TSG-RAN Working Group 1 meeting #7bis **TSGR1#7bis(99)f30**

Kiongju (Korea), Oct 4th – Oct 5th 99

Agenda Item :

Source : **Nortel Networks**

Title : CPCH access procedure, proposal for change of 25.214- version

Document for : Approval

1. Introduction

At the last WG1 meeting a text proposal to introduce a description of the CPCH access procedure into 25.214 was approved. However it was noted that the text needed to be modified later since it should be consistent with the RACH sub-channels. A WG1 note was added in order to reflect the recommendation from WG1 on this point.

In this contribution we address the CPCH access preamble and CPCH collision detection resource setting in terms of scrambling code/signature and access sub-channels. The proposal relies on a very flexible access resource allocation scheme. That scheme allows in particular to share one signature between the PRACH, the CPCH-AP and CPCH CD in time by assigning different access sub-channels to them. The scheme allows also to split the CPCH-AP, CPCH-CD and RACH preamble onto different signatures, and even different scrambling code. The proposal for flexibility of assigning access resource allows to dimension the access resource as a function of the CPCH size (number of CPCHs, allowed bit rates for each of the CPCHs). introduction at minimal cost at possible expense of decreased efficiency of CPCH

2. CPCH access preamble and CPCH-Collision detection sub-channels

2.1 The RACH sub-channel group and the access classes

Before discussing on the CPCH –AP and CPCH-CD access resource organisation, we would like here to summarise the principles for the RACH access resource organisation.

The RACH channel as currently defined in 25.214 consists of RACH sub-channels, where 12 of such sub-channels are mapped onto the 15 access-slots per 20 ms, with a mapping repeating on an 8 frame basis. A RACH is understood to correspond to one scrambling code and one signature.

A cell can support multiple signatures and /or multiple scrambling codes, leading to multiple RACH channels. For each of the scrambling codes and signatures, a cell can support a sub-set of the 12 sub-channels. The supported sub-channels can be organised into RACH sub-channel groups, for the support of Access Service Classes (ASC). To each of the ACS are assigned signatures and RACH sub-channel groups, one sub-channel group being assigned to on ACS only.

That RACH resource organisation is very flexible allowing to dimension the RACH resource in terms of signatures and/or RACH sub-channels in step of one sub-channel (one to two access-slot per frame). This allows to match the needs, while supporting multiple access classes.

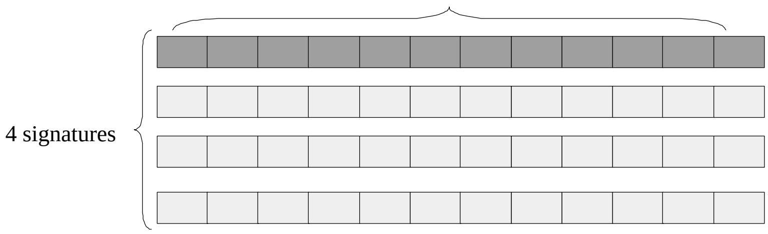
2.2 Generalisation of of the Access sub-channels to support RACH and CPCH in an unified way

For the CPCH two types of access resources need to be introduced, for the access preamble part on one side and for the collision detection on the other side. In the following we would like to list which are according to us the requirement for the design of the access preamble (AP) and detection collision (CD) access resources. We will in the following call access resource one signature+one sub-channel as defined for the RACH.

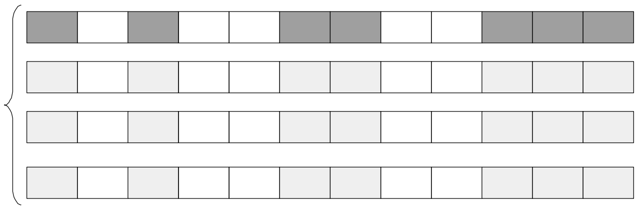
- It should be possible to dimension the AP and CP to allow good collision detection In order to have an effective collision detection, there must in particular be more collision detection resources than access preamble resource
- It should be possible to dimension the AP and CD access resource to match the CPCH resource itself. It is of no use to over-dimension the resource, providing more access opportunities than can effectively be answered to positively depending on the CPCH resource. However it should be possible to dimension the CPCH access resource in order to avoid blocking access to CPCH due to insufficient resource. In between there is a trade-off between amount of resource, which turns into processing capabilities ate node B, and access delay.
- The scheme must allow progressive introduction of CPCH, by avoiding a large price to pay in terms of processing capability for the access resource, while allowing to offer the service. It is understood that access resource is increased starting from an minimal access resource, the service quality can then improve. The scheme must then allow sub-optimal operation to take into account Node B processing constraints.
- It should be possible to have an integrated scheme for the RACH and CPCH, since for the access part these are quite similar. Though the it might be useful to the UTRAN to distinguish between RACH access and CPCH access, hence a segregation of the access resources, since there is no information content in the preamble.

From these requirements we derive the principle for the CPCH access resource organisation :

1) Both CPCH and RACH should rely on access sub-channels. For generalisation purposes, we should then replace RACH sub-channel by Access sub-channels.
2) The RACH sub-channel group principle should be extended beyond the Access service classes. The sub-channel can be grouped into the following categories :
    a) RACH service Access class
    b) CPCH access preamble
    c) CPCH collision detection
3) A cell can support one or multiple scrambling code, each of the scrambling can support one or multiple signatures and each of these signatures a sub set of the 12 sub-channels. Different mapping of the RACH service access class sub-channel group, CPCH-AP sub-channel groups and CPCH-CD sub-channel group should be allowed. Examples of these are as follow and is illustrated in the Fig-1:
    a) RACH, CPCH-AP, CPCH CD can use separate signatures (in or several each).
    b) RACH and CPCH-AP and CPCH-CD may share the same signature, and use different Access sub-channels
    c) RACH and CPCH-AP may share the same signature and CPCH-CD be mapped onto one or multiple signature.

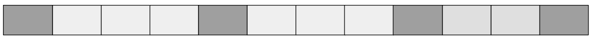


Case 1 : separate signatures for CPCH-CD and CPCH-AP, all sub-channels supported

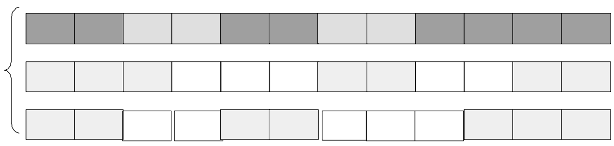


Case 2 : separate signatures for CPCH-CD and CPCH-AP,
sub-set of sub-channels supported, same sub-channels for AP and CD

CD-preamble sub-channel AP-preamble sub-channel



Case 3 : One signature for CPCH-CD, CPCH-AP and RACH, each using disjoint sub-channels groups



Case 4 : 2 signatures : One shared between CPCH-AP and RACH, and 2 for CPCH-CD but with different access groups between the two signatures.

RACH access sub-channels group

3. Text proposal

A text proposal was elaborate to reflect the required modification along the lines of the principle explained before. In order to generalise the RACH –sub-channels the terminology was adapted which requires also some editorial modification of the RACH section of 25.214 version 1.3.1. The text does not include yet any modification due to a modification of the split of functions between the physical layer and higher layers. In particular, a possible need to move the open loop power control and the selection of the first access slot from WG1 to WG2 specification is not reflected here. It is anticipated that additional changes are needed or will be combined with other proposals for change.

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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 available signatures , and RACH sub ~~RACH~~ 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 1~~Table 1~~, and is indicated by upper layer.

- The available spreading factors for the message part
- The uplink interference level in the cell

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- ~~RACH~~ channel group from the available ones for its ASC, The random function, for selecting the RACH sub- ~~RACH~~ 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-~~RACH~~ channel group with the help of SFN and Table 1~~Table 1~~. 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. A 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 1.The available access slots, Access, for different sub-~~RACH~~ 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

6.2 CPCH Access Procedures

<Editor's note: The following text should be revised to include the RACH sub-channel scheme as accepted for the RACH, and to be in line with OHG recommendations.>

For each CPCH physical channel allocated to a cell the following physical layer parameters are included in the System Information message:

- UL Access Preamble (AP) scrambling code set.
- For each of the UL Access Preamble scrambling code, the signature set
- For each of the signatures in each UL AP scrambling code, the Access preamble sub-channels group
- For each of the UL AP scrambling code, the AP- AICH preamble channelization code set.
- UL Collision Detection (CD) preamble scrambling code set.
- For each of the CD Preamble scrambling code, the signature set
- For each of the signatures in each UL CD scrambling code, the CD preamble sub-channels group
- For each of the UL CP scrambling code, the CD-AICH preamble channelization code set.
- CPCH UL scrambling code set.
- CPCH UL channelization code set. (variable, data rate dependant)
- DPCCH DL channelization code set.([256] chip)

  Note : There may be some overlap between the UL access preamble scrambling code set and the UL CD preamble code set. There may be as well some overlap between the AP signature set and CD signature set if they correspond to the same scrambling code.

The following are access, collision detection/resolution and CPCH data transmission parameters:

Power ramp-up, Access and Timing parameters (Physical layer parameters)

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

[RACH/CPCH]

5. T_{cpch} = CPCH transmission timing parameter: The range of T_{cpch} values is TBD. This parameter is similar to PRACH/AICH transmission timing parameter.

Note : It is FFS if ΔP_0 for the CPCH access may be different from ΔP_0 for the RACH access as defined in section 6.1.

The CPCH -access procedure in the physical layer is:

1) The UE MAC function selects a CPCH transport channel from the channels available in the assigned CPCH set The CPCH channel selection includes a dynamic persistence algorithm (similar to RACH) for the selected CPCH channel.

~~1.~~2) 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.

~~2.~~3) The UE sets the AP Retransmission Counter to N_AP_Retrans_Max (value TBD).

4) The UE randomly selects a CPCH-AP sub-channel group from the set of CPCH-AP sub-channel groups supported in the cell, considering all sub-channel groups on each of the signatures in the CPCH-AP scrambling code sets. The random function is TBD.

5) The UE Derives the available CPCH-AP access slots in the next two frames, defined by SFN and SFN+1 in the selected sub-RACH channel group with the help of SFN and Table 1Table 1 in section 6.1. The UE 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.

3.6) The UE transmits the AP using the MAC supplied uplink selected access slot, signature, and initial preamble transmission power.

4.1) 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:

a) Selects randomly a new uplink access slot. , among the access slots in the CPCH-AP sub-channel group used, as selected in 4.1. There must be a minimum distance of three or four access slots from the uplink access slot in which the last preamble was transmitted depending on the CPCH/AICH transmission timing parameter The Random function is TBD.

aThis new access slot must be one of the available access slots. There must be also a distance of three or four access slots from the uplink access slot in which the last preamble was transmitted depending on the CPCH/AICH transmission timing parameter. The selection scheme of this new access slot is TBD.

bb) Increases the preamble transmission power with the specified offset P $_0$ ΔP_0.

cc) Decrease the Preamble Retransmission Counter by one.

d2) If the Preamble Retransmission Counter < 0, the UE aborts the access attempt and sends a failure message to the MAC layer.

5.3) 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 aborts the access attempt and sends a failure message to the MAC layer.

6.4) Upon reception of AP-AICH, the access segment ends and the contention resolution segment begins. In this segment, the UE randomly selects one CPCH-CP sub-channel group from the set of CPCH-CP sub-channel groups supported in the cell.selects one of 16 signatures and transmits a CD Preamble, then waits for a CD-AICH from the base Node B.

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

8.6) If the UE receives a CD-AICH 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.

9.7) 9. If the UE receives a CD-AICH 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.

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

11.9) 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.

~~12.~~10) If the UE completes the transmission of the packet data, the UE sends a success message to the MAC layer.