TSG-RAN Working Group 1 meeting #11 *TSGR1#11(00)*0306
San Diego, U.S.A.

February 29 - March 03, 2000

Agenda Item: **Ad Hoc 18**

Source: **Siemens**

Title: **Uplink Synchronisation for seamless Hard Handover**

Document for: **Information and Discussion**

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1. Abstract

This paper presents an uplink synchronisation for the hard handover case, whereas the seamless hard handover described in [1] is assumed.

2. Introduction

Before any handover procedure is performed, the UE should monitor the CPICH, the SCH and CCPCH of the target cell and gains downlink synchronisation. But on the other hand no precise uplink synchronisation of an individual UE can be achieved by the target Node B, since no common uplink channel of an UE exists. So until the dedicated channel has not been established in the target cell, the uplink propagation time has to be derived from the downlink trip delay. The proposal made in [1] yields a transmission gap during the cell handover. This paper recommends to send an uplink synchronisation signal to the target cell in order to achieve an uplink synchronisation during this gap.

3. Uplink Synchronisation during Hard Handover

[1] proposes to use compressed mode in both the source cell and the target cell for a seamless hard handover. As demonstrated in figure 1, the last frame of the source cell and the first frame in the target cell will be compressed. The compressed mode yields an idle time between the last uplink transmission in the source cell and the first downlink transmission in the target cell.

During this idle time the UE should listen to the CPICH, SCH and CCPCH of the target cell in order to update the downlink synchronisation information. But the Node B can not listen to an uplink channel for the purpose of uplink pre-synchronisation before a link has been established in the target cell. Therefore the target Node B determines, assisted by the UE and source Node B, the downlink's trip delay as described in [1]. This downlink trip delay value will be also assumed for the uplink's propagation time (but the uplink's propagation time does not always fit to the downlink's one, e. g. if different paths are dominant in uplink and downlink due to non reciprocal fading). As a result only the first received DPCCH/DPDCH can be used for an precise uplink synchronisation at the target Node B, as described in [2]. The hard handover by using compressed mode offers the opportunity of gaining the uplink synchronisation before the DPCCH/DPDCH is received. This facilitates the synchronisation process and avoids data loss due to desynchronisation. As demonstrated in figure 1, an uplink synchronisation signal is sent in order to enable the uplink synchronisation in advance. This uplink synchronisation increases the probability of successful decoding of the first uplink received at the target Node B. Also in GSM the RACH is used for the unsynchronised handover. Even the synchronised handover engages optionally the RACH in order to get an as precise as possible Round Trip Time and Timing Advance, respectively. In contrast to the proposed UMTS hard handover, in GSM this RACH transmission causes an interruption of data flow and therefore data get lost.

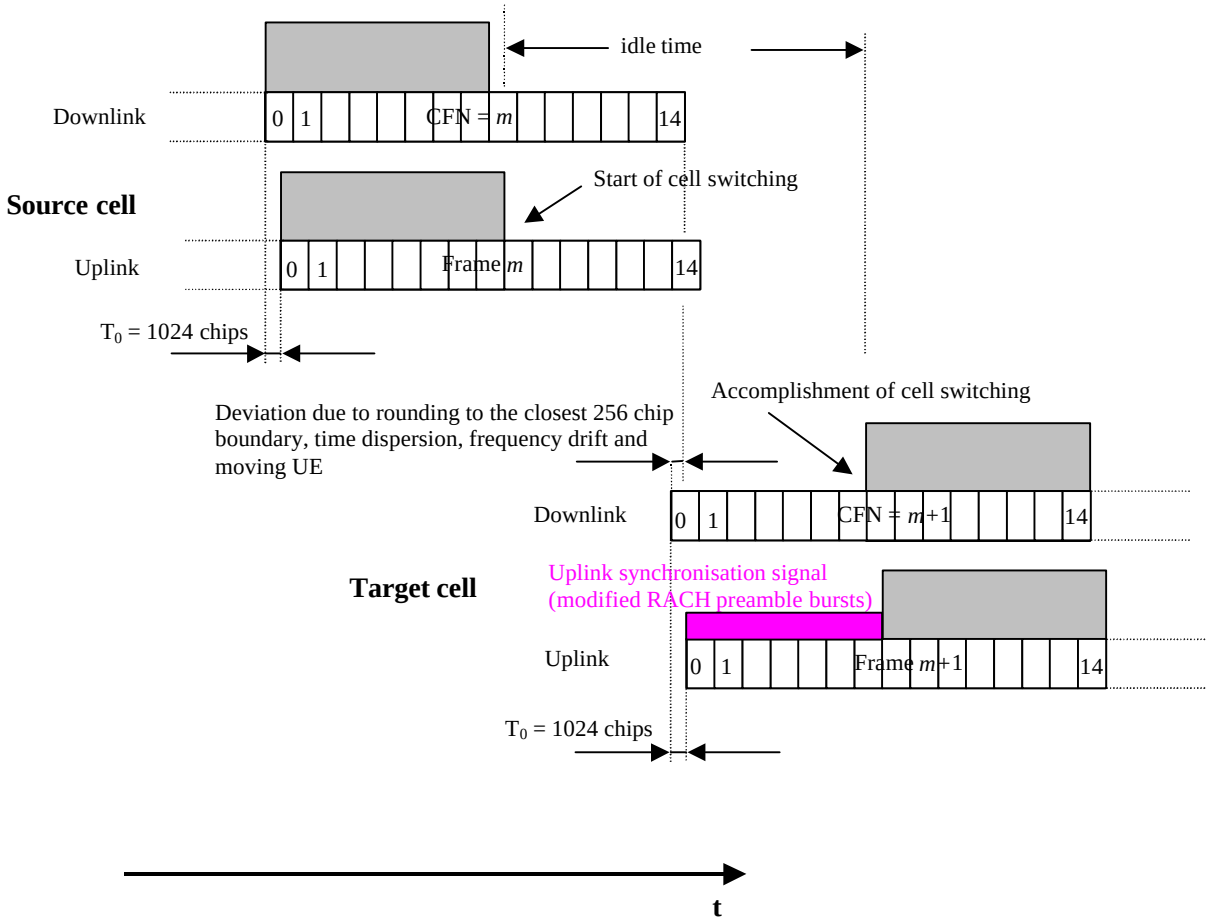

Figure 1: *Hard Handover by using compressed mode and uplink synchronisation signal*

3.1 Uplink synchronisation Signal

We recommend that the uplink synchronisation signal should correspond to a fix preamble signature of the 16 provided RACH preambles, e.g. the P_0 preamble (refer to table 3 of [3]). The scrambling code corresponds to the scrambling code, which is allocated to the target cell's uplink. This uplink synchronisation signal can last the whole gap length.

4. Conclusions

The gap, which is gained by using compressed mode during the hard handover, offers the possibility of performing an uplink synchronisation. Therefore the UE sends an uplink synchronisation signal, which corresponds basically to the RACH preamble code.

5. References

[1] TSGR1#11(00)0305; San Diego, U.S.A.; 02-2000; Siemens; Compressed Mode for seamless Hard Handover

[2] 3G TS 25.214 V3.1.1, Physical layer procedures (FDD)

[3] 3G TS 25.213 V3.1.1, Spreading and modulation (FDD)

3GPP/SMG Meeting #11
San Diego, U.S.A., Feb 29 – Mar 03 2000

Document R1-000306
e.g. for 3GPP use the format TP-99xxx
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CHANGE REQUEST

Please see embedded help file at the bottom of this page for instructions on how to fill in this form correctly.

25.214	CR	075	Current Version:	3.1.1

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

For submission to: *list expected approval meeting # here ↑*		for approval	X	strategic		*(for SMG use only)*
		for information		non-strategic		

Form: CR cover sheet, version 2 for 3GPP and SMG *The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc*

Proposed change affects: *(at least one should be marked with an X)*	(U)SIM		ME	X	UTRAN / Radio	X	Core Network	

Source: Siemens **Date:** 2000-02-21

Subject: Uplink Synchronisation for seamless Hard Handover

Work item:

Category: *(only one category shall be marked with an X)*

F	Correction	X	**Release:**	Phase 2	
A	Corresponds to a correction in an earlier release			Release 96	
B	Addition of feature			Release 97	
C	Functional modification of feature			Release 98	
D	Editorial modification			Release 99	X
				Release 00	

Reason for change:

Clauses affected: 4.3

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: This CR replaces the CR 074

4 Synchronisation procedures

4.1 Cell search

During the cell search, the UE searches for a cell and determines the downlink scrambling code and common channel frame synchronisation of that cell. How cell search is typically done is described in Annex C.

4.2 Common physical channel synchronisation

The radio frame timing of all common physical channels can be determined after cell search. The P-CCPCH radio frame timing is found during cell search and the radio frame timing of all common physical channel are related to that timing as described in 25.211.

4.3 DPCCH/DPDCH synchronisation

4.3.1 General

The synchronisation of the dedicated physical channels can be divided into three~~two~~ cases:

- when a downlink dedicated physical channel and uplink dedicated physical channel shall be set up in the serving cell at the same time;
- when a downlink and uplink dedicated physical channel shall be set up in the target cell at the same time during hard handover;
- or when a downlink dedicated physical channel shall be set up and there already exist an uplink dedicated physical channel.

The three~~two~~ cases are described in subclauses 4.3.2, 4.3.3 and 4.3.4~~3~~ respectively.

4.3.2 No existing uplink dedicated channel in the serving cell

The assumption for this case is that a DPCCH/DPDCH pair shall be set up in both uplink and downlink, and that there exist no uplink DPCCH/DPDCH already. This corresponds to the case when a dedicated physical channel is initially set up on a frequency.

The synchronization establishment procedures of the dedicated physical channel are described below. The synchronization establishment flow is shown in figure 1.

a) UTRAN starts the transmission of downlink DPCCH/DPDCHs. The DPDCH is transmitted only when there is data to be transmitted to the UE.

b) The UE establishes downlink chip synchronization and frame synchronization based on the CPICH timing and timing offset information notified from UTRAN. Frame synchronization can be confirmed using the Frame Synchronization Word. Successful frame synchronization is confirmed and reported to the higher layers when S_R successive frames have been confirmed to be frame synchronized. Otherwise, frame synchronization failure is reported to the higher layers.

c) The UE starts the transmission of the uplink DPCCH/DPDCHs at a frame timing exactly T_0 chips after the frame timing of the received downlink DPCCH/DPDCH. The DPDCH is transmitted only when there is data to be transmitted. The UE immediately starts inner-loop power control as described in sections 5.1.2 and 5.2.1, i.e. the transmission power of the uplink DPCCH/DPDCH follows the TPC commands generated by UTRAN, and the UE performs SIR estimation to generate TPC commands transmitted to UTRAN.

d) UTRAN establishes uplink channel chip synchronization and frame synchronization. Frame synchronization can be confirmed using the Frame Synchronization Word. Successful frame synchronization is confirmed and

reported to the higher layers when S_R successive frames have been confirmed to be frame synchronized. Otherwise, frame synchronization failure is reported to the higher layers.

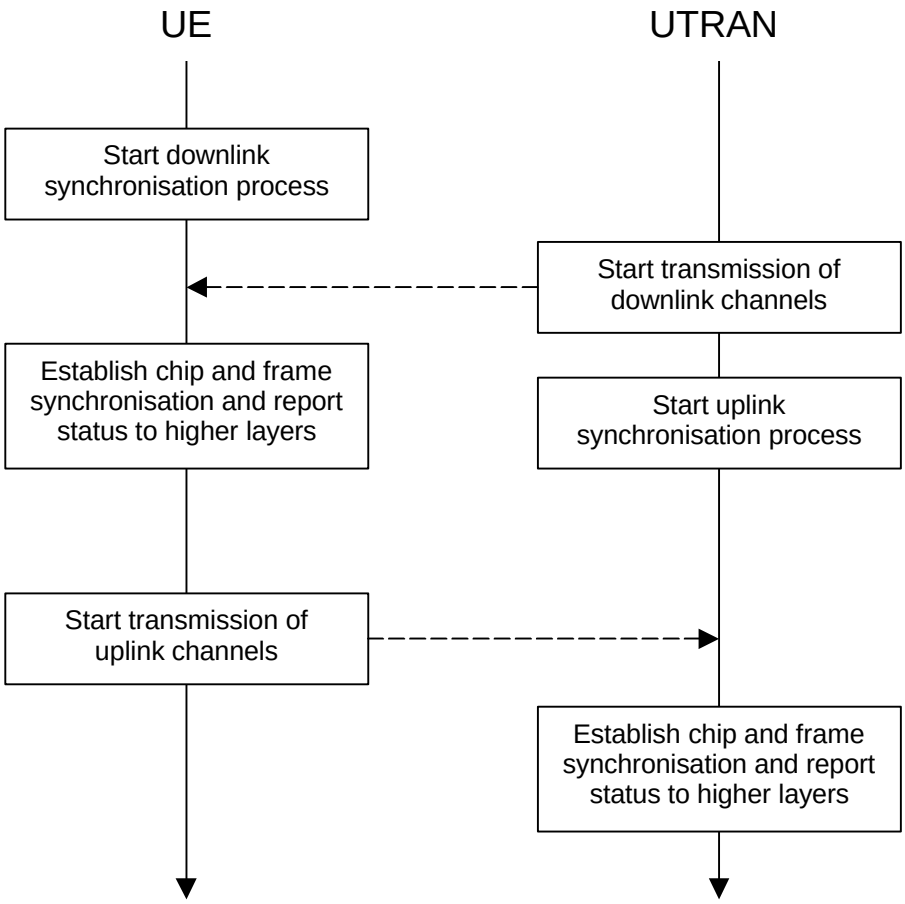

Figure 1: Synchronisation establishment flow for dedicated channels: uplink dedicated channel not existing

4.3.3 No existing uplink dedicated channel in the target cell (hard handover)

The assumption for this case is that a DPCCH/DPDCH pair shall be set up in both uplink and downlink in the target cell, and that there exist no uplink DPCCH/DPDCH already in the target cell.

The synchronisation establishment procedures of the dedicated physical channel are described below. The synchronisation establishment flow is shown in figure 2.

a) UTRAN sends a HANDOVER COMMAND to UE.

b) UE accomplishes the current transmission of uplink DPCCH/DPDCH by using compressed mode.

c) The UE establishes downlink chip and slot synchronisation.

d) The UE starts transmission of RACH preamble bursts.

e) UTRAN establishes uplink chip and slot synchronisation.

f) The UE starts the transmission of the uplink DPCCH/DPDCH at a frame timing exactly T_0 chips after the frame timing of the received downlink DPCCH/DPDCH (using compressed mode).

g) UTRAN establishes uplink channel chip synchronisation and frame synchronisation. Frame synchronisation can be confirmed using the Frame Synchronisation Word. Successful frame synchronisation is confirmed and reported to the higher layers when S_R successive frames have been confirmed to be frame synchronised. Otherwise, frame synchronisation failure is reported to the higher layers.

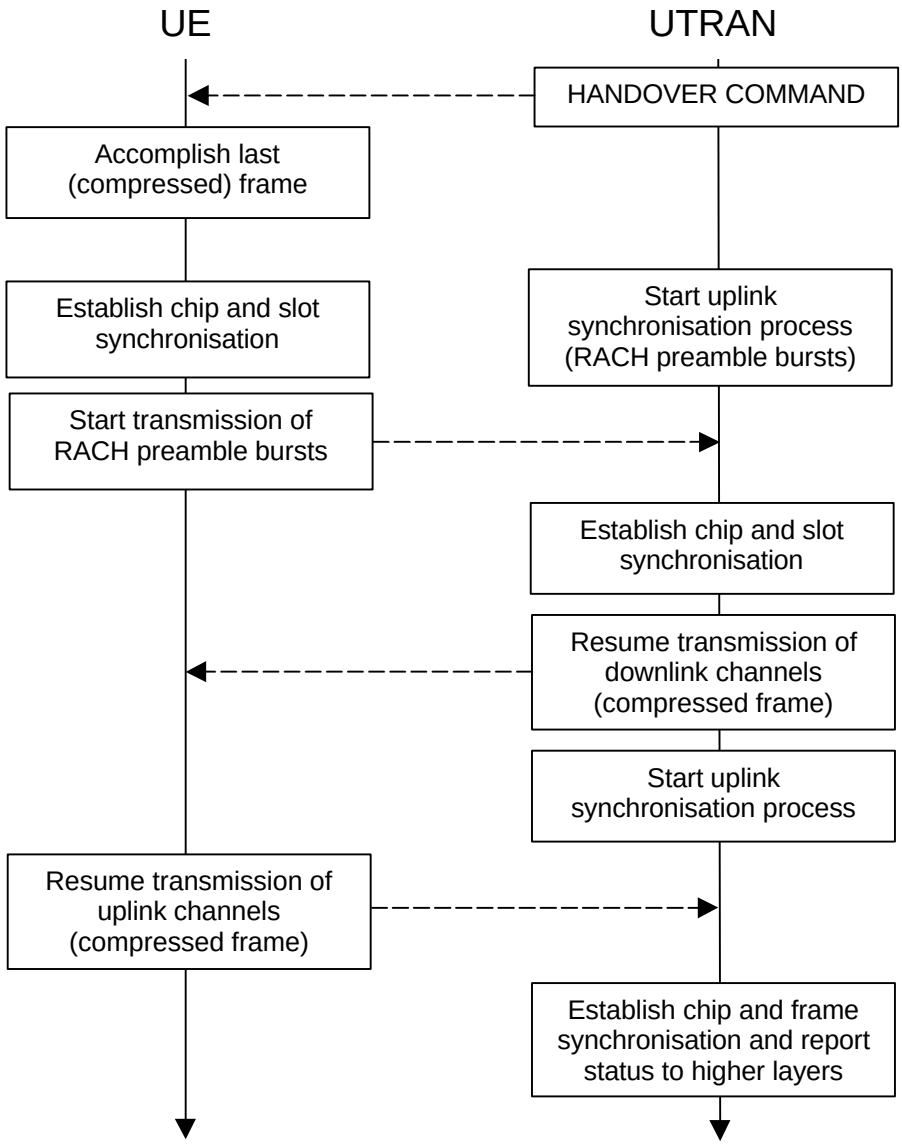

Figure 2: Synchronisation establishment flow for dedicated channels in the target cell: uplink dedicated channel not existing

Figure 3 depicts an example of a hard handover by utilising compressed mode.

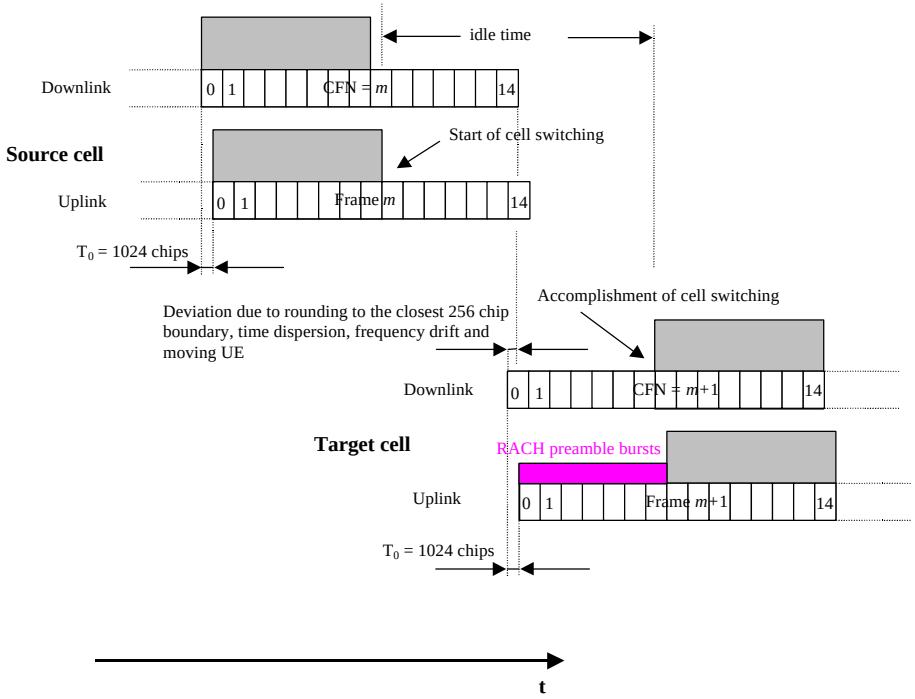

Figure 3: Example of a Hard handover by utilising compressed mode

4.3.43 With existing uplink dedicated channel

The assumption for this case is that there already exist DPCCH/DPDCHs in the uplink, and a corresponding dedicated physical channel shall be set up in the downlink. This corresponds to the case when a new cell has been added to the active set in soft handover and shall begin its downlink transmission.

At the start of soft handover, the uplink dedicated physical channel transmitted by the UE, and the downlink dedicated physical channel transmitted by the soft handover source cell continues transmitting as usual.

The synchronisation establishment flow is described in figure 2.

a) The UE starts the chip synchronisation establishment process of downlink channels from the handover destination. The uplink channels being transmitted shall continue transmission as before.

b) UTRAN starts the transmission of the downlink DPCCH/DPDCH at a frame timing such that the frame timing received at the UE will be within $T_0 \pm 148$ chips prior to the frame timing of the uplink DPCCH/DPDCH at the UE. UTRAN then starts the synchronization establishment process of the uplink DPCCH/DPDCH transmitted by the UE. Frame synchronization can be confirmed using the Frame Synchronization Word. Successful frame synchronization is confirmed and reported to the higher layers when S_R successive frames have been confirmed to be frame synchronized. Otherwise, frame synchronization failure is reported to the higher layers.

c) Based on the handover destination CPICH reception timing, the UE establishes chip synchronisation of downlink channels from handover destination cell. Frame synchronization can be confirmed using the Frame Synchronization Word. Successful frame synchronization is confirmed and reported to the higher layers when S_R successive frames have been confirmed to be frame synchronized. Otherwise, frame synchronization failure is reported to the higher layers.

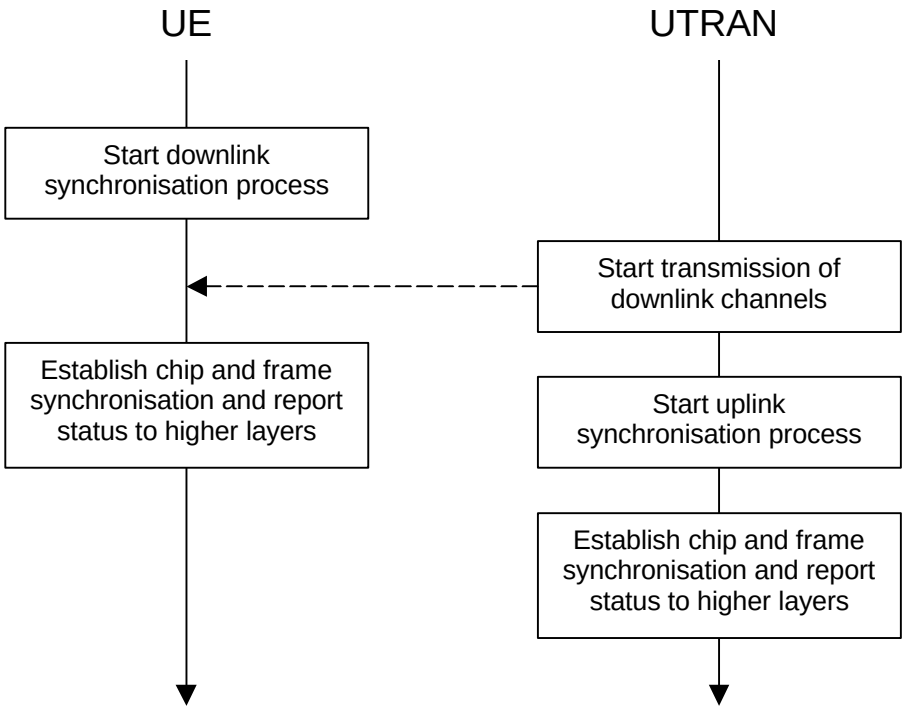

Figure 2: Synchronisation establishment flow for dedicated channels: uplink dedicated channel already existing

4.3.4 Transmission timing adjustments

During a connection the UE may adjust its DPDCH/DPCCH transmission time instant.

If the receive timing for any downlink DPCCH/DPDCH in the current active set has drifted, so the time between reception of the downlink DPCCH/DPDCH in question and transmission of uplink DPCCH/DPDCH lies outside the valid range, L1 shall inform higher layers of this, so that the network can be informed of this and downlink timing can be adjusted by the network.

NOTE: The maximum rate of uplink TX time adjustment, and the valid range for the time between downlink DPCCH/DPDCH reception and uplink DPCCH/DPDCH transmission in the UE is to be specified by RAN WG4.

5 Power control

5.1 Uplink power control

5.1.1 PRACH

5.1.1.1 General

The power control during the physical random access procedure is described in clause 6. The setting of power of the message control and data parts is described in the next sub-clause.

5.1.1.2 Setting of PRACH control and data part power difference

The message part of the uplink PRACH channel shall employ gain factors to control the control/data part relative power similar to the uplink dedicated physical channels. Hence, section 5.1.2.4 applies also for the RACH message part, with the differences that: