted.

When DTX is applied in the uplink and after a period of (N_OUTSYNC_IND / 2)-1 silent frames no data has to be transmitted, then a dummy special burst should be generated and transmitted in the next possible frame.

This dummy special burst should have the same slot format as the normal burst where DTX is used. The dummy special burst is filled with an arbitrary bit pattern, contains a TFCI and TPC bits if inner loop PC is applied. The TFCI of the dummy special burst should indicate that there is no data to be transmitted.