TSG-RAN Meeting #6 ***TSGRP#6(99)687***
Nice, France, 13 – 15 December 1999

Title: **Agreed CRs of category "B" (New features) to TS 25.214**

Source: **TSG-RAN WG1**

Agenda item: **5.1.3**

Spec	CR	Rev	Phase	Subject	Cat	Version-Current	Version-New	Doc
25.214	008	-	R99	Power offset of AICH and PICH	B	3.0.0	3.1.0	R1-99i64
25.214	021	-	R99	20 ms RACH message length	B	3.0.0	3.1.0	R1-99i40
25.214	024	2	R99	Setting of power in uplink compressed mode	B	3.0.0	3.1.0	R1-99k78
25.214	025	-	R99	Cleanup of synchronisation procedures	B	3.0.0	3.1.0	R1-99j24
25.214	029	-	R99	Out-of-synch handling	B	3.0.0	3.1.0	R1-99j59
25.214	030	2	R99	State update rule addition to SSDT specification	B	3.0.0	3.1.0	R1-99l70
25.214	033	-	R99	Uplink TX timing adjustment	B	3.0.0	3.1.0	R1-99j76
25.214	036	-	R99	Inclusion of idle periods for the IPDL LCS	B	3.0.0	3.1.0	R1-99k16
25.214	042	1	R99	Inclusion of adjustment loop in downlink power	B	3.0.0	3.1.0	R1-99l59

NOTE: The source of this document is TSG-RAN WG1. The source shown on each CR cover sheet is the originating organisation.

TSG-RAN Working Group 1 meeting #9
Dresden, Germany
November 30 – December 3, 1999

TSGR1#9(99)i64

Agenda item:

Source: Ericsson

Title: CR 25.214-008: Power offset of AICH and PICH

Document for: Decision

At WG1#8 it was decided that the UE is informed about the relative powers of AICH and PICH compared to the primary CPICH. This CR introduces text to document this in 25.214.

3GPP TSG RAN WG1 Meeting #9
Dresden, Germany, Nov 30 – Dec 3, 1999

Document ???99???
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or for SMG, use the format P-99-xxx

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25.214 CR 008 Current Version: 3.0.0

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

For submission to: TSG-RAN #6
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: (U)SIM [ ] ME [X] UTRAN / Radio [X] Core Network [ ]
(at least one should be marked with an X)

Source: Ericsson **Date:** 1999-11-18

Subject: Power offset of AICH and PICH

Work item:

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

F	Correction	
A	Corresponds to a correction in an earlier release	
B	Addition of feature	X
C	Functional modification of feature	
D	Editorial modification	

Release:

Phase 2	
Release 96	
Release 97	
Release 98	
Release 99	X
Release 00	

Reason for change: At WG1#8 it was decided that the UE should be informed about the relative powers of AICH and PICH compared to the primary CPICH

Clauses affected:

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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Appropriate scaling of the output power shall be performed by the UE, so that the output DPCCH power follows the inner loop power control with power steps of $\pm\Delta_{TPC}$ dB.

5.1.2.4.2 Signalled gain factors

When the gain factors β_c and β_d are signalled by higher layers for a certain TFC, the signalled values are used directly for weighting of DPCCH and DPDCH(s).

5.1.2.4.3 Computed gain factors

The gain factors β_c and β_d may also be computed for certain TFCs, based on the signalled settings for a reference TFC.

Let $\beta_{c,ref}$ and $\beta_{d,ref}$ denote the signalled gain factors for the reference TFC. Further, let $\beta_{c,j}$ and $\beta_{d,j}$ denote the gain factors used for the TFC in the *j*:th radio frame.

Define the variable

$$K_{ref} = \sum_i RM_i \cdot N_i \,,$$

where RM_i is the semi-static rate matching attribute for transport channel i (defined in TS 25.212 section 4.2.7), N_i is the number of bits output from the radio frame segmentation block for transport channel i (defined in TS 25.212 section 4.2.6.1), and the sum is taken over all the transport channels i in the reference TFC.

Similarly, define the variable

$$K_j = \sum_i RM_i \cdot N_i \,,$$

where the sum is taken over all the transport channels i in the TFC used in the *j*:th frame.

The variable A_j is then computed as:

$$A_j = \frac{\beta_{d,ref}}{\beta_{c,ref}} \cdot \sqrt{\frac{K_j}{K_{ref}}} \,.$$

The gain factors for the TFC in the *j*:th radio frame are then computed as follows:

If $A_j > 1$, then $\beta_{d,j} = 1.0$ and $\beta_{c,j} = \lfloor 1/A_j \rfloor$, where $\lfloor \bullet \rfloor$ means rounding to closest lower quantized β-value.
If $A_j \le 1$, then $\beta_{d,j} = \lceil A_j \rceil$ and $\beta_{c,j} = 1.0$, where $\lceil \bullet \rceil$ means rounding to closest higher quantized β-value.

The quantized β-values is defined in TS 25.213 section 4.2.1, table 1.

5.2 Downlink power control

The transmit power of the downlink channels is determined by the network. In general the ratio of the transmit power between different downlink channels is not specified and may change with time. However, regulations exist as described in the following sub-clauses.

5.2.1 DPCCH/DPDCH

5.2.1.1 General

The downlink transmit power control procedure controls simultaneously the power of a DPCCH and its corresponding DPDCHs. The power control loop adjusts the power of the DPCCH and DPDCHs with the same amount, i.e. the relative power difference between the DPCCH and DPDCHs is not changed.

The relative transmit power offset between DPCCH fields and DPDCHs is determined by the network The TFCI, TPC and pilot fields of the DPCCH are offset relative to the DPDCHs power by PO1, PO2 and PO3 dB respectively. The power offsets may vary in time.

5.2.1.2 Ordinary transmit power control

The downlink inner-loop power control adjusts the network transmit power in order to keep the received downlink SIR at a given SIR target, SIR_{target}. A higher layer outer loop adjusts SIR_{target} independently for each connection.

The UE should estimate the received downlink DPCCH/DPDCH power of the connection to be power controlled. Simultaneously, the UE should estimate the received interference. The obtained SIR estimate SIR_{est} is then used by the UE to generate TPC commands according to the following rule: if $SIR_{est} > SIR_{target}$ then the TPC command to transmit is “0”, requesting a transmit power decrease, while if $SIR_{est} < SIR_{target}$ then the TPC command to transmit is “1”, requesting a transmit power increase.

When the UE is not in soft handover the TPC command generated is transmitted in the first available TPC field in the uplink DPCCH.

When the UE is in soft handover it should check the downlink power control mode (DPC_MODE) before generating the TPC command

- if DPC_MODE = 0 : the UE sends a unique TPC command in each slot and the TPC command generated is transmitted in the first available TPC field in the uplink DPCCH
- if DPC_MODE = 1 : the UE repeats the same TPC command over 3 slots and the new TPC command is transmitted such that there is a new command at the beginning of the frame.

The DPC_MODE parameter is a UE specific parameter controlled by the UTRAN.

As a response to the received TPC commands, UTRAN may adjust the downlink DPCCH/DPDCH power. The transmitted DPCCH/DPDCH power may not exceed Maximum_DL_Power, nor may it be below Minimum_DL_Power.

< Note: It should be clarified with WG3 if Maximum_DL_Power and Minimum_DL_Power are given as absolute values or relative. >

< Note: It is not clear to what extent the UTRAN response to the received TPC commands should be specified. Until this has been clarified, the text in the paragraph below should be seen as an example of UTRAN behaviour. >

Changes of power shall be a multiple of the minimum step size $\Delta_{TPC,min}$ dB. It is mandatory for UTRAN to support $\Delta_{TPC,min}$ of 1 dB, while support of 0.5 dB is optional.

< Note: It needs to be clarified if an upper limit on the downlink power step should be specified. >

’When SIR measurements cannot be performed due to downlink out-of-synchronisation, the TPC command transmitted shall be set as “1” during the period of out-of-synchronisation.

5.2.1.3 Power control in compressed mode

The aim of downlink power control in uplink or/and downlink compressed mode is to recover as fast as possible a signal-to-interference ratio (SIR) close to the target SIR after each transmission gap.

The UE behaviour is the same in compressed mode as in normal mode, described in subclause 5.2.1.2, i.e. TPC commands should be generated based on the estimated received SIR.

The UTRAN behaviour during compressed mode is not specified. As an example, the algorithm can be similar to uplink power control in downlink compressed mode as described in sub-clause 5.1.2.3.

In downlink compressed mode or in simultaneous downlink and uplink compressed mode, the transmission of downlink DPCCH and DPDCH(s) is stopped.

5.2.1.4 Site selection diversity transmit power control

5.2.1.4.1 General

Site selection diversity transmit power control (SSDT) is an optional macro diversity method in soft handover mode.

Operation is summarised as follows. The UE selects one of the cells from its active set to be ‘primary’, all other cells are classed as ‘non primary’. The main objective is to transmit on the downlink from the primary cell, thus reducing the interference caused by multiple transmissions in a soft handover mode. A second objective is to achieve fast site selection without network intervention, thus maintaining the advantage of the soft handover. In order to select a primary cell, each cell is assigned a temporary identification (ID) and UE periodically informs a primary cell ID to the connecting cells. The non-primary cells selected by UE switch off the transmission power. The primary cell ID is delivered by UE to the active cells via uplink FBI field. SSDT activation, SSDT termination and ID assignment are all carried out by higher layer signalling.

5.2.1.4.1.1 Definition of temporary cell identification

Each cell is given a temporary ID during SSDT and the ID is utilised as site selection signal. The ID is given a binary bit sequence. There are three different lengths of coded ID available denoted as "long", "medium" and "short". The network decides which length of coded ID is used. Settings of ID codes for 1-bit and 2-bit FBI are exhibited in Table 1 and Table 2, respectively.

Table 1 : Settings of ID codes for 1 bit FBI

ID label	ID code "long"	ID code "medium"	ID code "short"
a	000000000000000	0000000(0)	00000
b	111111111111111	1111111(1)	11111
c	000000001111111	0000111(1)	00011
d	111111110000000	1111000(0)	11100
e	000011111111000	0011110(0)	00110
f	111100000000111	1100001(1)	11001
g	001111000011110	0110011(0)	01010
h	110000111100001	1001100(1)	10101

Table 2 : Settings of ID codes for 2 bit FBI

ID label	ID code (Column and Row denote slot position and FBI-bit position.) "long"	"medium"	"short"
a	0000000(0) 0000000(0)	000(0) 000(0)	000 000
b	1111111(1) 1111111(1)	111(1) 111(1)	111 111
c	0000000(0) 1111111(1)	000(0) 111(1)	000 111
d	1111111(1) 0000000(0)	111(1) 000(0)	111 000
e	0000111(1) 1111000(0)	001(1) 110(0)	001 100
f	1111000(0) 0000111(1)	110(0) 001(1)	110 011
g	0011110(0) 0011110(0)	011(0) 011(0)	010 010
h	1100001(1) 1100001(1)	100(1) 100(1)	101 101

ID must be terminated within a frame. If FBI space for sending a given ID cannot be obtained within a frame, hence if the entire ID is not transmitted within a frame but must be split over two frames, the last bit(s) of the ID is(are) punctured. The relating bit(s) to be punctured are shown with brackets in Table 1 and Table 2.

5.2.1.4.2 TPC procedure in UE

The TPC procedure of the UE in SSDT is identical to that described in subclause 5.2.3.2.

5.2.1.4.3 Selection of primary cell

The UE selects a primary cell periodically by measuring the RSCP of CPICHs transmitted by the active cells. The cell with the highest CPICH RSCP is detected as a primary cell.

5.2.1.4.4 Delivery of primary cell ID

The UE periodically sends the ID code of the primary cell via portion of the uplink FBI field assigned for SSDT use (FBI S field). A cell recognises its state as non-primary if the following two conditions are fulfilled simultaneously:

- the received primary ID code does not match with the own ID code,
- and the received uplink signal quality satisfies a quality threshold, Qth, a parameter defined by the network.

Otherwise the cell recognises its state as primary.

At the UE, the primary ID code to be sent to the cells is segmented into a number of portions. These portions are distributed in the uplink FBI S-field. The cell in SSDT collects the distributed portions of the primary ID code and then detects the transmitted ID. Period of primary cell update depends on the settings of code length and the number of FBI bits assigned for SSDT use as shown in Table 3

Table 3 : Period of primary cell update

code length	The number of FBI bits per slot assigned for SSDT 1	2
"long"	1 update per frame	2 updates per frame

"medium"	2 updates per frame	4 updates per frame
"short"	3 updates per frame	5 updates per frame

5.2.1.4.5 TPC procedure in the network

In SSDT, a non-primary cell can switch off its DPDCH output (i.e. no transmissions).

The cell manages two downlink transmission power levels, P1, and P2. Power level P1 is used for downlink DPCCH transmission power level and this level is updated as the same way specified in 5.2.3.2 regardless of the selected state (primary or non-primary). The actual transmission power of TFCI, TPC and pilot fields of DPCCH is set by adding P1 and the offsets PO1, PO2 and PO3, respectively, as specified in 5.2.3.1. P2 is used for downlink DPDCH transmission power level and this level is set to P1 if the cell is selected as primary, otherwise P2 is switched off. The cell updates P1 first and P2 next, and then the two power settings P1 and P2 are maintained within the power control dynamic range. Table 4 summarizes the updating method of P1 and P2.

Table 4 : Updating of P1 and P2

State of cell	P1 (DPCCH)	P2 (DPDCH)
non primary	Updated by the same way as specified in 5.2.3.2	Switched off
primary		= P1

5.2.2 Power Control with DSCH

The DSCH power control can be based on the following solutions, which are selectable, by the network.

- Inner-loop power control based on the power control commands sent by the UE on the uplink DPCCH.
- Slow power control.

5.2.3 AICH

The UE is informed about the relative transmit power of the AICH (measured as the power per transmitted acquisition indicator) compared to the primary CPICH transmit power by the higher layers.

5.2.4 PICH

The UE is informed about the relative transmit power of the PICH compared to the primary CPICH transmit power by the higher layers.

3GPP TSG RAN WG1 Meeting #9
Dresden, Germany, Nov 30 – Dec 3, 1999

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25.214	**CR**	**021**	Current Version:	3.0.0

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

For submission to:	TSG-RAN #6	for approval	X	strategic	(for SMG
list expected approval meeting # here ↑		for information		non-strategic	use only)

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:	Nokia	**Date:**	24.11.99
Subject:	20 ms RACH message length		
Work item:			

Category:	F	Correction		**Release:** Phase 2	
	A	Corresponds to a correction in an earlier release		Release 96	
(only one category	B	Addition of feature	X	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:	Addition of 20 ms RACH message length was agreed in RAN WG1#8 (New York 12.-15.10). See documents R1-99f58 and R1-99h72.
Clauses affected:	6.1

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:	

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6 Random access procedure

6.1 RACH Random Access Procedure

Before the random-access procedure is executed, the UE should acquire the following information from the BCH :

- The preamble spreading code(s) / message scrambling code(s) used in the cell
- The message length in time, either 10 or 20 ms
- The available signatures , and RACH sub-channel(s) groups for each ASC, where a sub-channel group is defined as a group of some of the sub-channels defined in table 7, and is indicated by upper layer.
- The available spreading factors for the message part
- The uplink interference level in the cell
- The primary CCPCH transmit power level
- The AICH transmission timing parameter as defined in 25.211.
- The power offset $\Delta P_{p\text{-}m}$ between preamble and the message part.
- The power offsets ΔP_0 (power step when no acquisition indicator is received, step 7.3) and ΔP_1 (power step when negative acquisition is received, see step 8.3)

The random-access procedure is:

1) The UE randomly selects a preamble spreading code from the set of available spreading codes. The random function is TBD.

2) The UE sets the preamble transmit power to the value P_{RACH} given in Section 5.1.1. [*Editor's note: Here it is assumed that the initial power back-off is included in the "Constant Value" of 5.1.1*]

3) The UE implements the dynamic persistence algorithm by:

   3.1) Monitor the broadcast channel (BCH).

   3.2) Read the current persistence factor, *N*, from the BCH.

   3.3) If $N = 0$, the UE proceeds to step 4. Otherwise, the UE generate an integer uniform random variable R in the interval $[0, 1, \ldots, 2^N - 1]$.

   3.4) If the outcome of the random draw $R = 0$, the UE proceeds to step 4. Otherwise, the UE defers the transmission of the message for one frame and repeats step 3.

4) The UE:

   4.1) Randomly selects the RACH sub-channel group from the available ones for its ASC, The random function, for selecting the RACH sub-channel group from the available ones is TBD.

   4.2) Derives the available access slots in the next two frames, defined by SFN and SFN+1 in the selected RACH sub-channel group with the help of SFN and table 7. Randomly selects one access slot from the available access slots in the next frame, defined by SFN, if there is one available. If there is no access slot available in the next frame, defined by SFN then, randomly selects one access slot from the available access slots in the following frame, defined by SFN+1. Random function is TBD.

   4.3) Randomly selects a signature from the available signatures within the ASC given by higher layers. Random function is TBD.

5) The UE sets the Preamble Retransmission Counter to Preamble_Retrans_Max (value TBD).

6) The UE transmits its preamble using the selected uplink access slot, signature, and preamble transmission power..

7) If the UE does not detect the positive or negative acquisition indicator corresponding to the selected signature in the downlink access slot corresponding to the selected uplink access slot, the UE:

   7.1) Selects a new uplink access slot, as next available access slot, i.e. next slot in the sub-channel group used, as selected in 4.1

   7.2) Randomly selects a new signature from the available signatures within the ASC given by higher layers. Random function is TBD.

   7.3) Increases the preamble transmission power with the specified offset ΔP_0.

   7.4) Decrease the Preamble Retransmission Counter by one.

   7.5) If the Preamble Retransmission Counter > 0, the UE repeats from step 6 otherwise an error indication is passed to the higher layers and the random-access procedure is exited.

8) If the UE detects the negative acquisition indicator corresponding to the selected signature in the downlink access slot corresponding to the selected uplink access slot, the UE:

   8.1) Selects a new uplink access slot as in 7.1

   8.2) Randomly selects a new signature from the available signatures within the ASC given by higher layers. Random function is TBD.

   8.3) Modifies the preamble transmission power with the specified offset ΔP_1.

   8.4) Repeats from step 6

9) The UE transmits its random access message three or four uplink access slots after the uplink access slot of the last transmitted preamble depending on the AICH transmission timing parameter. Transmission power of the random access message is modified from that of the last transmitted preamble with the specified offset $\Delta P_{p\text{-}m}$.

10) An indication of successful random-access transmission is passed to the higher layers.

Dynamic persistence is provided for managing interference and minimising delay by controlling access to the RACH channel. The system will publish a dynamic persistence value on the BCH, the value of which is dependent on the estimated backlog of users in the system.

Table 7: The available access slots for different RACH sub-channels

	Sub-channel Number											
Frame number	0	1	2	3	4	5	6	7	8	9	10	11
SFN modulo 8=0	0	1	2	3	4	5	6	7				
SFN modulo 8=1	12	13	14						8	9	10	11
SFN modulo 8=2				0	1	2	3	4	5	6	7	
SFN modulo 8=3	9	10	11	12	13	14						8
SFN modulo 8=4	6	7					0	1	2	3	4	5
SFN modulo 8=5			8	9	10	11	12	13	14			
SFN modulo 8=6	3	4	5	6	7					0	1	2
SFN modulo 8=7						8	9	10	11	12	13	14

TSG-RAN Working Group 1 meeting #9 **TSGR1#9(99)k78**
Dresden, Germany
November 30 – December 3, 1999

Agenda item:

Source: Ericsson

Title: Setting of power in uplink compressed mode, revised

Document for: Approval

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1 Introduction

In compressed mode data is only transmitted in a part of the frame. In [1] a number of formats for uplink compression are given. With these formats between 3 and 7 slots are used as a gap. Thereby measurements on other frequencies and other systems can be made. Uplink compressed mode is used together with downlink compressed mode when measuring on other frequencies, on TDD and on GSM 1800.

In uplink the DPDCH and DPCCH signals are transmitted simultaneously on different codes. The gap of the DPDCH and DPCCH have the same length but the compression is not done in a similar way on the DPDCH as on the DPCCH code. In DPDCH the data is compressed either by puncturing, by using only half the spreading factor or by higher layer signalling transmitting fewer information bits in the compressed frame. In DPCCH there are four kinds of bits, pilot, TPC, FBI and TFCI. The number of TPC and FBI bits per slot is not changed. When there are TFCI bits the number of TFCI bits per slot is increased in order to transmit all 32 TFCI bits for the frame. Instead the number of pilot bits is decreased, see [1].

The power levels of the DPDCH and of the DPCCH codes respectively in compressed mode depends on the compression methods. The power offset between the codes during compressed mode can either be signalled or computed by the UE. In this contribution this power offset is computed in the UE, based on the offsets used during normal frames given the datarate in the actual frame and on the level of compression.

2 DPCCH power in compressed mode

The DPCCH formats when in compressed mode are listed in [1]. The formats that have TFCI bits contains fewer pilot bits than the formats when not in compressed mode. The reason for that the number of pilot bits is decreased compared to when in non compressed mode is that the number of TFCI bits shall be the same during a frame. Thereby a robust scheme with a good reliability of the transport format detection is used. In order to keep the same channel quality the energy of the pilot must be kept equal. Thereby the channel estimate and power control performance during the compressed slots is kept at approximately the same level as in normal mode. The power of the DPCCH shall therefore be increased by the factor

$$P_{DPCCH,C} \geq P_{DPCCH,N} \cdot \frac{N_{Pilot,N}}{N_{Pilot,C}}$$

where $P_{DPCCH,C}$ is the power of the DPCCH channel when in compressed mode and $P_{DPCCH,N}$ is the power of the DPCCH in normal mode (non-compressed mode). $N_{Pilot,N}$ and $N_{Pilot,C}$ is the number of pilot bits per slot in normal and compressed mode respectively.

3 DPDCH power in compressed mode

When a DPDCH frame is compressed, either the spreading factor is decreased by a factor 2, the coded data is punctured so that the number of transmitted bits is decreased or by higher signalling the number of transmitted information bits in the frame is decreased. Thereby a gap in the transmission is achieved so that measurements o other frequencies can be made.

In order to get a good quality the transmitted energy per information bit shall be the same independent of if the channel is in compressed mode or not. Therefore given the number of information bits the power of the DPDCH shall be changed so that the total frame is transmitted with the same total energy. The DPDCH is then transmitted with the power

$$P_{DPDCH,C} \geq P_{DPDCH,N} \cdot \frac{15}{N_{slots,C}}$$

where $P_{DPDCH,C}$ is the power of the DPDCH channel when in compressed mode and $P_{DPDCH,N}$ is the power the DPDCH channel should be transmitted with when in normal mode. $N_{slots,C}$ is the number of slots transmitted in a frame when in compressed mode as defined in [1].

This means that if higher layer scheduling is used to decrease the number of information bits the power of the compressed frame is not necessarily increased during a compressed frame, instead the total energy transmitted on the DPDCH during the frame and thereby $P_{DPDCH,N}$ is decreased due to lower information bit rate.

4 Beta setting in compressed mode

Based on the above reasoning, the beta setting in compressed mode is therefore given by the ratio of the square root of the power ratio between DPDCH and DPCCH as:

$$\frac{\beta_{d,c}}{\beta_{c,c}} \geq \frac{\beta_{d,N}}{\beta_{c,N}} \cdot \sqrt{\frac{15 \cdot N_{Pilot,C}}{N_{slots,C} \cdot N_{Pilot,N}}} .$$

5 Conclusions

A proposal of the beta setting while in compressed mode is given. With this proposal the loss of compressed mode should be minimized since the pilots are transmitted with the same energy per slot on the DPCCH. The transmitted information bit energy of the DPDCH channel is also kept constant.

References

[1]. TS 25.212 Coding and Multiplexing

Revision information

In revision 1 of the CR, the following things have been fixed:

- It was pointed out that the gain factors used in compressed frames should be derived from the gain factors used in normal frames, regardless of how those gain factors had been computed. This has now been fixed, so the method is general, i.e. first we associate gain factors with every TFC in normal mode, then we recalculate dthem for compressed mode.
- Changed terminology "TFC in j:th frame" to "j:th TFC".
- Changed to latest version of CR front page.
- Updated the heading of the CR.

In revision 2 of the CR, the following things have been fixed:

- It was clarified that the power step during the recovery period is $\pm\Delta_{RP\text{-}TPC}$ dB.

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Dresden, Germany, Nov 30 – Dec 3, 1999

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25.214	**CR**	**024r2**	Current Version:	3.0.0

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

For submission to:	TSG-RAN #6	for approval	X	strategic		*(for SMG use only)*
list expected approval meeting # here ↑		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: Ericsson **Date:** 1999-11-28

Subject: Setting of power in uplink compressed mode

Work item:

Category:				**Release:**		
	F	Correction			Phase 2	
	A	Corresponds to a correction in an earlier release			Release 96	
(only one category	B	Addition of feature	X		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: The power setting in the UE in uplink compressed mode is not yet specified. This CR adds that information.

Clauses affected: 5.1.2.4

Other specs affected:			
	Other 3G core specifications	X	→ 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:

5.1.2.4 Setting of the uplink DPCCH/DPDCH power difference

5.1.2.4.1 General

The uplink DPCCH and DPDCH(s) are transmitted on different codes as defined in section 4.2.1 of TS 25.213. The gain factors β_c and β_d may vary for each TFC. There are two ways of controlling the gain factors of the DPCCH code and the DPDCH codes for different TFCs in normal (non-compressed) frames:

- β_c and β_d are signalled for the TFC, or
- β_c and β_d is computed for the TFC, based on the signalled settings for a reference TFC.

Combinations of the two above methods may be used to associate β_c and β_d values to all TFCs in the TFCS. The two methods are described in sections 5.1.2.4.2 and 5.1.2.4.3 respectively. Several reference TFCs may be signalled from higher layers.

The gain factors may vary on radio frame basis depending on the current TFC used. Further, the setting of gain factors is independent of the inner loop power control. This means that at the start of a frame, the gain factors are determined and the inner loop power control step is applied on top of that.

Appropriate scaling of the output power shall be performed by the UE, so that the output DPCCH power follows the inner loop power control with power steps of $\pm\Delta_{TPC}$ dB.

The gain factors during compressed frames are based on the gain factors defined in normal frames, as specified in 5.1.2.4.4.

5.1.2.4.2 Signalled gain factors

When the gain factors β_c and β_d are signalled by higher layers for a certain TFC, the signalled values are used directly for weighting of DPCCH and DPDCH(s).

5.1.2.4.3 Computed gain factors

The gain factors β_c and β_d may also be computed for certain TFCs, based on the signalled settings for a reference TFC.

Let $\beta_{c,ref}$ and $\beta_{d,ref}$ denote the signalled gain factors for the reference TFC. Further, let $\beta_{c,j}$ and $\beta_{d,j}$ denote the gain factors used for the TFC in the j:th radio frame.

Define the variable

$$K_{ref} = \sum_i RM_i \cdot N_i \ ,$$

where RM_i is the semi-static rate matching attribute for transport channel i (defined in TS 25.212 section 4.2.7), N_i is the number of bits output from the radio frame segmentation block for transport channel i (defined in TS 25.212 section 4.2.6.1), and the sum is taken over all the transport channels i in the reference TFC.

Similarly, define the variable

$$K_j = \sum_i RM_i \cdot N_i \ ,$$

where the sum is taken over all the transport channels i in the TFC used in the j:th frame.

The variable A_j is then computed as:

$$A_j = \frac{\beta_{d,ref}}{\beta_{c,ref}} \cdot \sqrt{\frac{K_j}{K_{ref}}} \ .$$

The gain factors for the TFC in the j:th radio frame are then computed as follows:

If $A_j > 1$, then $\beta_{d,j} = 1.0$ and $\beta_{c,j} = \lfloor 1/A_j \rfloor$, where $\lfloor \bullet \rfloor$ means rounding to closest lower quantized β–value.

If $A_j \le 1$, then $\beta_{d,j} = \lceil A_j \rceil$ and $\beta_{c,j} = 1.0$, where $\lceil \bullet \rceil$ means rounding to closest higher quantized β-value.

The quantized β-values is defined in TS 25.213 section 4.2.1, table 1.

5.1.2.4.4 Setting of the uplink DPCCH/DPDCH power difference in compressed mode

The gain factors used during a compressed frame for a certain TFC are calculated from the gain factors used in normal (non-compressed) frames for that TFC. Let $\beta_{c,j}$ and $\beta_{d,j}$ denote the gain factors for the j:th TFC in a normal frame. Further, let $\beta_{c,C,j}$ and $\beta_{d,C,j}$ denote the gain factors used for the j:th TFC when the frame is compressed. The variable $A_{C,j}$ is computed as:

$$A_{C,j} = \frac{\beta_{d,j}}{\beta_{c,j}} \cdot \sqrt{\frac{15 \cdot N_{pilot,C}}{N_{slots,C} \cdot N_{pilot,N}}},$$

where $N_{pilot,C}$ is the number of pilot bits per slot when in compressed mode, and $N_{pilot,N}$ is the number of pilot bits per slot in normal mode. $N_{slots,C}$ is the number of slots in the compressed frame used for transmitting the data.

The gain factors for the j:th TFC in a compressed frame are computed as follows:

If $A_{C,j} > 1$, then $\beta_{d,C,j} = 1.0$ and $\beta_{c,C,j} = \lfloor 1/A_{C,j} \rfloor$, where $\lfloor \bullet \rfloor$ means rounding to closest lower quantized β–value. Since $\beta_{c,j}$ may not be set to zero, if the above rounding results in a zero value, $\beta_{c,j}$ shall be set to the lowest quantized amplitude ratio of 0.0667 as specified in TS 25.213.

If $A_{C,j} \le 1$, then $\beta_{d,C,j} = \lceil A_{C,j} \rceil$ and $\beta_{c,C,j} = 1.0$, where $\lceil \bullet \rceil$ means rounding to closest higher quantized β-value.

The quantized β-values is defined in TS 25.213 section 4.2.1, table 1.

Appropriate scaling of the output power shall be performed by the UE, so that the output DPCCH power follows the inner loop power control with power steps of $\pm\Delta_{TPC}$ dB ($\pm\Delta_{RP\text{-}TPC}$ dB during the recovery period) with an additional power offset during a compressed frame of $N_{pilot,N} / N_{pilot,C}$.

TSG-RAN Working Group 1 meeting #9 **_TSGR1#9(99)j24_**
Dresden, Germany
November 30 – December 3, 1999

Agenda item:

Source: Ericsson

Title: CR 25.214-025: Cleanup of synchronisation procedures

Document for: Decision

Section 4, Synchronisation procedures, in TS 25.214 needs some cleaning up:

- The references in section 4.3.1 are incorrect.
- Figure 1 and 2 can be improved.
- The text under figures 1 and 2 should be aligned.
- The timing $T_0 \pm$ [148] chips was previously a working assumption, hence the brackets, but since no concerns have been raised this should be modified to $T_0 \pm 148$.

This CR introduces the changes to TS 25.214.

3GPP TSG RAN WG1 Meeting #9
Dresden, Germany, Nov 30 – Dec 3, 1999

Document ??99???
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

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25.214	**CR**	**025**	Current Version:	3.0.0

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

For submission to:	TSG-RAN #6	for approval	X	strategic		*(for SMG use only)*
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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: Ericsson **Date:** 1999-11-23

Subject: Cleanup of synchronisation procedures

Work item:

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

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

Reason for change:

- The references in section 4.3.1 are incorrect.
- Figure 1 and 2 can be improved.
- The text under figures 1 and 2 should be aligned.
- The timing $T_0 \pm$ [148] chips was previously a working assumption, hence the brackets, but since no concerns have been raised this should be modified to $T_0 \pm 148$.

Clauses affected: 4.3.1, 4.3.2, 4.3.3

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:

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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 two cases:

- when a downlink dedicated physical channel and uplink dedicated physical channel shall be set up at the same time;
- or when a downlink dedicated physical channel shall be set up and there already exist an uplink dedicated physical channel.

The two cases are described in subclauses ~~5.5.1~~4.3.2 and ~~5.5.2~~4.3.3 respectively.

4.3.2 No existing uplink dedicated channel

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.

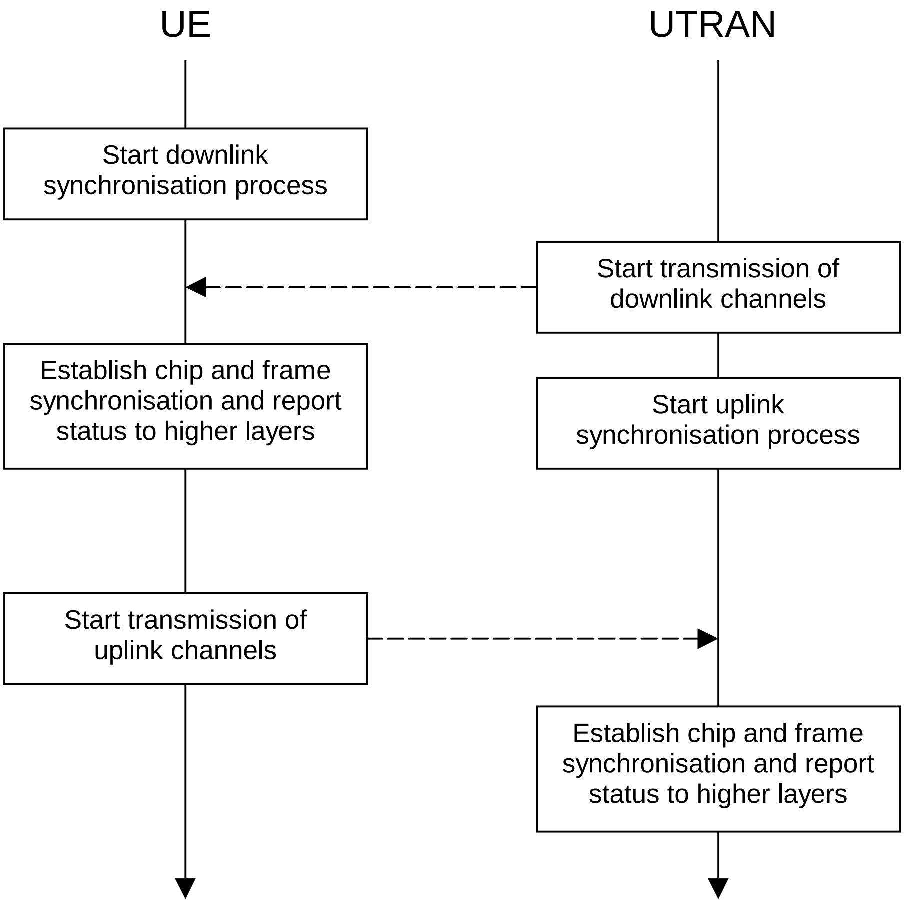
The synchronization establishment procedures of the dedicated physical channel are described below. The synchronization establishment ~~process~~ flow is shown in figure 1.

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~~3~~, 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.



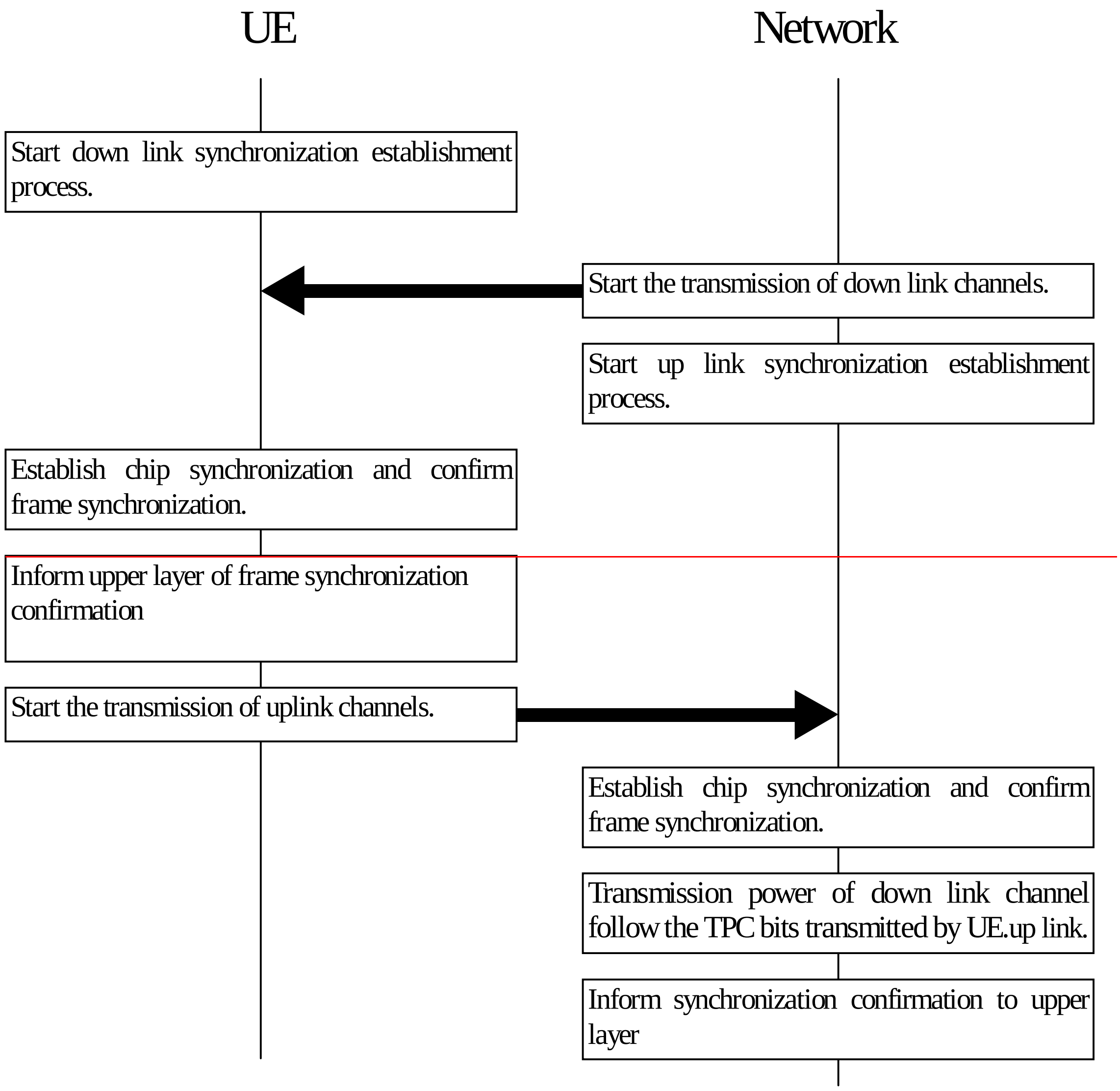


Figure 1: Synchronis~~z~~ation establishment flow for~~of~~ dedicated channels: uplink dedicated channel not existing

4.3.3 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.

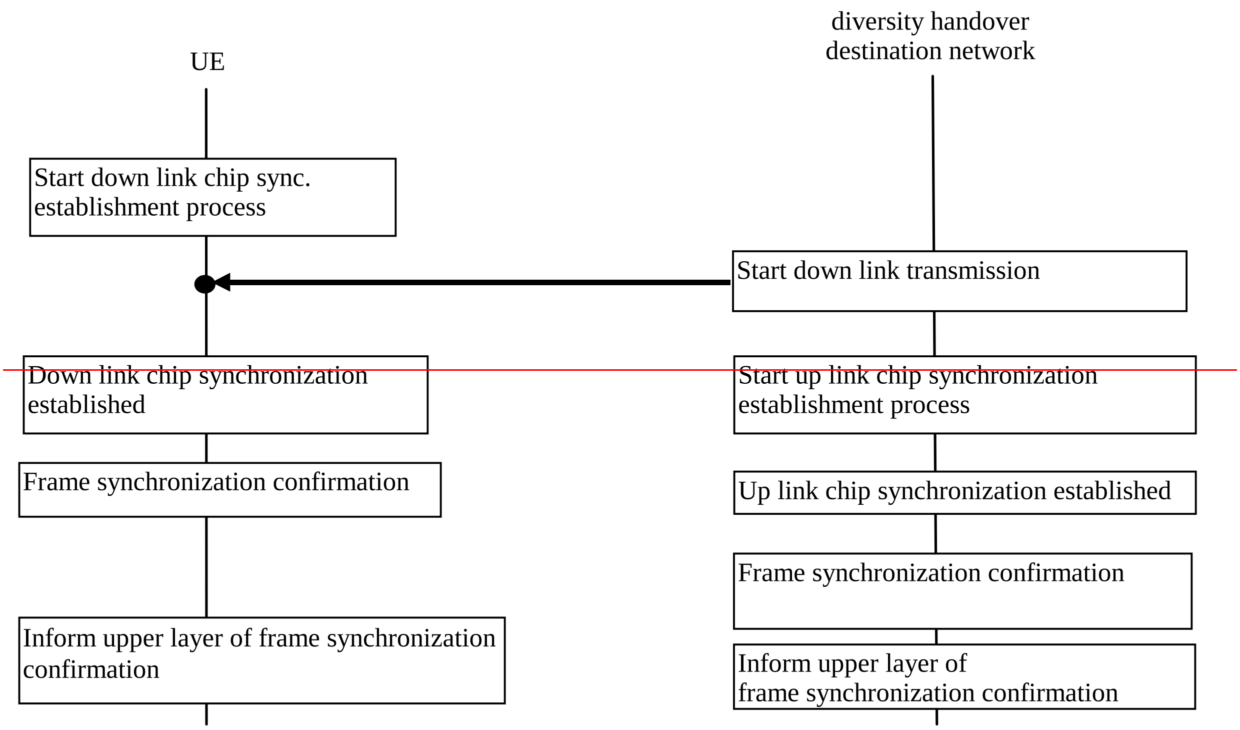
At the start of soft handover, the uplink dedicated physical channel transmitted by the UE, and the downlink dedicated physical channel transmitted by the soft handover source cell continues transmitting as usual.

The synchronisation establishment flow ~~upon intra/inter-cell soft handover~~ 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.



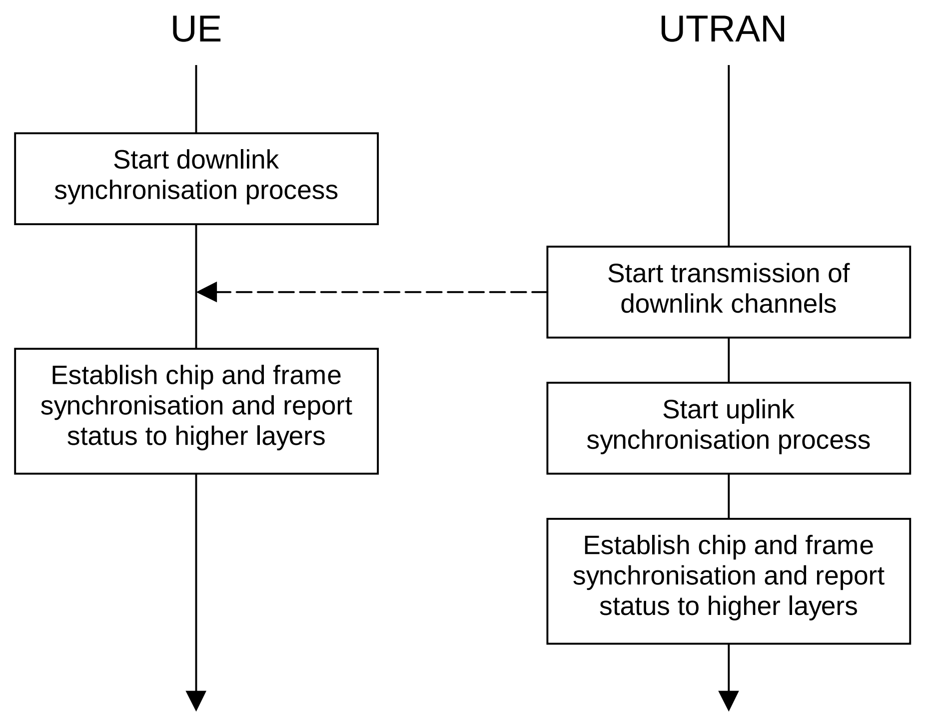


Figure 2: Synchronis~~z~~ation establishment flow for dedicated channels: ~~upon intra/inter-cell soft handover~~uplink dedicated channel already existing

During a connection, in some cases the UE is allowed to change its transmission timing. When the UE is not in soft handover or in soft handover with cells that all are known to have the same timing reference, the UE may adjust its DPDCH/DPCCH transmission time instant. <Note: maximum rate of the adjustment should be specified in R4> Otherwise, the UE may not adjust its DPDCH/DPCCH transmission time instant.

3GPP TSG RAN WG1#9 **Tdoc R1-(99)j59**
Dresden, Germany
November 30th - December 3rd, 1999 **Meeting No. 9**
Agenda Item: Ad Hoc 9

Source: Nokia

Out-of-synch handling in UTRA FDD

1. Introduction.

This contribution proposes to clarify the out-of-synch handling behaviour for the UE operation in TS 25.214.

2. UE operation

The UE operation is specified in connection with the power control section as the out of synch operation directly impacts the UE operation. The following approach is proposed:

- The UE shall monitor the active link(s) to determine if the link is out-of-synchronisation or not. Depending on the situation the UE may use for example CPICH or pilot symbol patterns or combination there off to determine the synchronisation status.

- If N_out_synch_frames_1 frames are passed that have been found to be out-of-synchronisation, the UE shall turn of uplink transmission, the value for N_out_synch_frames_1 given by the higher layers.

This is the basic functionality that is definitely needed. For the power control operation one could then ask whether it makes sense to follow the power control command decoding if the frame is detected to be out-of-synchronisation. Having there an additional parameter gives the option to "freeze" the UE power level. Setting the parameter N_out_synch_frames_2 equal to N_out_synch_frames1 disables the option.

- If N_out_synch_frames2 is detected to be out-of-synchronisation, the UE shall maintain the output power level, controlled by inner loop power control, constant while out-of-synchronisation state lasts or until N_out_synch_frames_1 reached when the transmission shall be turned off.

- During downlink out-of-synchronisation, the TPC command sent in the uplink shall be set as “1” during the period of out-of-synchronisation. (This should be the result of SIR estimation anyway in out-of-synch situation)

This is proposed to be covered together with inner loop uplink power control in 25.214.

3. Node B operation

For Node B the only thing that is recommended to be specified is that Node B gives synch indication to higher layers. The Node B behaviour with respect to the transmission power control behaviour is not proposed to be specified in out-of-synch state. For Node B the main thing is that out-of-synch indication is provided to RNC which can then decide on further actions. The CR attached will not provide text for Node B operation, but if desired such a text can be included based on the received comments to this CR as well.

4. Conclusions

The attached CR-029 is recommended to be to included in 25.214 for cover the UE behaviour in out of synchronisation situation. Further it is worth informing WG2 if the issue that they are aware of the parameters to be handled by higher layers. For the Node B synchronisation indication, WG3 is also involved, thus they should be informed of possible developments with respect to Node B side. Further it is noted that TDD sight needs some considerations as well.

3GPP TSG RAN WG1 Meeting #9 ***Document* *R1-99j58***

Dresden Germany, Nov. 30-Dec. 3 1999

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or for SMG, use the format P-99-xxx

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25.214	**CR**	**029**	Current Version:	3.0.0

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

For submission to:	TSG RAN#6	for approval	X	strategic		*(for SMG*
list expected approval meeting # here ↑		for information		non-strategic		*use only)*

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: (U)SIM [ ] ME [X] UTRAN / Radio [X] Core Network [ ]
(at least one should be marked with an X)

Source: Nokia **Date:** 29.11.1999

Subject: Out-of-synch handling

Work item:

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

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

Reason for change: For the out-of-synchronisation situation only empty header exists in 25.214.

Clauses affected:

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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5.1.2.2 Ordinary transmit power control

5.1.2.2.1 General

The initial uplink transmit power to use is decided using an open-loop power estimate, similar to the random access procedure.

< Editor's note: This needs to be elaborated, how is the estimate derived? >

The maximum transmission power at the maximum rate of DPDCH is designated for uplink and control must be performed within this range.

< *Editor's note: The necessity of this range needs to be confirmed.* > The maximum transmit power value of the inner-loop TPC is set by the network using higher layer signalling.

The uplink inner-loop power control adjusts the UE transmit power in order to keep the received uplink signal-to-interference ratio (SIR) at a given SIR target, SIR_{target}.

The serving cells (cells in the active set) should estimate signal-to-interference ratio SIR_{est} of the received uplink DPCH . The serving cells then generates TPC commands and transmits the commands once per slot according to the following rule: if $SIR_{est} > SIR_{target}$ then the TPC command to transmit is “0”, while if $SIR_{est} < SIR_{target}$ then the TPC command to transmit is “1”.

Upon reception of one or more TPC commands in a slot, the UE derives a single TPC command, TPC_cmd, for each slot, combining multiple TPC commands if more than one is received in a slot. Two algorithms shall be supported by the UE for deriving a TPC_cmd, as described in subclauses 5.1.2.2.2 and 5.1.2.2.3. Which of these two algorithms is used is an UE-specific parameter and is under the control of the UTRAN.

The step size Δ_{TPC} is a UE specific parameter, under the control of the UTRAN that can have the values 1 dB or 2 dB.

After deriving of the combined TPC command TPC_cmd using one of the two supported algorithms, the UE shall adjust the transmit power of the uplink dedicated physical channels with a step of Δ_{TPC} dB according to the TPC command. If TPC_cmd equals 1 then the transmit power of the uplink DPCCH and uplink DPDCHs shall be increased by Δ_{TPC} dB. If TPC_cmd equals -1 then the transmit power of the uplink DPCCH and uplink DPDCHs shall be decreased by Δ_{TPC} dB. If TPC_cmd equals 0 then the transmit power of the uplink DPCCH and uplink DPDCHs shall be unchanged.

Any power increase or decrease shall take place immediately before the start of the pilot field on the DPCCH.

5.1.2.2.1.1 Out of synchronisation handling

The UE shall monitor the active link, or links in case of soft handover, to determine if the link is out-of-synchronisation or not. Depending on the situation the UE may use for example CPICH or pilot symbol patterns or combination there off to determine the link synchronisation status.

If N_out_synch_frames_1 frames that have passed have been found to be out-of-synchronisation for all links, the UE shall turn off uplink transmission. The value for N_out_synch_frames_1 is given by the higher layers.

If N_out_synch_frames_2 is detected to be out-of-synchronisation, the UE shall maintain the output power level, controlled by inner loop power control, constant while out-of-synchronisation state lasts or until N_out_synch_frames_1 reached when the transmission shall be turned off. The TPC command sent in the uplink shall be set as “1” during the period of out-of-synchronisation.

5.1.2.2.2 Algorithm 1 for processing TPC commands

5.1.2.2.2.1 Derivation of TPC_cmd when only one TPC command is received in each slot

When a UE is not in soft handover, only one TPC command will be received in each slot. In this case, the value of TPC_cmd is derived as follows:

- If the received TPC command is equal to 0 then TPC_cmd for that slot is –1.
- If the received TPC command is equal to 1, then TPC_cmd for that slot is 1.

5.1.2.2.2.2 Combining of TPC commands known to be the same

When a UE is in soft handover, multiple TPC commands may be received in each slot from different cells in the active set. In some cases, the UE has the knowledge that some of the transmitted TPC commands in a slot are the same. This is the case e.g. with receiver diversity or so called softer handover when the UTRAN transmits the same command in all the serving cells the UE is in softer handover with. For these cases, the TPC commands known to be the same are combined into one TPC command, to be further combined with other TPC commands as described in subclause 5.1.2.2.2.3.

5.1.2.2.2.3 Combining of TPC commands not known to be the same

In general in case of soft handover, the TPC commands transmitted in the same slot in the different cells may be different.

This subclause describes the general scheme for combination of the TPC commands not known to be the same and then provides an example of such a scheme. It is to be further decided what should be subject to detailed standardisation, depending on final requirements. The example might be considered as the scheme from which minimum requirement will be derived or may become the mandatory algorithm.

5.1.2.2.2.3.1 General scheme

First, the UE shall estimate the signal-to-interference ratio PC_SIR_i on each of the power control commands TPC_i, where i = 1, 2, …, N and N is the number of TPC commands not known to be the same, that may be the result of a first phase of combination according to subclause 5.1.2.2.2.2.

Then the UE assigns to each of the TPC_i command a reliability figure W_i, where W_i is a function β of PC_SIR_i, $W_i = \beta(PC\_SIR_i)$. Finally, the UE derives a combined TPC command, TPC_cmd, as a function γ of all the N power control commands TPC_i and reliability estimates W_i:

$TPC\_cmd = \gamma (W_1, W_2, \ldots W_N, TPC_1, TPC_2, \ldots, TPC_N)$, where TPC_cmd can take the values 1 or -1.

5.1.2.2.2.3.2 Example of the scheme

A particular example of the scheme is obtained when using the following definition of the functions β and γ:

For β: the reliability figure W_i is set to 0 if $PC\_SIR_i < PC\_thr$, otherwise W_i is set to 1. This means that the power control command is assumed unreliable if the signal-to-interference ratio of the TPC commands is lower than a minimum value PC_thr.

For γ: if there is at least one TPC_i command, for which $W_i = 1$ and $TPC_i = 0$, or if $W_i = 0$ and $TPC_i = 0$ for all N TPC_i commands, then TPC_cmd is set to 1, otherwise TPC_cmd is set to 1. Such a function γ means that the power is decreased if at least one cell for which the reliability criterion is satisfied asks for a power decrease.

5.1.2.2.3 Algorithm 2 for processing TPC commands

NOTE: Algorithm 2 makes it possible to emulate smaller step sizes than the minimum power control step specified in section 5.1.2.2.1, or to turn off uplink power control by transmitting an alternating series of TPC commands.

5.1.2.2.3.1 Derivation of TPC_cmd when only one TPC command is received in each slot

When a UE is not in soft handover, only one TPC command will be received in each slot. In this case, the UE shall process received TPC commands on a 5-slot cycle, where the sets of 5 slots shall be aligned to the frame boundaries and there shall be no overlap between each set of 5 slots.

The value of TPC_cmd is derived as follows:

- For the first 4 slots of a set, TPC_cmd = 0.
- For the fifth slot of a set, the UE uses hard decisions on each of the 5 received TPC commands as follows:
- If all 5 hard decisions within a set are 1 then TPC_cmd = 1 in the 5^{th} slot.
  - If all 5 hard decisions within a set are 0 then TPC_cmd = -1 in the 5^{th} slot.
  - Otherwise, TPC_cmd = 0 in the 5^{th} slot.

5.1.2.2.3.2 Combining of TPC commands known to be the same

When a UE is in soft handover, multiple TPC commands may be received in each slot from different cells in the active set. In some cases, the UE has the knowledge that some of the transmitted TPC commands in a slot are the same. This is the case e.g. with receiver diversity or so called softer handover when the UTRAN transmits the same command in all the serving cells the UE is in softer handover with. For these cases, the TPC commands known to be the same are combined into one TPC command, to be processed and further combined with any other TPC commands as described in subclause 5.1.2.2.3.3.

5.1.2.2.3.3 Combining of TPC commands not known to be the same

In general in case of soft handover, the TPC commands transmitted in the same slot in the different cells may be different.

This subclause describes the general scheme for combination of the TPC commands not known to be the same and then provides an example of such scheme. It is to be further decided what should be subject to detailed standardisation, depending on final requirements. The example might be considered as the scheme from which minimum requirement will be derived or may become the mandatory algorithm.

5.1.2.2.3.3.1 General scheme

The UE shall make a hard decision on the value of each TPC_i, where i = 1, 2, …, N and N is the number of TPC commands not known to be the same, that may be the result of a first phase of combination according to subclause 5.1.2.2.3.2..

The UE shall follow this procedure for 3 consecutive slots, resulting in N hard decisions for each of the 3 slots.

The sets of 3 slots shall be aligned to the frame boundaries and there shall be no overlap between each set of 3 slots.

The value of TPC_cmd is zero for the first 2 slots. After 3 slots have elapsed, the UE shall determine the value of TPC_cmd for the third slot in the following way:

The UE first determines one temporary TPC command, TPC_temp_i, for each of the N sets of 3 TPC commands as follows:

- If all 3 hard decisions within a set are “1”, $TPC\_temp_i = 1$
- If all 3 hard decisions within a set are “0”, $TPC\_temp_i = -1$
- Otherwise, $TPC\_temp_i = 0$

Finally, the UE derives a combined TPC command for the third slot, TPC_cmd, as a function γ of all the N temporary power control commands TPC_temp_i:

$TPC\_cmd(3^{rd}\ slot) = \gamma\ (TPC\_temp_1, TPC\_temp_2, \ldots, TPC\_temp_N)$, where $TPC\_cmd(3^{rd}$ slot) can take the values 1, 0 or –1.

5.1.2.2.3.3.2 Example of the scheme

A particular example of the scheme is obtained when using the following definition of the function γ:

TPC_cmd is set to 1 if $\frac{1}{N}\sum_{i=1}^{N} TPC\_temp_i > 0.5$.

TPC_cmd is set to -1 if $\frac{1}{N}\sum_{i=1}^{N} TPC\_temp_i < -0.5$.

Otherwise, TPC_cmd is set to 0.

3GPP TSG RAN WG1 Meeting #9
Dresden, Germany, 30th Nov –3rd Dec 1999

***Document* R1(99)l70**
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25.214	**CR**	**030r2**	Current Version:	3.0.0

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

For submission to:	TSG-RAN #6	for approval	X	strategic		*(for SMG use only)*
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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		UTRAN / Radio	X	Core Network	

Source:	NEC and Telecom MODUS	**Date:**	1999-11-24
Subject:	State update rule addition to SSDT specification		
Work item:			

Category:				**Release:**		
	F	Correction			Phase 2	
	A	Corresponds to a correction in an earlier release			Release 96	
(only one category	B	Addition of feature	X		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: To handle compressed mode in SSDT operation.
To align primary state update timing among active cells.

Clauses affected: 5.2.1.4.2, 5.2.1.4.4 and 5.2.1.4.5

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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ID must be terminated within a frame. If FBI space for sending a given ID cannot be obtained within a frame, hence if the entire ID is not transmitted within a frame but must be split over two frames, the last bit(s) of the ID is(are) punctured. The relating bit(s) to be punctured are shown with brackets in table 3 and table 4.

5.2.1.4.2 TPC procedure in UE

The TPC procedure of the UE in SSDT is identical to that described in subclause 5.2.3.25.2.1.2 or 5.2.1.3 in compressed mode.

5.2.1.4.3 Selection of primary cell

The UE selects a primary cell periodically by measuring the RSCP of CPICHs transmitted by the active cells. The cell with the highest CPICH RSCP is detected as a primary cell.

5.2.1.4.4 Delivery of primary cell ID

The UE periodically sends the ID code of the primary cell via portion of the uplink FBI field assigned for SSDT use (FBI S field). A cell recognises its state as non-primary if the following two conditions are fulfilled simultaneously:

- the received primary ID code does not match with the own ID code,
- - and the received uplink signal quality satisfies a quality threshold, Qth, a parameter defined by the network.
- and, when the uplink link compressed mode, does not results in excessive levels of puncturing on the coded ID. The acceptable level of puncturing on the coded ID is less than (int)N_{ID}/3 symbols in the coded ID (where N_{ID} is the length of the coded ID).

Otherwise the cell recognises its state as primary.

The state of the cells (primary or non-primary) in the active set with update synchronous. If a cell receives the last portion of the coded ID in uplink slot #j, the state of cell is updated in downlink slot#{(j+1+T_{os}) mod 15}. Where T_{os} is defined as a constant of 2 time slots. The updating of cell state is unchanged by the operation of downlink compressed mode.

At the UE, the primary ID code to be sent to the cells is segmented into a number of portions. These portions are distributed in the uplink FBI S-field. The cell in SSDT collects the distributed portions of the primary ID code and then detects the transmitted ID. Period of primary cell update depends on the settings of code length and the number of FBI bits assigned for SSDT use as shown in table 5

Table 5: Period of primary cell update

code length	The number of FBI bits per slot assigned for SSDT	
	1	2
"long"	1 update per frame	2 updates per frame
"medium"	2 updates per frame	4 updates per frame
"short"	3 updates per frame	5 updates per frame

5.2.1.4.5 TPC procedure in the network

In SSDT, a non-primary cell can switch off its DPDCH output (i.e. no transmissions).
The cell manages two downlink transmission power levels, P1, and P2. Power level P1 is used for downlink DPCCH transmission power level and this level is updated as the same way specified in 5.2.3.25.2.1.2 or 5.2.1.3 in compressed mode regardless of the selected state (primary or non-primary). The actual transmission power of TFCI, TPC and pilot fields of DPCCH is set by adding P1 and the offsets PO1, PO2 and PO3, respectively, as specified in 5.2.3.15.2.1.1. P2 is used for downlink DPDCH transmission power level and this level is set to P1 if the cell is selected as primary, otherwise P2 is switched off. The cell updates P1 first and P2 next, and then the two power settings P1 and P2 are maintained within the power control dynamic range. Table 6 summarizes the updating method of P1 and P2.

Table 6: Updating of P1 and P2

<table>
<tr><th>State of cell</th><th>P1 (DPCCH)</th><th>P2 (DPDCH)</th></tr>
<tr><td>non primary</td><td rowspan="2">Updated by the same way as specified in ~~5.2.3.2~~5.2.1.2 or 5.2.1.3 in compressed mode</td><td>Switched off</td></tr>
<tr><td>Primary</td><td>= P1</td></tr>
</table>

TSG-RAN Working Group 1 meeting #9 **TSGR1#9(99)j76**
Dresden, Germany
November 30 – December 3, 1999

Agenda item:

Source: Ericsson

Title: CR 25.214-033: Uplink TX timing adjustment

Document for: Decision

---

1 Introduction

It was concluded at WG1#7, that there should be two methods to cope with timing adjustments due to UE movement, clock drift, etc:

1. Adjusting the TX timing in the UE. This has so far only been accepted for the case when the UE is not in soft handover or in soft handover with cells that all are known to have the same timing reference.

2. Adjustment of TX timing in the Node B. This should be based on feedback from the UE when such adjustment is needed.

However, the two methods are still not fully specified as will be shown in the following sections.

2 Adjusting the TX timing in the UE

We believe that the UE shall always be allowed to change its TX timing, i.e. also in the normal soft handover case, where no common timing reference is used for the cells.

The reason is that if the UE gets problems with its TPC loop because the links' timing is drifting, then it has to drop the link that gives the UE the problem. That link may very well be the best (strongest) link. If the UE instead was allowed to shift its TX timing so that the best link was kept at all times, then the quality the UE sees will be better. Of course, the shifting of timing might force another link out of the receiving window, but that link should then be the weakest one.

Also, to our understanding, the WG4 discussions have not been limited to the non-soft handover case.

Finally, the UE clock has much worse stability than the network's clock. In general, one should avoid using the system's worst clock to control the data transport in the network, since this will lead to increased number of frame slips. The UE shall, in all cases, adjust its timing to that of the network. In effect, this means that the UE shall try to cope with the receive timing to as large extent as possible (by shifting its uplink TX timing), and to only order adjustments of downlink timing when really needed. If the UE in soft handover is not allowed to shift its TX timing, this will lead to increased need of shifting the downlink timing instead. This is a much more complicated procedure, and costs signalling capacity.

3 Adjustment of TX timing in the Node B

Adjustment of TX timing in Node B of the downlink shall be triggered by a UE report that it has problems with the received timing. While WG1 agreed to use this technique at WG1#7, up to now there has been no text proposed for the specifications that indicate that this signalling from the UE to network exist.

Although the signalling message itself of course is outside the scope of WG1, it would be good to have some mentioning in the WG1 specifications that L1 shall detect when radio links are drifting too far away from the optimum reception time. It is up to WG4 to define exactly the criteria when such a message shall be sent to the network.

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Dresden, Germany, Nov 30 – Dec 3, 1999

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25.214	**CR**	**033**	Current Version:	3.0.0

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

For submission to: TSG-RAN #6	for approval	X	strategic		(for SMG use only)
list expected approval meeting # here ↑	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: (U)SIM [ ] ME [X] UTRAN / Radio [X] Core Network [ ]
(at least one should be marked with an X)

Source: Ericsson **Date:** 1999-11-23

Subject: Uplink TX timing adjustment

Work item:

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

F	Correction		
A	Corresponds to a correction in an earlier release		
B	Addition of feature	X	
C	Functional modification of feature		
D	Editorial modification		

Release:

Phase 2	
Release 96	
Release 97	
Release 98	
Release 99	X
Release 00	

Reason for change:
- Allowing UE TX timing adjustment also in soft handover gives better performance and less signalling.
- To be able to support signalling to network to adjust DL TX timing, mentioning of L1 supervision is needed. WG2 will define the signalling message.

Clauses affected: 4.3.3

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:

4.3.3 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 upon intra/inter-cell soft handover 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.

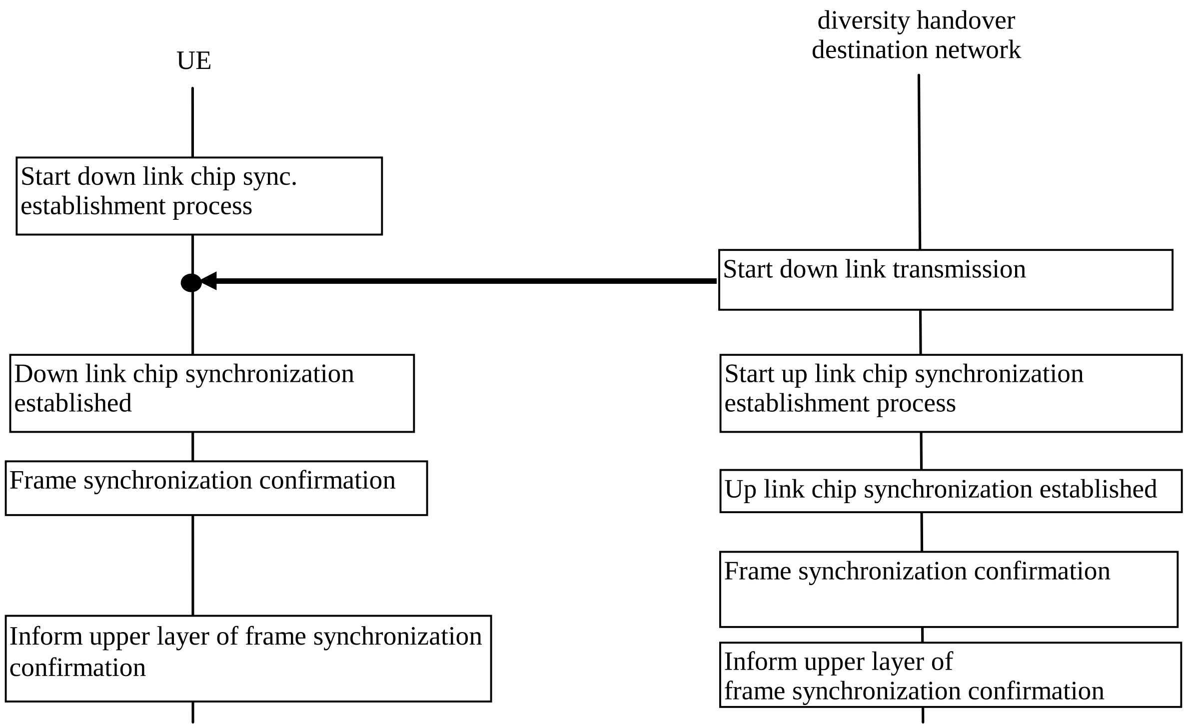

Figure 2: Synchronization establishment flow upon intra/inter-cell soft handover

4.3.4 Transmission timing adjustments

During a connection , in some cases the UE is allowed to change its transmission timing. When the UE is not in soft handover or in soft handover with cells that all are known to have the same timing reference, the UE may adjust its DPDCH/DPCCH transmission time instant. <Note: maximum rate of the adjustment should be specified in R4> Otherwise, the UE may not 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.

TSG-RAN Working Group 1 meeting #9 **_TSGR1#9(99)k16_**
Dresden, Germany
November 30 – December 3, 1999

Agenda item: Location Services

Title: CR 25.214-036: Inclusion of idle periods for the IPDL LCS method

Source: Nokia,Ericsson

Document for: Decision

Background

The following CR includes a physical procedure to implement the idle periods in the case of IPDL in support of location services. A text proposal (R1-99k71) was presented in AH17 2/12/99 which was approved with some minor changes. This change request is based on that text proposal with the required changes made.

***Document* R1#9(99)k16**
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25.214 CR 036 Current Version: 3.0.0

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] for information [ ] — strategic [ ] non-strategic [ ] *(for SMG use only)*
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Proposed change affects: (U)SIM [ ] ME [X] UTRAN / Radio [X] Core Network [ ]
(at least one should be marked with an X)

Source: Nokia,Ericsson **Date:** 1999-11-30

Subject: Inclusion of idle periods for the IPDL LCS

Work item: 25.214

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

F	Correction		
A	Corresponds to a correction in an earlier release		
B	Addition of feature	X	
C	Functional modification of feature		
D	Editorial modification		

Release:

Phase 2	
Release 96	
Release 97	
Release 98	
Release 99	X
Release 00	

Reason for change: Needed to support the IPDL LCS method, which has been decided to be included in R99.

Clauses affected: New Section 10

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:

10 Idle Periods for IPDL Location method.

To support time difference measurements that need to be made for location services there needs to be Idle Periods created in the DownLink (IPDL) during which time all channels from a node B are temporally seized. During these Idle Periods the visibility of neighbour basestations from the UE is improved thus allowing the measurements to be performed.

The Idle Periods are arranged in a predetermined pseudo random fashion according to higher layer parameters, these parameters are used by layer 1 to arrange and use these Idle Periods. Idle Periods differ from compressed mode in that they are shorter in duration, all channels are silent simultaneously, and no attempt is made to prevent data loss.

In general there are two modes for these Idle Periods:

- Continuous mode, and
- Burst mode

In continuous mode the Idle Periods are active all the time. In burst mode the Idle Periods are arranged in bursts where each burst contains enough Idle Periods to allow a UE to make sufficient measurements for its location to be calculated. The bursts are separated by a period where no Idle Periods occur.

10.1 Parameters of IPDL

The follow parameters are signalled to the UE via higher layers:

IP_Status: This is a logic value that indicates if the Idle Periods are arranged in continuous or burst mode.

IP_Spacing: The number of 10ms frames between the start of a frame that contains an Idle Period and the next frame that contains an Idle Period. (Note that there is at most one Idle Period in a frame)

IP_Length: The length of the Idle Periods, expressed in symbols of the CPICH.

IP_offset: A cell specific offset (can be used to synchronise Idle Periods from different sectors within a node B).

Seed: A seed for a pseudo random number generator.

Additionally in the case of burst mode operation the following parameters are also communicated to the UE.

Burst_Start: The SFN where the first burst of Idle Periods starts.

Burst_Length: The number of Idle Periods in a burst of Idle Periods.

Burst_Freq: The number of frames of the primary CPICH between the start of a burst and the start of the next burst.

10.2 Calculation of Idle Period Position

The position of the x^{th} Idle Period relative to the start of a burst, expressed in symbols of the CPICH, is given by the formula (assuming the Idle Periods are indexed from 1, i.e. the first Idle Period is x=1 etc):

$$x * IP\_Spacing * 150 + rand(x \bmod 64) \bmod Max\_dev + IP\_offset$$

$$\begin{aligned} where: \quad & Max\_dev = 150 - IP\_Length, \\ & rand(n) = (106 * rand(n-1) + 1283) \bmod 6075, \quad and \\ & rand(0) = Seed \end{aligned}$$

Continuous mode can be considered as a specific case of the burst mode with just one burst spanning the whole SFN cycle. Note also that x will be reset to x=1 for the first idle period in a SFN cycle for both continuous and burst modes and will also, in the case of burst mode, be reset for the first Idle Period in every burst.

Figure 10.1 below illustrates the Idle Periods for the Burst Mode case.

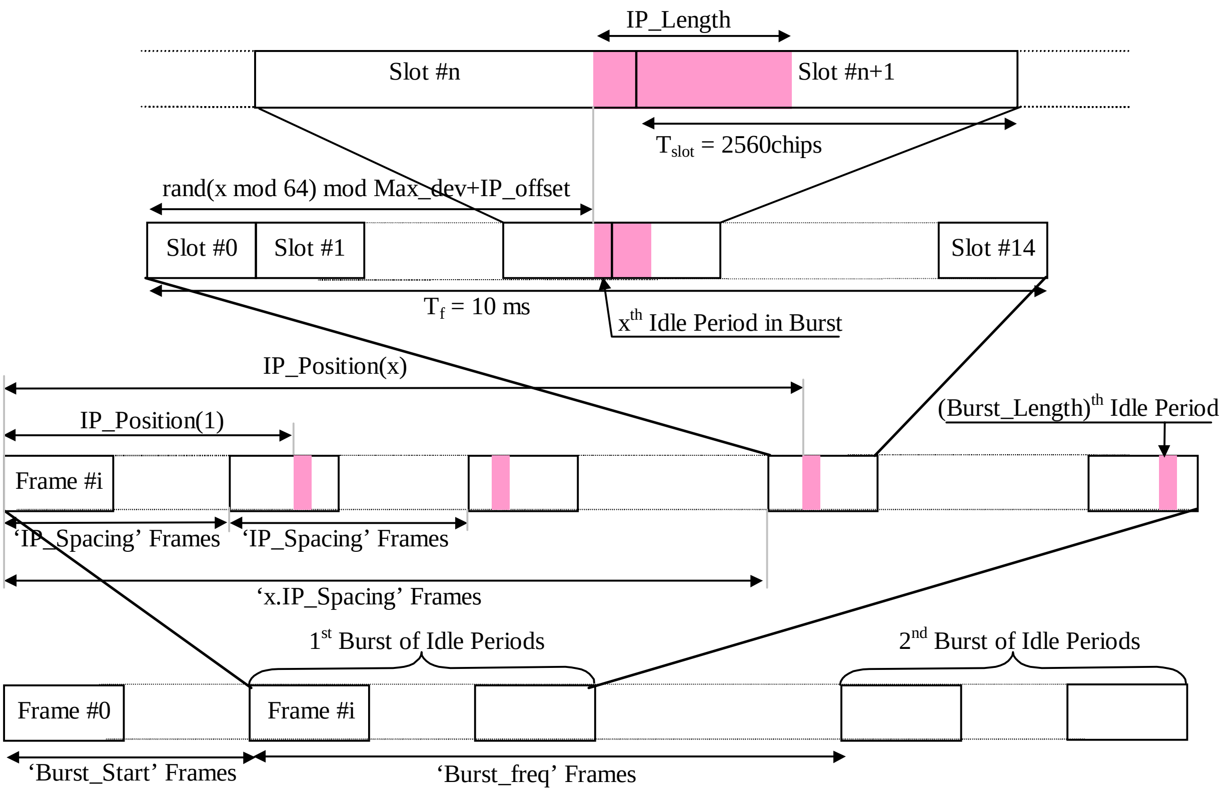

Figure 10.1: Idle Period placement in the case of burst mode operation.

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Dresden, Germany, Nov 30 – Dec 3, 1999

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25.214 CR 042r1 Current Version: 3.0.0

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

For submission to:	TSG RAN #6	For approval	X	Strategic	(for SMG use only)
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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: (U)SIM [ ] ME [ ] UTRAN / Radio [X] Core Network [ ]
(at least one should be marked with an X)

Source: NEC **Date:** 1999-12-3

Subject: Inclusion of adjustment loop in downlink power control

Work item:

Category:				**Release:**		
	F	Correction			Phase 2	
	A	Corresponds to a correction in an earlier release			Release 96	
(only one category	B	Addition of feature	X		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: To align with Layer 2/3 specifications, regarding adjustment loop control.

Clauses affected: 5.2.1.2

Other specs affected:			
	Other 3G core specifications	X	→ 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:

5.2.1.2 Ordinary transmit power control

5.2.1.2.1 General

The downlink inner-loop power control adjusts the network transmit power in order to keep the received downlink SIR at a given SIR target, SIR_{target}. A higher layer outer loop adjusts SIR_{target} independently for each connection.

The UE should estimate the received downlink DPCCH/DPDCH power of the connection to be power controlled. Simultaneously, the UE should estimate the received interference. The obtained SIR estimate SIR_{est} is then used by the UE to generate TPC commands according to the following rule: if $SIR_{est} > SIR_{target}$ then the TPC command to transmit is "0", requesting a transmit power decrease, while if $SIR_{est} < SIR_{target}$ then the TPC command to transmit is "1", requesting a transmit power increase.

When the UE is not in soft handover the TPC command generated is transmitted in the first available TPC field in the uplink DPCCH.

When the UE is in soft handover it should check the downlink power control mode (DPC_MODE) before generating the TPC command

- if DPC_MODE = 0 : the UE sends a unique TPC command in each slot and the TPC command generated is transmitted in the first available TPC field in the uplink DPCCH
- if DPC_MODE = 1 : the UE repeats the same TPC command over 3 slots and the new TPC command is transmitted such that there is a new command at the beginning of the frame.

The DPC_MODE parameter is a UE specific parameter controlled by the UTRAN.

As a response to the received TPC commands, UTRAN may adjust the downlink DPCCH/DPDCH power. The transmitted DPCCH/DPDCH power may not exceed Maximum_DL_Power, nor may it be below Minimum_DL_Power.

< Note: It should be clarified with WG3 if Maximum_DL_Power and Minimum_DL_Power are given as absolute values or relative. >

< Note: It is not clear to what extent the UTRAN response to the received TPC commands should be specified. Until this has been clarified, the text in the paragraph below should be seen as an example of UTRAN behaviour. >

Changes of power shall be a multiple of the minimum step size $\Delta_{TPC,min}$ dB. It is mandatory for UTRAN to support $\Delta_{TPC,min}$ of 1 dB, while support of 0.5 dB is optional.

< Note: It needs to be clarified if an upper limit on the downlink power step should be specified. >

When SIR measurements cannot be performed due to downlink out-of-synchronisation, the TPC command transmitted shall be set as "1" during the period of out-of-synchronisation.

5.2.1.2.2 Adjustment loop

UTRAN may further employ adjustment loop, in which they change their calculated transmission powers *P(i)* in every slot according to the following equation:

$$P(i+1) = P(i) + S_{INNER}(i) + S_{ADJ}(i)$$

$$S_{ADJ}(i) = sign\{(1 - r)(P_{REF} - P(i))\}\ min\{|(1 - r)(P_{REF} - P(i))|, S_{ADJ\_MAX}\}$$

where

$P(i)$: calculated transmission power of UTRAN access point in dBm,

$S_{INNER}(i)$: inner loop control in dB,

$S_{ADJ}(i)$: adjustment loop control in dB,

$sign\{x\}$: sign function of the value x, i.e. +1 when x>0, 0 when x=0, and –1 when x<0,

r: convergence coefficient ($0 \le r \le 1$),

P_{REF}: reference transmission power in dBm,

S_{ADJ_MAX}: maximum power change limit by adjustment loop in dB.

The actual change in the transmitted power level due to the adjustment loop is a value which is the nearest allowed TPC step to $S_{ADJ}(i)$. The parameters, r, P_{REF}, and S_{ADJ_MAX} shall be signalled by higher layers. S_{ADJ_MAX} shall be a multiple of the minimum step size $\bullet_{TPC,min}$ dB.