TSG-RAN Working Group 1 meeting #11
San Diego, CA, USA
February 29 – March 3, 2000

TSGR1#11(00)0388

To: TSG RAN WG3

Cc: TSG RAN WG2

Source: TSG RAN WG1

Title: Liaison on radio link synchronisation

RAN WG1 would like to inform RAN WG2 and WG3 that a concept for radio link synchronisation has been agreed in RAN WG1. Hence, CRs have been agreed for both FDD and TDD (R1-00-0372 and R1-00-0365 respectively, both attached to this liaison) that describes the in-sync/out-of-sync concept along the lines decided by the RRM ad hoc.

In general RAN WG1 would like to know if the agreed concept is in line with the assumptions in RAN WG2 and WG3.

In particular, RAN WG1 would like to know if the use of the RL Restored procedure, moving from an initial state to the in-sync state to indicate when a radio link set first obtains synchronisation (cf. figure 1 in R1-00-0372), is in line with RAN WG3's assumed use of this procedure. Is the proposed use acceptable, or would it be better to specify a new procedure for this particular case?

Further, RAN WG1 also would like to point out that the parameter values of T_RLFAILURE, N_OUTSYNC_IND, and N_INSYNC_IND are assumed to be configurable using NBAP signalling. Is this in line with the RAN WG3 assumptions?

Finally, RAN WG1 would like to thank RAN WG3 for their liaison R3-00-0839, "LS to WG1 on the definition of a RL Set". RAN WG1 will update the specifications to use the proposed terminology of radio link sets. The term has already been introduced in the text on radio link synchronisation for UTRA/FDD.

TSG-RAN Working Group 1 meeting #11
San Diego, CA, USA
February 29 – March 3, 2000

TSGR1#11(00)0372

Agenda item:

Source: Ericsson, Nokia

Title: CR 25.214-066r1: Radio link synchronisation in UTRA/FDD

Document for: Decision

This contribution introduces the radio link synchronisation concept in TS 25.214 V3.1.0, according to the guidelines agreed by the RRM ad hoc (excerpt from approved RRM ad hoc report):

- NBAP will be used both for reporting out-of-synch and in-synch detection.
- Action: RAN WG1 is to determine the criteria for the downlink case.
- Action: RAN WG1 is to determine the reference algorithm for out-of-synch and in-synch detection in the Node B (uplink). For TDD it was accepted that a use of periodic in-sync reporting is FFS.
- Action: RAN WG3 is to add the parameters in support of this reference algorithm in NBAP (uplink).
- Action: RAN WG4 is to define tests (detection point is when UE switches off uplink transmission).

The changes proposed are the following:

- Use of the synchronisation status primitives is defined.
- The detailed downlink criteria for synchronisation status is defined. It has been noted that it may be difficult to put a direct requirement on the TPC error rate. What is really needed is that the case with "bad DPCCH", which leads to bad TPC command detection and increased uplink interference due to the TPC errors, should be testable and tests should be defined in WG4 to ensure that triggering is working well. However, some text is still needed in the WG1 specification. Hence, the very loose terminology "DPCCH" quality is used. If this can be translated into pilot bits SIR, TPC bits SIR, TPC command error rate etc, will be determined by WG4's definition of the test.
- Three uplink radio link states are introduced to explain how Node B shall behave and what messages to generate in the different situations that can arise.
- The network functions that take the inputs from the primitives and trigger the RL Failure and RL Restored procedures are defined.
- The parameter S_R is not needed. Radio link establishment failure is specified in TS 25.331, and there also all the involved counters are described. Excerpt from TS 25.331, section 8.5.4:

  "When a physical dedicated channel establishment is initiated by the UE, the UE shall start a timer T312 and wait for layer 1 to indicate N312 successive 'in sync' indications. At this occasion, the physical channel is considered established and the timer T312 is stopped and reset. If the timer T312 expires before the physical channel is established, the UE shall consider this as a 'physical channel establishment failure'."
- When a new radio link is added, the UE may not be in a position to start the chip and frame synchronisation *before* transmission of the new radio link is started. This is because non-synchronised activation can be used in the network, and then Node B may start transmission before the UE has received the active set update message via RRC. This has been reflected in deleting the current text in bullet a) in the new section 4.3.2.3.

- Since the order of activation of different steps of the synchronisation process is unknown, figures 1 and 2 are incorrect. Instead of correcting the figures they have been deleted, since the process is more clearly described in the text.
- The radio link establishment procedures have been updated to reflect the fact that more then one radio link can be added at the same time. The current description talks about adding one radio link at the time.

In revision 1 of the CR the following changes have been made:

- The concept of radio link sets, defined by WG3, has been included in the text.
- The uplink description has been modified to not talk of reporting of the primitives from Layer 1. It is now stated that the primitives are reported to the RL Failure/Restored triggering, which is clearly within Node B.
- It has been clarified that not necessarily one of the two primitives is reported in every radio frame. There are radio frames when neither primitive will be reported. However, the synchronisation status shall be checked every radio frame.
- Further, it has been clarified that when no CRC is available on any TrCH, then the CRC criterion for in-sync is always fulfilled.

This CR supersedes CR 25.214-051 (R1-00-0054) already approved by RAN WG1.

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**	**066r1**	Current Version:	3.1.0

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

For submission to:	TSG-RAN #7	for approval	X	strategic	
list expected approval meeting # here ↑		for information		non-strategic	

(for SMG 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: Ericsson, Nokia **Date:** 2000-03-01

Subject: Radio link synchronisation in UTRA/FDD

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	
C	Functional modification of feature	X
D	Editorial modification	

Release:

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

Reason for change:

- Detailed criteria for downlink use of synchronisation status primitives is missing.
- Detailed criteria for uplink use of synchronisation status primitives is missing.
- Reference algorithm for use of uplink synchronisation status primitives for triggering RL Failure and RL Restored is missing.
- Exact criteria to determine when the UE shall switch off its transmitter to avoid generating uplink excessive interference is elaborated.
- Criteria to determine when the UE may switch on its transmitter again is missing.
- Current text concerning radio link establishment needs correction to be in line with assumptions in other groups.

Clauses affected: 4, 5.1.2.2.1.1

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:

Other comments:

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 Synchronisation primitives

4.3.1.1 General

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

4.3.1.2 Downlink synchronisation primitives

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

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

- The UE estimates the DPCCH quality over the last 200 ms period to be worse than a threshold Q_{out}. This criterion shall never be fulfilled during the first 200 ms of the dedicated channel's existence. Q_{out} is defined implicitly by the relevant tests in TS 25.101.

- The last 20 transport blocks, as observed on all TrCHs using CRC, are received with incorrect CRC. In addition, over the last 200 ms, no transport block has been received with correct CRC.

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

- The UE estimates the DPCCH quality over the last 200 ms period to be better than a threshold Q_{in}. This criterion shall always be fulfilled during the first 200 ms of the dedicated channel's existence. Q_{in} is defined implicitly by the relevant tests in TS 25.101.

- At least one transport block, as observed on all TrCHs using CRC, is received with correct CRC. If there is no TrCH using CRC, this criterion is always fulfilled.

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

4.3.1.3 Uplink synchronisation primitives

Layer 1 in the Node B shall every radio frame check synchronisation status of all radio link sets. Synchronisation status is indicated to the RL Failure/Restored triggering function using either the CPHY-Sync-IND or CPHY-Out-of-Sync-IND primitive. Hence, only one synchronisation status indication shall be given per radio link set.

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

4.3.2 Radio link establishment

4.3.2.1~~1~~ General

The ~~synchronisation of the dedicated physical channels~~establishment of a radio link can be divided into two cases:

- when there is no existing radio link, i.e. when at least ~~a~~one downlink dedicated physical channel and one uplink dedicated physical channel are to~~shall~~ be set up~~ at the same time~~;
- or when one or several radio links already exist, i.e. when at least one~~a~~ downlink dedicated physical channel is to~~shall~~ be set up and there~~ already exist~~ an uplink dedicated physical channel already exists.

The two cases are described in sub-clauses 4.3.2.2 and 4.3.2.3 respectively.

In Node B, each radio link set can be in three different states: initial state, out-of-sync state and in-sync state. Transitions between the different states is shown in figure 1 below. The state of the Node B at the start of radio link establishment is described in the following sub-clauses. Transitions between initial state and in-sync state are described in sub-clauses 4.3.2.2 and 4.3.2.3 and transitions between the in-sync and out-of-sync states are described in sub-clause 4.3.3.2.

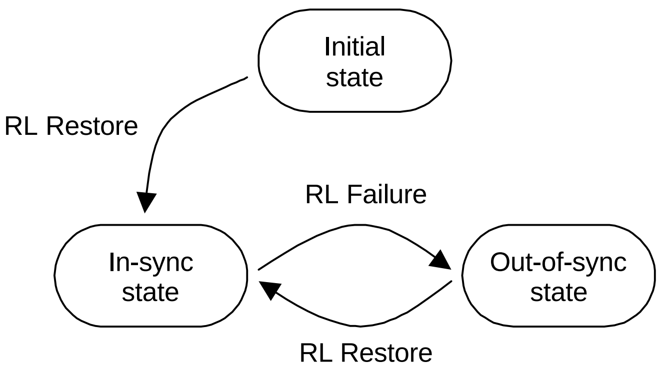


Figure 1: Node B radio link set states and transitions.

4.3.2.2 No existing ~~uplink dedicated channel~~radio link

~~The assumption for this case is that~~When one or several radio links are to be established and there is no existing radio link for the UE already, a dedicated physical channel~~DPCCH/DPDCH~~ is to be set up in uplink and at least one dedicated physical channel is to be ~~pair shall be ~~set up ~~in both uplink and ~~in 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.

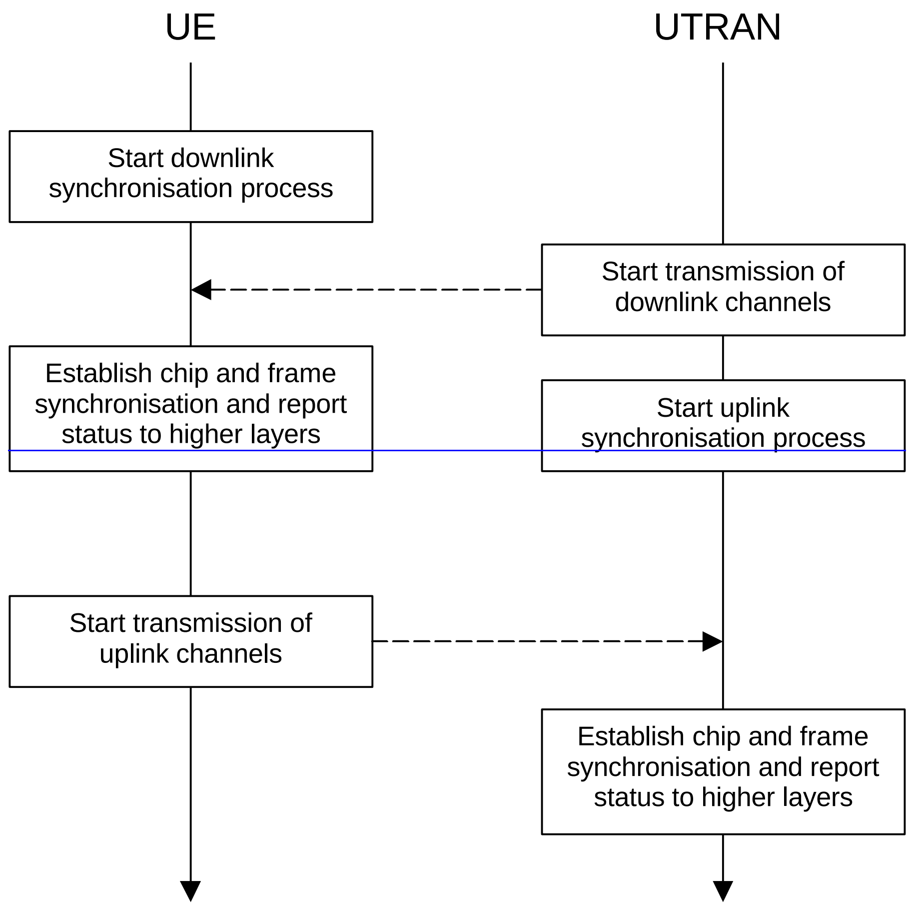
~~The synchronization establishment procedures of the dedicated physical channel are described below. ~~The radio link~~synchronization~~ establishment~~ flow~~ is ~~shown in figure 1.~~as follows:

a) Node B considers the radio link sets which are to be set up to be in the initial state. 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 synchronis~~z~~ation based on the P-CCPCH~~CPICH~~ timing and timing offset information notified from UTRAN. Frame synchronis~~z~~ation can be confirmed using the f~~F~~rame s~~S~~ynchronis~~z~~ation w~~W~~ord. Downlink synchronisation status is reported to higher layers every radio frame according to sub-clause 4.3.1.2.~~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.~~ When higher layers consider the downlink physical channel established, uplink DPCCH/DPDCH transmission is started. The timing of the start of the uplink channels is as defined in sub-clause 7.7 in [1].

d) UTRAN establishes uplink ~~channel~~ chip ~~synchronization~~ and frame synchronis~~z~~ation. Frame synchronis~~z~~ation can be confirmed using the f~~F~~rame s~~S~~ynchronis~~z~~ation w~~W~~ord. ~~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.~~ Radio link sets remain in the initial state until N_INSYNC_IND successive in-sync indications are received from layer 1, when Node B shall trigger the RL Restore procedure indicating which radio link set has obtained synchronisation. When RL Restore has been triggered the radio link set shall be considered to be in the in-sync state. The parameter value of N_INSYNC_IND is configurable, see TS 25.433. The RL Restore procedure may be triggered several times, indicating when synchronisation is obtained for different radio link sets.



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

4.3.2.3 ~~With existing uplink dedicated channel~~One or several existing radio links

When one or several radio links are to be established and one or several radio links already exist, ~~The assumption for this case is that there already exist~~ there is an existing DPCCH/DPDCH ~~s~~ in the uplink, and at least one corresponding dedicated physical channel shall be set up in the downlink. This corresponds to the case when ~~a~~ new radio links ~~cell has been~~are added to the active set ~~in soft handover~~ and ~~shall begin its~~ downlink transmission starts for those radio links.

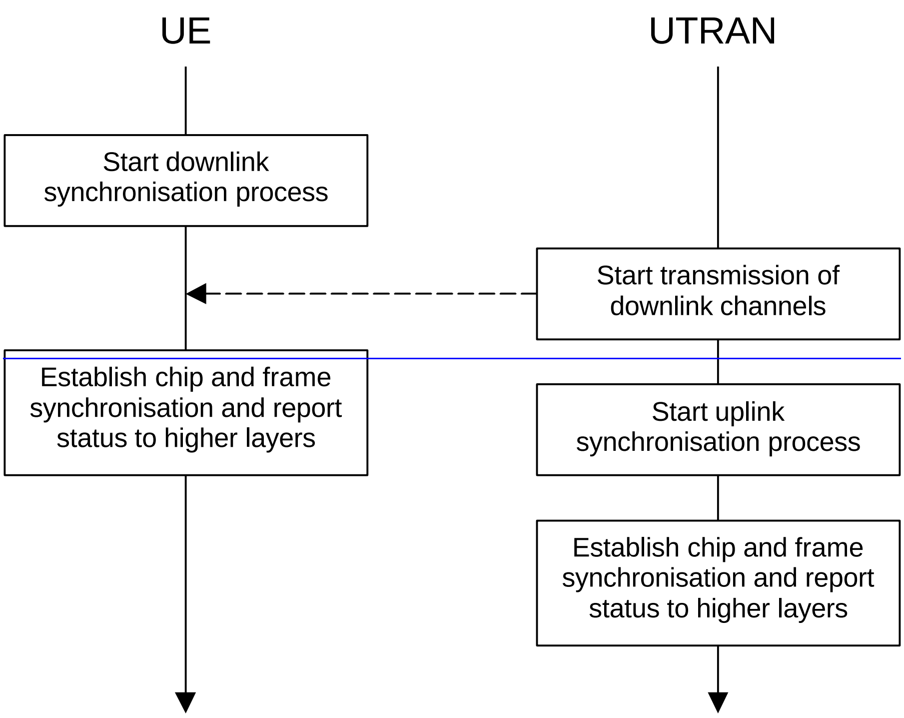
~~At the start of soft handover, the uplink dedicated physical channel transmitted by the UE, and the downlink dedicated physical channel transmitted by the soft handover source cell continues transmitting as usual.~~

The radio link~~synchronisation~~ establishment~~ flow~~ is ~~described in figure 2~~as follows~~.~~:

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.~~Node B considers new radio link sets to be set up to be in initial state.

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. Simultaneously, UTRAN ~~then starts the synchronization establishment process of the~~ establishes uplink chip and frame synchronisation of the new radio link~~DPCCH/DPDCH transmitted by the UE~~. Frame synchronis~~z~~ation can be confirmed using the f~~F~~rame s~~S~~ynchronization w~~W~~ord. ~~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.~~ Radio link sets considered to be in the initial state shall remain in the initial state until N_INSYNC_IND successive in-sync indications are received from layer 1, when Node B shall trigger the RL Restore procedure indicating which radio link set has obtained synchronisation. When RL Restore is triggered the radio link set shall be considered to be in the in-sync state. The parameter value of N_INSYNC_IND is configurable, see TS 25.433. The RL Restore procedure may be triggered several times, indicating when synchronisation is obtained for different radio link sets.

c) ~~Based on the handover destination CPICH reception timing, t~~The UE establishes chip and frame synchronisation of the new radio link~~downlink channels from handover destination cell~~. -Frame synchronis~~z~~ation can be confirmed using the f~~F~~rame s~~S~~ynchronization w~~W~~ord. ~~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.~~Downlink synchronisation status shall be reported to higher layers every radio frame according to sub-clause 4.3.1.2.



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

4.3.3 Radio link monitoring

4.3.3.1 Downlink radio link failure

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

4.3.3.2 Uplink radio link failure/restore

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

The uplink radio link failure/restore criteria is based on the synchronisation status primitives CPHY-Sync-IND and CPHY-Out-of-Sync-IND, indicating in-sync and out-of-sync respectively. Note that only one synchronisation status indication shall be given per radio link set.

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

When the radio link set is in the out-of-sync state, after receiving N_INSYNC_IND successive in-sync indications Node B shall trigger the RL Restore procedure and indicate which radio link set has re-established synchronisation. When the RL Restore procedure is triggered, the state of the radio link set change to the in-sync state.

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

4.3.4 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:

- b_c is the gain factor for the control part (similar to DPCCH),
- b_d is the gain factor for the data part (similar to DPDCH),
- no inner loop power control is performed.

5.1.2 DPCCH/DPDCH

5.1.2.1 General

The uplink 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. The relative transmit power offset between DPCCH and DPDCHs is determined by the network and signalled to the UE using higher layer signalling.

5.1.2.2 Ordinary transmit power control

5.1.2.2.1 General

The initial uplink transmit power is set by higher layers.

By means of higher layer signalling, a maximum transmission power for uplink inner-loop power control may be set to a lower value than what the terminal power class is capable of. Power control shallbe performed within the allowed range.

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.~~

The UE shall shut its transmitter off when the UE estimates the DPCCH quality over the last 200 ms period to be worse than a threshold Q_{out}. This criterion is never fulfilled during the first 200 ms of the dedicated channel's existence. Q_{out} is defined implicitly by the relevant tests in TS 25.101.

The UE can turn its transmitter on when the UE estimates the DPCCH quality over the last 200 ms period to be better than a threshold Q_{in}. This criterion is always fulfilled during the first 200 ms of the dedicated channel's existence. Q_{in} is defined implicitly by the relevant tests in TS 25.101. When transmission is resumed, the power of the DPCCH shall be the same as when the UE transmitter was shut off.

3GPP TSG-RAN Working Group 1 Meeting No. 11
San Diego, USA, 28 FEB 2000 - 03 MAR 2000

Agenda Item: Ad Hoc 18

Source: Nokia, Ericsson

Title: Out-of-sync handling for UTRA TDD

Document for: Approval

The aim of the CR presented below is to describe the out-of-sync handling with the corresponding procedures for UTRA TDD. The criteria for the uplink transmission is set and it is according to the received burst quality estimation.

In comparison to the FDD proposal an additional criteria is added to address the TDD specific timeslot dependent intercell interference. This criteria allows the UE to continue with the UL transmission for an extended period based on the reception of the downlink common channel (beacon function).

In the case of DTX in the uplink there will be a need to periodically transmit a 'dummy' burst which will help avoid erroneous out-of-sync reporting. This 'dummy' burst will have the same slot format as the normal burst where DTX is used. This burst will not carry any user data.

3GPP TSG RAN WG1 Meeting #11
San Diego, USA, 28 FEB 2000 - 03 MAR 2000

Document ***R1-00-0365***
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

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25.224 **CR** **014r1** Current Version: V3.1.0

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

For submission to: TSG RAN #7	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 :* 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: Nordic, Ericsson

Date: 23.02.2000

Subject: Out-of-sync handling for UTRA TDD

Work item: TS25.224

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: Completion of the out-of-sync work item for release 99 for UTRA TDD.

Clauses affected: 4.2.2, 4.2.3, 4.4, 4.6

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

Other comments:

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4.2.2 Uplink Control

4.2.2.1 Common Physical Channel

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

$$P_{PRACH} = L_{P\text{-}CCPCH} + I_{BTS} + \text{Constant value}$$

where

P_{PRACH} : Transmitter power level in dBm,

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

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

Constant value: This value shall be set by higher Layer (operator matter).

4.2.2.2 Dedicated Physical Channel

The initial transmission power is decided in a similar manner as PRACH. After the synchronisation between UTRAN and UE is established, the UE transits into open-loop transmitter power control (TPC).

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

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

where

P_{UE} : Transmitter power level in dBm,

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

L_0: Long term average of path loss in dB

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

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

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

Constant value: This value shall be set by higher Layer (operator matter).

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

4.2.2.2.1 Out of synchronisation handling

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

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

- If the UE detect the beacon channel reception level [10 dBm] above the handover triggering level, then the UE uses [320] ms estimation period for the burst quality evaluation.

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

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

4.2.3 Downlink Control

4.2.3.1 Common Physical Channel

The Primary CCPCH transmit power can be changed based on network determination on a slow basis. The reference transmit power of P-CCPCH is signaled on the BCH on a periodic basis.

4.2.3.2 Dedicated Physical Channel

- The initial transmission power of the downlink Dedicated Physical Channel is set by the network. After the initial transmission, the UTRAN transits into SIR-based inner loop TPC as similar to the FDD mode

The measurement of received SIR shall be carried out periodically at the UE. When the measured value is higher than the target SIR value, TPC bit = „0„. When this is lower than the target SIR value, TPC bit = „1„. At the UTRAN, soft decision on the TPC bits is performed, and when it is judged as „0„, the transmission power may be reduced by one step, whereas if judged as „1„, the transmission power may be raised by one step.

When the TPC bit cannot be received due to out-of-synchronisation, the transmission power value shall be kept at a constant value. When SIR measurement cannot be performed due to out-of-synchronisation, the TPC bit shall always be = „1„ during the period of being out-of-synchronisation.

A higher layer outer loop adjusts the target SIR.

4.2.3.2.1 Out of synchronisation handling

When the dedicated physical channel out of sync criteria based on the received burst quality is as given in the section 4.4.2 then the UE shall set the uplink TPC bit = „1„ . The CRC based criteria shall not be taken into account in TPC bit value setting.

4.4 Synchronisation and Cell Search Procedures

4.4.1 Cell Search

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

This initial cell search is carried out in three steps:

Step 1: Slot synchronisation

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

Step 2: Frame synchronisation and code-group identification

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

In Cases 2 and 3 it is required to detect the position of the next synchronization slots. To detect the position of the next synchronization slots, the primary synchronization code is correlated with the received signal at offsets of 7 and 8 time slots from the position of the primary code that was detected in Step 1.

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

Step 3: Scrambling code identification

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

4.4.2 Dedicated channel synchronisation

4.4.2.1 Synchronisation primitives

4.4.2.1.1 General

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

4.4.2.1.2 Downlink synchronisation primitives

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

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

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

- If the UE detect the beacon channel reception level [10 dBm] above the handover triggering level, the UE uses [320] ms estimation period for the burst quality evaluation.

- The last [16] transport blocks, as observed on all TrCHs using CRC, are received with incorrect CRC. In addition, over the last [160] ms, no transport block has been received with correct CRC. In case the beacon channel reception criteria is fulfilled the values are [32] transport blocks and [320] ms respectively.

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

- The UE estimates the burst reception quality over the last [160] ms period to be better than a threshold Q_{in}. This criterion is always fulfilled during the first [160] ms of the dedicated channel's existence. Q_{in} is defined implicitly by the relevant tests in TS 25.104.

- At least one transport block, as observed on all TrCHs using CRC, is received with correct CRC. If there is no TrCH using CRC, this criterion is always fullfiled.

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

4.4.2.1.3 Uplink synchronisation primitives

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

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

4.4.2.2 Radio link monitoring

4.4.2.2.1 Downlink radio link failure

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

4.4.2.2.2 Uplink radio link failure/restore

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

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

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

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

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

4.5 ODMA Relay Probing

This section describes the probe-response procedure used by ODMA nodes to detect neighbours which may be used as relays during a call.

4.5.1 Initial Mode Probing

The initial mode probing procedure is activated by a UE when it is switched on and has no information about its surroundings. In this case the UE will synchronise with the ODMA Random Access Channel (ORACH) which is used by all UEs to receive and broadcast system routing control information and data. The UE begins a probing session by periodically broadcasting a probe packet on the ORACH. The broadcast probe includes the current neighbour list for the UE which will initially be empty. If a neighbouring UE, UE*a*, receives the broadcast packet it will register the UE as a neighbour and send an addressed response probe. The response probe is transmitted at random to avoid contention with other UEs and typically one response is sent for every *n* broadcast probes received from a particular UE.

The next time the UE transmits a broadcast probe the neighbour list will have one new entry, UE*a*, and an associated quality indicator (a weighted factor based on the received signal strength of the response probe). It is through this basic mechanism that each UE builds a neighbour list.

4.5.2 Idle Mode Probing

The Idle Mode Probing procedure is activated when the UE has synchronised with the ORACH but is not transmitting data. This procedure is the same as that described above after ORACH synchronisation.

The ODMA Idle Mode Probing procedure controls the rate of probing on the ORACH to reduce interference levels and regulate power consumption. The procedure is governed by a state machine, which consists of the following states: full probing, duty maintained probing, and relay prohibited. Each state defines the number of probing opportunities within one *N* multiframe, and a probing activity parameter *K* which is the ratio of probe transmission time to probe monitoring time.

Full probing

Full probing is the case where probing is allowed on every ORACH timeslot within an *N* multiframe. The UE_R will probe on the ORACH at a rate defined by the probing activity parameter *K*.

Duty Maintained probing

The duty maintained probing is the case where probing is allowed on *M* slots of an *N* multiframe. The UE_R will probe on the *M* ORACH slots in an *N* multiframe at a rate defined by the probing activity parameter *K*.

Relay Prohibited

In this mode the UE_R would cease all of its ODMA probing activities and will fall into standard TDD or FDD operation.

The probing activity levels for given state machines are illustrated in Figure 1 for a system with an ORACH for M slots per N × 16 multiframe.

Note that the distribution of probing opportunities within a multiframe may not necessarily be consecutive and located at the beginning of a multiframe.

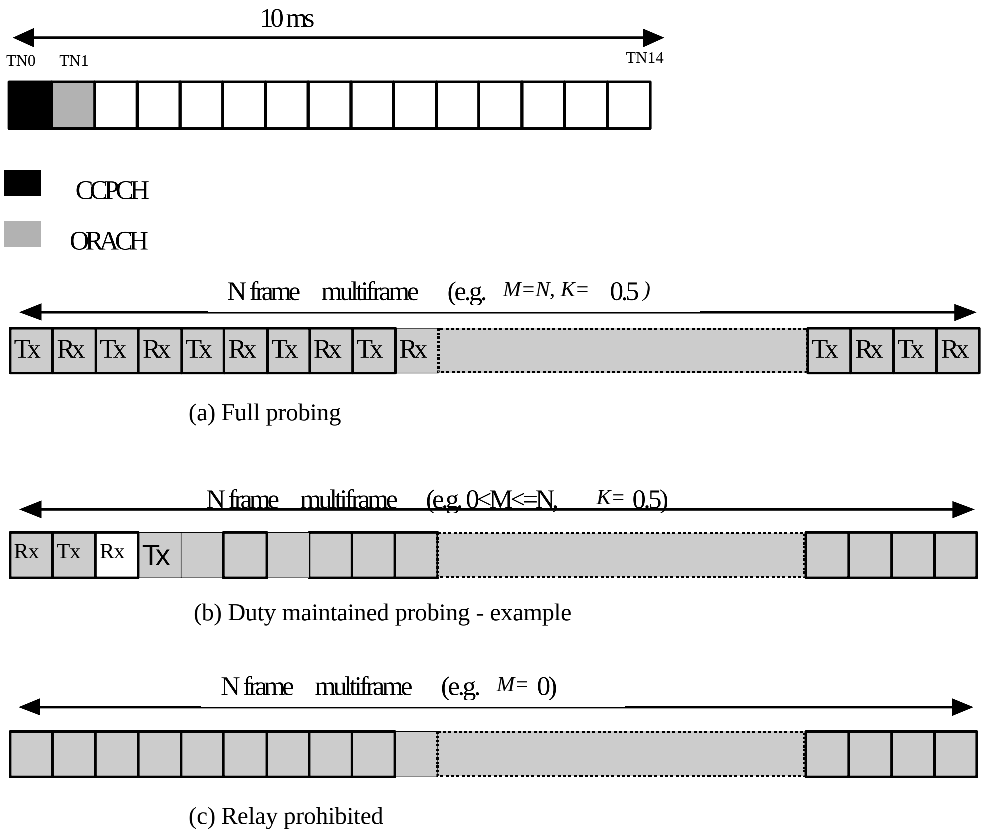

Figure 1: Probing state machines and mechanism

4.5.3 Active Mode Probing

The Active Mode Probing procedure is activated when the UE has synchronised with the ORACH and is transmitting data.

With ODMA, data may be relayed on either the ODMA Random Access Channel (ORACH) or the ODMA dedicated transport channel (ODCH), depending on the volume of data to be sent. When a UE has small amounts of data to send it may transmit an addressed probe response packet on the ORACH at an interval proportional to air interface modem rate, R_{CCH}, and is defined by *Probe_timer_1*. This interval also defines the broadcast probe interval, *Probe_timer_2*, which is typically five times longer than *Probe_timer_1*. Every time an UE transmits a response probe containing data on the ORACH, it may be received, but not acknowledged, by third party neighbour UEs, and provides an implicit indication of activity. In this instance broadcast probes are not necessary and *Probe_timer_2* is reset after every addressed probe transmission. Only when an UE has no data to send is it necessary to transmit a broadcast probe every *Probe_timer_2* seconds to register its active status with its neighbours.

In order to avoid overlapping packet transmissions the length of the packet may not exceed the probe timer interval, *Probe_timer_1*. The relationship between the different probe timers is illustrated in Figure 2.

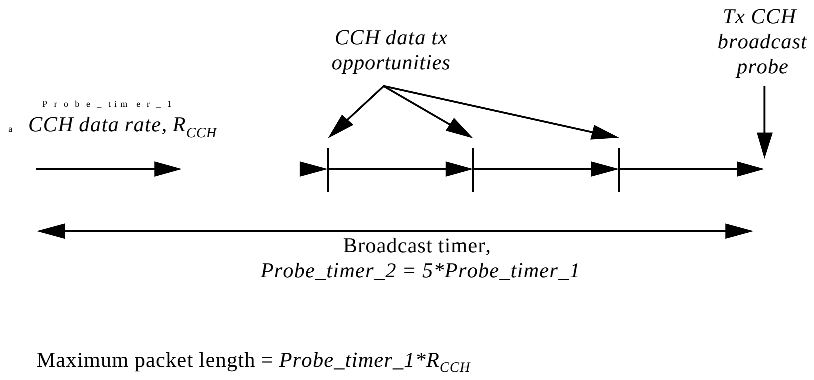

Figure 2: Probe timer relationships

4.6 Discontinuous transmission (DTX) of Radio Frames

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

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

When DTX is applied in the uplink and after a period of [16] / 2-1 silent frames no data has to be transmitted, then a dummy burst should be generated and transmitted in the next possible frame.

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