3GPP TSG RAN WG1#12 Tdoc R1-(00)-0551
Seoul, Korea
April 10th - 14th, 2000

Agenda Item:
Source: **Nokia**
Title: **25.214-096 : Correction to RACH subchannel definition**
Document for: **Decision**

---

1 Introduction

The current RACH access slot selection definition contains some ambiguity.

In TS25.211 in chapters 7.1 and 7.3, it is clearly stated that AICH is transmitted in parallel with the P-CCPCH. See for example the AICH access slots in figure 27. Further, in TS25.211, chapter 7.3 it is clearly stated that AICH is divided to downlink access slots and RACH to uplink access slots. Uplink access slot numbers are bound to downlink numbers as defined in the second paragraph of 7.3.

If we assume that SFN is e.g. #8 and we send preamble using uplink access slot #0 then the preamble is transmitted during frame number #7. The exact timing inside frame #7 depends on the AICH transmission timing parameter.

This is because:

- uplink access slots are numbered based on the downlink access slots
- uplink access slot is sent τ_{p-a} chips before the corresponding downlink access slot
- downlink access slot #0 is aligned to the start of every even frame

=> uplink access slot of SFN=#8, access slot #0 is transmitted during the frame SFN = #7

If we then look at the TS25.214, chapter 6.1.1, there is following definition: "Access slot #i is transmitted in parallel to P-CCPCH frames for which SFN mod 8 = 0...". And in table 7 it is defined that access slot #0 belongs to sub-channel number #0, which is transmitted when SFN modulo 8 is zero. Based on 25.211 this is not true.

Thus these two specs, TS25.214 and TS25.211 are now in conflict. The text of TS25.214, chapter 6.1.1 is really talking about AICH access slots (based on which the uplink access slots are defined). The definition should be clarified in the text. Since chapter heading in TS25.214, chapter 6.1.1 is RACH sub channels, the text should define RACH access slots, not AICH access slots. The actual problem is the SFN modulo 8 definitions, it applies to AICH channel, not to RACH.

2 Proposed correction

It is proposed that RACH subchannels are defined with the help of so called uplink access frame F, and that F is a time shifted version of SFN. The new definition is given below, and is contained in the attached CR:

Uplink access frame F is a time shifted version of SFN frame. Uplink access frame F starts τ_{p-a} (or τ_{p-a1}) chips prior to SFN frame.

A RACH sub-channel defines a sub-set of the total set of access slots. There are a total of 12 RACH sub-channels. RACH sub-channel #i (i = 0, …, 11) consists of the following access slots:

- First one is access slot #i in uplink access frame F for which F mod 8 = 0 or F mod 8 = 1
- Every 12th access slot relative to this access slot.

3GPP/TSG RAN WG1 Meeting #12
Seoul, Korea, April 10th-14th 2000

Document R1-00-0551
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

CHANGE REQUEST

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

25.214	**CR**	**096**	Current Version:	3.2.0

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

For submission to:	TSG RAN #8	for approval	X	strategic		*(for SMG*
list expected approval meeting # here ↑		for information		non-strategic		*use only)*

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

Source: Nokia **Date:** 2000-04-08

Subject: Correction to RACH subchannel definition

Work item: UTRAN

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

Reason for change: At the present TS25.211 and TS25.214 are not aligned with respect to RACH subchannel definition. TS25.211 defines that AICH channel is aligned with SCCPCH and SFN. TS 25.211 further defines that there is a time shift between AICH and RACH frames. On the other hand TS 25.214 defines RACH subchannels with the help of SFN, which leads to ambiguity. This CR defines that RACH subchannels are defined with the help of so called uplink access frame F, and that F is a time shifted version of SFN.

Clauses affected: 6.1, 6.2

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:

help.doc

<--------- double-click here for help and instructions on how to create a CR.

6 Random access procedure

6.1 Physical random access procedure

The physical random access procedure described in this section is initiated upon request of a PHY-Data-REQ primitive from the MAC sublayer (cf. TS 25.321).

Before the physical random-access procedure can be initiated, Layer 1 shall receive the following information from the higher layers (RRC) :

- The preamble scrambling code
- The message length in time, either 10 or 20 ms
- The AICH_Transmission_Timing parameter [0 or 1].
- The available signatures and RACH sub-channel groups for each Access Service Class (ASC), where a sub-channel group is defined as a group of some of the sub-channels defined in Section 6.1.1.
- The power-ramping factor Power_Ramp_Step [integer > 0].
- The parameter Preamble_Retrans_Max [integer > 0].
- The initial preamble power Preamble_Initial_Power.
- The power offset $\Delta P_{p\text{-}m} = P_{message\text{-}control} - P_{preamble}$, measured in dB, between the power of the last transmitted preamble and the control part of the random-access message
- The set of Transport Format parameters. This includes the power offset between the data part and the control part of the random-access mesagee for each Transport Format.

Note that the above parameters may be updated from higher layers before each physical random access procedure is initiated.

At each initiation of the physical random access procedure, Layer 1 shall receive the following information from the higher layers (MAC):

- The Transport Format to be used for the PRACH message part.
- The ASC of the PRACH transmission.
- The data to be transmitted (Transport Block Set).

The physical random-access procedure shall be performed as follows:

1 Randomly select the RACH sub-channel group from the available ones for the given ASC. The random function shall be such that each of the allowed selections is chosen with equal probability.

2 Derive the available access slots in the next two uplink access frames, defined by ~~SFN~~ F and ~~SFN~~F +1 in the selected RACH sub-channel group with the help of ~~SFN~~F and table 7. Randomly select one uplink access slot from the available access slots in the next uplink access frame, defined by ~~SFN~~F, if there is one available. If there is no access slot available in the next uplink access frame, defined by ~~SFN~~F then, randomly select one access slot from the available access slots in the following uplink access frame, defined by ~~SFN~~F+1. The random function shall be such that each of the allowed selections is chosen with equal probability.

3 Randomly select a signature from the available signatures for the given ASC. The random function shall be such that each of the allowed selections is chosen with equal probability.

4 Set the Preamble Retransmission Counter to Preamble_Retrans_Max.

5 Set the preamble transmission power to Preamble_Initial_Power.

6 Transmit a preamble using the selected uplink access slot, signature, and preamble transmission power.

7 If no positive or negative acquisition indicator (AI ≠ +1 nor –1) corresponding to the selected signature is detected in the downlink access slot corresponding to the selected uplink access slot:

7.1 Select a new uplink access slot as next available access slot, i.e. next access slot in the sub-channel group used, as selected in 1

7.2 Randomly selects a new signature from the available signatures within the given ASC. The random function shall be such that each of the allowed selections is chosen with equal probability.

7.3 Increase the preamble transmission power by ΔP_0 = Power_Ramp_Step [dB].

7.4 Decrease the Preamble Retransmission Counter by one.

7.5 If the Preamble Retransmission Counter > 0 then repeat from step 6. Otherwise pass L1 status ("No ack on AICH") to the higher layers (MAC) and exit the physical random access procedure.

8 If a negative acquisition indicator corresponding to the selected signature is detected in the downlink access slot corresponding to the selected uplink access slot, pass L1 status ("Nack on AICH received") to the higher layers (MAC) and exit the physical random access procedure.

9 Transmit the 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 control part of the random access message should be $\Delta P_{p\text{-}m}$ [dB] higher than the power of the last transmitted preamble. Transmission power of the data part of the random access message is set according to Section 5.1.1.2.

10 Pass L1 status "RACH message transmitted" to the higher layers and exit the physical random access procedure.

6.1.1 Uplink access frame F and RACH sub-channels

Uplink access frame F is a time shifted version of SFN frame. Uplink access frame F starts $\tau_{p\text{-}a}$ (or $\tau_{p\text{-}a1}$) chips prior to SFN frame.

A RACH sub-channel defines a sub-set of the total set of access slots. There are a total of 12 RACH sub-channels. RACH sub-channel #i (i = 0, …, 11) consists of the following access slots:

~~-Access slot #i transmitted in parallel to P-CCPCH frames for which SFN mod 8 = 0 or SFN mod 8 = 1.~~

- First one is access slot #i in uplink access frame F for which F mod 8 = 0 or F mod 8 = 1

- Every 12[th] access slot relative to this access slot.

The access slots of different RACH sub-channels are also illustrated in Table 7.

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

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

6.2 CPCH Access Procedures

For each CPCH physical channel in a CPCH set allocated to a cell the following physical layer parameters are included in the System Information message: L1 shall receive the following information from the higher layers (RRC).

- UL Access Preamble (AP) scrambling code.
- UL Access Preamble signature set
- The Access preamble slot sub-channels group
- AP- AICH preamble channelization code.
- UL Collision Detection(CD) preamble scrambling code.
- CD Preamble signature set
- CD preamble slot sub-channels group
- CD-AICH preamble channelization code.
- CPCH UL scrambling code.
- DPCCH DL channelization code.([512] chip)

NOTE: There may be some overlap between the AP signature set and CD signature set if they correspond to the same scrambling code.

The following physical layer parameters are received from the RRC layer:

1) N_AP_retrans_max = Maximum Number of allowed consecutive access attempts (retransmitted preambles) if there is no AICH response. This is a CPCH parameter and is equivalent to Preamble_Retrans_Max in RACH.

2) $P_{RACH} = P_{CPCH}$ = Initial open loop power level for the first CPCH access preamble sent by the UE.

   [RACH/CPCH parameter]

3) ΔP_0 = Power step size for each successive CPCH access preamble.

   [RACH/CPCH parameter]

4) ΔP_1 = Power step size for each successive RACH/CPCH access preamble in case of negative AICH. A timer is set upon receipt of a negative AICH. This timer is used to determine the period after receipt of a negative AICH when ΔP_1 is used in place of ΔP_0.

   [RACH/CPCH parameter]

5) T_{cpch} = CPCH transmission timing parameter: This parameter is identical to PRACH/AICH transmission timing parameter.

   [RACH/CPCH parameter]

6) $L_{pc\text{-}preamble}$ = Length of power control preamble (0 or 8 slots)

   [CPCH parameter]

7) $N_{Start\_Message}$ = Number of frames for the transmission of Start of Message Indicator in DL-DPCCH for CPCH

8) The set of Transport Format parameters. This includes a Transport Format to PCPCH mapping table.

L1 shall receive the following information from MAC prior to packet transmission:

1) Transport Format of the message part.

2) The data to be transmitted is delievered to L1 once every TTI until the data buffer is empty.

The overall CPCH -access procedure consists of two parts:

1) Upon receipt of a Status-REQ message from the MAC layer, the UE shall start monitoring the CSICH to determine the availability of the transport formats in the transport format subset included in the Status-REQ message. UTRAN transmits availability of each PCPCH or maximum available data rate with availability of each PCPCH over the CSICH in case CA is active. Upper layers will supply the UE with information to map the transport formats to the PCPCHs. The UE shall send a Status-CNF message to the MAC layer containing the transport format subset listing the transport formats of the requested subset which are currently indicated as ‘available’.

The actual access procedure is then:

2) Upon receipt of the Access-REQ message from the MAC layer, which contains an identified transport format from the available ones ,the following sequence of events occur. The use of step 2a or 2b depends on whether availability of each PCPCH or the Maximum available data rate along with the availability of each PCPCH is transmitted over CSICH. Note that in the first case, each access resource combination (AP signatures and access subchannel group) maps to each PCPCH resource and in the second case each access resource combination maps to each data rate.

2a) (In case CA is not Active) The UE shall test the value(s) of the most recent transmission of the CSICH Status Indicator(s) corresponding to the PCPCH channel(s) for the identified transport format included in the Access-REQ message. If this indicates that no channel is ‘available’ the UE shall abort the access attempt and send a failure message to the MAC layer. The UE shall also retain the availability status of the each PCPCH for further verification in a later phase.

2b) (In case CA is active) The CSICH Status Indicators indicate the maximum available data rate along with individual PCPCH availability. The UE shall test the value of the most recent transmission of the Status Indicator(s). If this indicates that the maximum available data rate is less than the requested data rate, the UE shall abort the access attempt and send a failure message to the MAC layer. The PHY provides the availability information to the MAC. The UE shall also retain the availability status of the each PCPCH for further channel assignment message verification in a later phase in case of success.

3) The UE sets the preamble transmit power to the value $P_{CPCH\_}$ which is supplied by the MAC layer for initial power level for this CPCH access attempt.

4) The UE sets the AP Retransmission Counter to N_AP_Retrans_Max.

5a) In the case CA is not active, the uplink access slot and signature to be used for the CPCH-AP transmission are selected in the following steps:

   a) The UE selects randomly one PCPCH from the set of available PCPCH channel(s) as indicated on the CSICH and supporting the identified transport format included in the Access-REQ message. The random function shall be such that each of the allowed selections is chosen with equal probability.

   b) The UE randomly selects a CPCH-AP signature from the set of available signatures in the access resource combination corresponding to the selected PCPCH in step a). The random function shall be such that each of the allowed selections is chosen with equal probability.

   c) Using the AP access slot sub-channel group of the access resource combination corresponding to selected PCPCH in step a), the UE derives the available CPCH-AP access slots in the next two uplink access frames, defined by ~~SFN~~F and ~~SFN~~F+1 with the help of ~~SFN~~F and table 7 in section 6.1. The UE randomly selects one access slot from the available access slots in the next uplink access frame, defined by ~~SFN~~F, if there is one available. If there is no access slot available in the next uplink access frame, defined by ~~SFN~~F then, randomly selects one access slot from the available access slots in the following uplink access frame, defined by ~~SFN~~F+1. The random function shall be such that each of the allowed selections is chosen with equal probability.

5b) In the case CA is active, the uplink access slot and signature to be used for the CPCH-AP transmission are selected in the following setps:

   a) The UE randomly selects a CPCH-AP signature from the set of available signatures in the access resource combination corresponding to the transport format identified in the Access-REQ message. The random function shall be such that each of the allowed selections is chosen with equal probability.

   b) Using the AP access slot sub-channel group of the access resource combination corresponding to the transport format identified in the Access-REQ message, the UE derives the available CPCH-AP access slots in the next two uplink access frames, defined by ~~SFN~~F and ~~SFN~~F+1 with the help of ~~SFN~~F and table 7 in section 6.1. The UE randomly selects one access slot from the available access slots in the next uplink access frame, defined by SFNF, if there is one available. If there is no access slot available in the next uplink access frame, defined by SFNF then, randomly selects one access slot from the available access slots in the following uplink access frame, defined by SFNF+1. The random function shall be such that each of the allowed selections is chosen with equal probability.

6) The UE transmits the AP using the selected uplink access slot and signature, and MAC supplied initial preamble transmission power. The following sequence of events occur based on whether availability of each PCPCH or the Maximum available data rate along with the availability of each PCPCH is transmitted over CSICH.

6a) (In case CA is not Active) The UE shall test the value of the most recent transmission of the Status Indicator corresponding to the identified CPCH transport channel immediately before AP transmission. If this indicates that the channel is 'not available' the UE shall abort the access attempt and send a failure message to the MAC layer. Otherwise the UE transmits the AP using the UE selected uplink signature and access slot, and the initial preamble transmission power from step 3, above.

6b) (In case CA is active) The Status Indicator indicates the maximum available data rate as well as the availability of each PCPCH. The UE shall test the value of the Status Indicator. If this indicates that the maximum available data rate is less than the requested data rate, the UE shall abort the access attempt and send a failure message to the MAC layer. Otherwise the UE shall transmit the AP using the UE selected uplink access slot, the MAC supplied signature and initial preamble transmission power from step 3, above.

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 shall test the value of the most recent transmission of the Status Indicator corresponding to the selected PCPCH immediately before AP transmission. If this indicates that the PCPCH is 'not available' the UE shall abort the access attempt and send a failure message to the MAC layer. Otherwise the following steps shall be executed:

   a) Selects the new uplink access slot from the available access slot, i.e, next access slot in the sub-channel group used. There must be a minimum distance of three or four (per Tcpch parameter) access slots from the uplink access slot in which the last preamble was transmitted depending on the CPCH/AICH transmission timing parameter.

   b) Increases the preamble transmission power with the specified offset ΔP. Power offset ΔP_0 s is used unless the negative AICH timer is running, in which case ΔP_1 is used instead.

   c) Decrease the AP Retransmission Counter by one.

   d) If the AP Retransmission Counter < 0, the UE aborts the access attempt and sends a failure message to the MAC layer.

8) If the UE detects the AP-AICH_nak (negative acquisition indicator) corresponding to the selected signature in the downlink access slot corresponding to the selected uplink access slot, the UE aborts the access attempt and sends a failure message to the MAC layer. The UE sets the negative AICH timer to indicate use of ΔP_1 use as the preamble power offset until timer expiry

9) Upon reception of AP-AICH_ack with matching signature, the access segment ends and the contention resolution segment begins. In this segment, the UE randomly selects a CD signature from the CD signature set and also select one-CD access slot sub-channel from the CD sub-channel group supported in the celland transmits a CD Preamble, then waits for a CD/CA-ICH and the channel assignment (CA) (in case CA is active) message from the Node B. The slot selection procedure is as follows:

   a) The next available slot when the PRACH and PCPCH scrambling code are not shared. Furthermore, the PCPCH AP preamble scrambling code and CD Preamble scrambling codes are different.

   b) When the PRACH and PCPCH AP preamble scrambling code and CD preamble scrambling code are shared, the UE randomly selects one of the available access slots in the next 12 access slots. Number of CD sub-channels will be greater than 2.

10) If the UE does not receive a CD/CA-ICH in the designated slot, the UE aborts the access attempt and sends a failure message to the MAC layer.

11) If the UE receives a CD/CA-ICH in the designated slot with a signature that does not match the signature used in the CD Preamble, the UE aborts the access attempt and sends a failure message to the MAC layer.

12a) (In case CA is not Active) If the UE receives a CDI from the CD/CA-ICH with a matching signature , the UE transmits the power control preamble $\tau_{cd-p-pc-p}$ ms later as measured from initiation of the CD Preamble. . The transmission of the message portion of the burst starts immediately after the power control preamble.

12b) (In case CA is active) If the UE receives a CDI from the CD/CA-ICH with a matching signature and CA message that points out to one of the PCPCH's (mapping rule is in [5]) that were indicated to be free by the last received CSICH broadcast, the UE transmits the power control preamble $\tau_{cd-p-pc-p}$ ms later as measured from initiation of the CD Preamble. The transmission of the message portion of the burst starts immediately after the power control preamble. If the CA message received points out the channel that was indicated to be busy on the last status information transmission received on the CSICH, the UE shall abort the access attempt and send a failure message to the MAC layer.

NOTE: If the $L_{pc-preamble}$ parameter indicates a zero length preamble, then there is not power control preamble and the message portion of the burst starts $\tau_{cd-p-pc-p}$ ms after the initiation of the CD Preamble

13) The UE shall test the value of Start of Message Indicator received from DL-DPCCH for CPCH during the first $N_{Start\_Message}$ frames after Power Control preamble. Start of Message Indicator is a known sequence repeated on a frame by frame basis. The value of $N_{Start\_Message}$ shall be provided by the higher layers.

14) If the UE does not detect Start of Message Indicator in the first $N_{Start\_Message}$ frames of DL-DPCCH for CPCH after Power Control preamble, the UE aborts the access attempt and sends a failure message to the MAC layer. Otherwise, UE continuously transmits the packet data.

15) During CPCH Packet Data transmission, the UE and UTRAN perform inner-loop power control on both the CPCH UL and the DPCCH DL.

16) After the first $N_{Start\_Message}$ frames after Power Control preamble, upon the detection of an Emergency Stop command sent by UTRAN, the UE halts CPCH UL transmission, aborts the access attempt and sends a failure message to the MAC layer.

17) If the UE detects loss of DPCCH DL during transmission of the power control preamble or the packet data, the UE halts CPCH UL transmission, aborts the access attempt and sends a failure message to the MAC layer.

18) If the UE completes the transmission of the packet data, the UE sends a success message to the MAC layer