

Agenda Item:

Source: Nortel Networks, Nokia

Title: Text proposal for RACH sub-channel definition

Document for: Approval

1. Introduction

This document proposes a text proposal on the sub channel definition as agreed in Ad-Hoc 3 meeting.

1. Text proposal

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 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, and is indicated by upper layer.
- ~~The available sub RACH channels, defined by parameter A. A contains four bits. The A parameter values 0000≤A≤0111 are used with AICH transmission timing parameter value 0, and values 0000≤A≤1111 with AICH transmission timing parameter value 1. If a certain bit position in parameter A has value 1, it means that corresponding sub RACH channel is available. Sub RACH channel_# can have a value among {0,1,2,3}. The LSB of parameter A corresponds to sub RACH channel_# = 0, and the MSB of parameter A corresponds to sub RACH_channel_# = 3. The available access slots for different sub RACH channels are shown in tables 5 and 6 for transmission timing parameter values 0 and 1, respectively.~~
- The available spreading factors for the message part
- The uplink interference level in the cell
- The primary CCPCH transmit power level
- The AICH transmission timing parameter as defined in 25.211.
- The power offsets ΔP_0 (power step when no acquisition indicator is received, step 7.3) and ΔP_1 (power step when negative acquisition is received, see step 8.3)

The random-access procedure is:

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

2. The UE sets the preamble transmit power to the value P_{RACH} given in Section 5.1.1. [*Editor's note: Here it is assumed that the initial power back-off is included in the "Constant Value" of 5.1.1*]
3. The UE implements the dynamic persistence algorithm by:
 - 3.1 Reading the current dynamic persistence value from the BCH.
 - 3.2 Perform a random draw against the current dynamic persistence value. The random function is TBD.
 - 3.3 Defer transmission for one frame and repeat step 3 if the result of the random draw is negative, otherwise proceed to step 4.

[*Editor's note: The dynamic persistence value may not be transmitted every frame, depending on the BCH scheduling, i.e step 3.1 cannot be executed every iteration.*]

4 The UE:

4.1 Randomly selects the sub RACH channel group from the available ones ~~for its ASC-, with the help of A parameter and AICH transmission timing parameter. The A parameter values $0000 \leq A \leq 0111$ are used with AICH transmission timing parameter value 0, and values $0000 \leq A \leq 1111$ with AICH transmission timing parameter value 1. If a certain bit position in parameter A has value 1, it means that corresponding sub RACH channel is available, among the possible {0,1,2,3}~~. The random function, for selecting the sub RACH channel group from the available ones is TBD.

~~4.2~~ Derives the available access slots in the next two frames, defined by frame SFN and SFN+1 in the selected sub-RACH channel group with the help of SFN and ~~AICH transmission timing parameter value~~ Table 1.

~~—If AICH transmission timing parameter value is 0, the access slots of frame SFN are defined by $Access = 3 * N + (SFN \text{ modulo } 2) + \text{sub_RACH_channel_}\#$, where N has values of the range $0 \leq N \leq 4$, and sub_RACH_channel_# is the selected sub_RACH_channel, with the condition that only the values between $0 \leq Access \leq 7$ are valid in frames with even SFN and only the values between $8 \leq Access \leq 14$ are valid in frames with odd SFN. UE selects the available access slot to which there is smallest distance.~~

- ~~• If AICH transmission timing parameter value is 1, the access slots of frame SFN are defined by $Access = 4 * N + (SFN \text{ modulo } 8) + \text{sub_RACH_channel_}\#$, where N has values of the range $0 \leq N \leq 3$, and sub_RACH_channel_# is the selected sub_RACH_channel, with the condition that only the values between $0 \leq Access \leq 7$ are valid in frames with even SFN and only the values between $8 \leq Access \leq 14$ are valid in frames with odd SFN. UE selects the available access slot to which there is smallest distance.~~

4.2 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, ~~by using the timing requirements for τ_{p-p} defined in TS 25.211, where it is defined that $\tau_{p-p} = 3$ access slots if AICH transmission timing value is set to 0, and $\tau_{p-p} = 4$ access slots if AICH transmission timing value is set to 1~~ 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 .
- [Editor's note: Note clear if the Preamble Retransmission Counter should be decremented and tested in this case]
- 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...
 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

Table 1 The available access slots, Access, for different sub-RACH channels, when AICH transmission timing parameter = 0.

Frame-number	Sub-RACH channel_#=0 (A=001) Access	Sub-RACH channel_#=1 (A=010) Access	Sub-RACH channel_#=2 (A=100) Access
SFN modulo 2=0	0, 3, 6	1, 4, 7	2, 5
SFN modulo 2=1	9, 12	10, 13	8, 11, 14

Table 2 The available access slots, Access, for different sub-RACH channels, when AICH transmission timing parameter = 1.

Frame-number	Sub-RACH channel_#=0 (A=0001) Access	Sub-RACH channel_#=1 (A=0010) Access	Sub-RACH channel_#=2 (A=0100) Access	Sub-RACH channel_#=3 (A=1000) Access
SFN modulo 8=0	0, 4	1, 5	2, 6	3, 7

SFN modulo 8=1	8,12	9,13	10,14	11
SFN modulo 8=2	1,5	2,6	3,7	0,4
SFN modulo 8=3	9,13	10,14	11	8,12
SFN modulo 8=4	2,6	3,7	0,4	1,5
SFN modulo 8=5	10,14	11	8,12	9,13
SFN modulo 8=6	3,7	0,4	1,5	2,6
SFN modulo 8=7	11	8,12	9,13	10,14
