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

TSGR1#11(00)0245

Agenda item:

Source: Ericsson

Title: CR 25.213-023r1: Number of PRACH scrambling codes

Document for: Decision

In the RRC specification, TS 25.331, the PRACH preamble scrambling codes are assumed to be numbered 0, 1, …, 255. This is probably based on some old WG1 assumptions. WG1 currently defines all 2^{24} possible PRACH preamble codes. This is a big overkill, which will cost some additional signalling over the radio interface, something that should be avoided.

However, limiting the number of scrambling codes to 256 may be a bit too restrictive, considering that the amount of possible codes are much higher than that. The downlink code planning resource (the downlink primary scrambling code) has the size 512. Assuming the same planning effort for the PRACH in uplink, and further assuming up to 16 PRACH codes per cell on the average, leads to a need of 16×512=8192 PRACH preamble codes. Addressing of the codes are done using 4 bits, since each group of 16 PRACH codes are directly associated with one particular downlink primary scrambling code. This number is seen as a reasonable trade-off between signalling overhead and future-proofness.

This CR introduces the necessary changes to TS 25.213. Further, WG2 will need to update the value range of the parameter in the RRC specification.

3GPP TSG RAN WG1 Meeting #11
San Diego, USA, February 29 – March 3, 2000

Document ???99???
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.

25.213	**CR**	**023r1**	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		(for SMG use only)
list expected approval meeting # here ↑		for information		non-strategic		

Form: CR cover sheet, version 2 for 3GPP and SMG The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc

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

Source: Ericsson **Date:** 2000-02-22

Subject: Number of RACH scrambling codes

Work item:

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

Reason for change: There is a mismatch between the WG1 and WG2 specifications on the number of PRACH preamble scrambling codes. It is proposed that 16 different PRACH preamble codes are defined per downlink primary scrambling code, as a reasonable trade-off between signalling overhead and future-proofness. Further, the connection between RACH preamble scrambling codes and RACH message part scrambling codes is clarified.

Clauses affected:

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

Other comments:

4.3.2.5 PRACH message part scrambling code

The scrambling code used for the PRACH message part is 10 ms long, and there are 8192 different PRACH scrambling codes defined.~~, cell-specific and has a one-to-one correspondence to the scrambling code used for the preamble part.~~

The *n*:th PRACH message part scrambling code, denoted $S_{r\text{-}msg,n}$, where $n = 0, 1, \ldots, 8191$, is based on the long scrambling sequence and is defined as

$S_{r\text{-}msg,n}(i) = C_{long,n}(i + 4096), \;\; i = 0, 1, \ldots, 38399$

where the lowest index corresponds to the chip transmitted first in time and $C_{long,n}$ is defined in section 4.3.2.2.

The message part scrambling code has a one-to-one correspondence to the scrambling code used for the preamble part. For one PRACH, the same code number is used for both scrambling codes, i.e. if the PRACH preamble scrambling code used is $S_{r\text{-}pre,m}$ then the PRACH message part scrambling code is $S_{r\text{-}msg,m}$, where the number *m* is the same for both codes.

4.3.2.6 PCPCH message part scrambling code

The set of scrambling codes used for the PCPCH message part are 10 ms long, cell-specific and have a one-to-one correspondence to the signature sequences and the access sub-channels used by the access preamble part. Both long or short scrambling codes can be used to scramble the CPCH message part.

The *n*:th PCPCH message part scrambling code, denoted $S_{c\text{-}msg,n}$, is based on the scrambling sequence and is defined as

In the case when the long scrambling codes are used,

$S_{r\text{-}msg,n}(i) = C_{long,n}(i + 8192), \;\; i = 0, 1, \ldots, 38399$

where the lowest index corresponds to the chip transmitted first in time and $C_{long,n}$ is defined in section 4.3.2.2.

In the case when the access resources are shared between the RACH and CPCH, then $S_{c\text{-}msg,n}$ is defined as

$S_{r\text{-}msg,n}(i) = C_{long,n}(i + 4096), \;\; i = 0, 1, \ldots, 38399$

where the lowest index corresponds to the chip transmitted first in time and $C_{long,n}$ is defined in section 4.3.2.2.

In the case the short scrambling codes are used,

$S_{r\text{-}msg,n}(i) = C_{short,n}(i), \;\; i = 0, 1, \ldots, 38399$

4.2.3.7 PCPCH power control preamble scrambling code

The scrambling code for the PCPCH power control preamble is the same as for the PCPCH message part, as described in section 4.2.3.6 above. The phase of the scrambling code shall be such that the end of the code is aligned with the frame boundary at the end of the power control preamble.

4.3.3 PRACH preamble codes

4.3.3.1 Preamble code construction

The random access preamble code $C_{pre,n,}$ is a complex valued sequence. It is built from a preamble scrambling code $S_{r\text{-}pre,n}$ and a preamble signature $C_{sig,s}$ as follows:

$$C_{pre,n,s}(k) = S_{r\text{-}pre,n}(k) \times C_{sig,s}(k) \times e^{j\left(\frac{\pi}{4} + \frac{\pi}{2}k\right)}, \;\; k = 0, 1, 2, 3, \ldots, 4095,$$

where k=0 corresponds to the chip transmitted first in time and $S_{r\text{-}pre,n}$ and $C_{sig,s}$ are defined in 4.3.3.2 and 4.3.3.3 below respectively.

4.3.3.2 Preamble scrambling code

The scrambling code for the PRACH preamble part is constructed from the long scrambling sequences. There are 8192 PRACH preamble scrambling codes in total.

The *n*:th preamble scrambling code, $n = 0, 1, \ldots, 8191$, is defined as:

$$S_{r\text{-}pre,n}(i) = c_{long,1,n}(i),\ i = 0, 1, \ldots, 4095,$$

where the sequence $c_{long,1,n}$ is defined in section 4.3.2.2.

The 8192 PRACH preamble scrambling codes are divided into 512 groups with 16 codes in each group. There is a one-to-one correspondence between the group of PRACH preamble scrambling codes in a cell and the primary scrambling code used in the downlink of the cell. The *k*:th PRACH preamble scrambling code within the cell with downlink primary scrambling code *m*, $k = 0, 1, 2, \ldots, 15$ and $m = 0, 1, 2, \ldots, 511$, is $S_{r\text{-}pre,n}(i)$ as defined above with $n = 16 \times m + k$.

4.3.3.3 Preamble signature

The preamble signature corresponding to a signature s consists of 256 repetitions of a length 16 signature $P_s(n)$, n=0…15. This is defined as follows:

$$C_{sig,s}(i) = P_s(i \text{ modulo } 16),\ i = 0, 1, \ldots, 4095.$$

The signature $P_s(n)$ is from the set of 16 Hadamard codes of length 16. These are listed in table 3.

Table 3: Preamble signatures

Preamble signature	Value of *n*															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
$P_0(n)$	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
$P_1(n)$	1	-1	1	-1	1	-1	1	-1	1	-1	1	-1	1	-1	1	-1
$P_2(n)$	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1
$P_3(n)$	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1	1	-1	-1	1
$P_4(n)$	1	1	1	1	-1	-1	-1	-1	1	1	1	1	-1	-1	-1	-1
$P_5(n)$	1	-1	1	-1	-1	1	-1	1	1	-1	1	-1	-1	1	-1	1
$P_6(n)$	1	1	-1	-1	-1	-1	1	1	1	1	-1	-1	-1	-1	1	1
$P_7(n)$	1	-1	-1	1	-1	1	1	-1	1	-1	-1	1	-1	1	1	-1
$P_8(n)$	1	1	1	1	1	1	1	1	-1	-1	-1	-1	-1	-1	-1	-1
$P_9(n)$	1	-1	1	-1	1	-1	1	-1	-1	1	-1	1	-1	1	-1	1
$P_{10}(n)$	1	1	-1	-1	1	1	-1	-1	-1	-1	1	1	-1	-1	1	1
$P_{11}(n)$	1	-1	-1	1	1	-1	-1	1	-1	1	1	-1	-1	1	1	-1
$P_{12}(n)$	1	1	1	1	-1	-1	-1	-1	-1	-1	-1	-1	1	1	1	1
$P_{13}(n)$	1	-1	1	-1	-1	1	-1	1	-1	1	-1	1	1	-1	1	-1
$P_{14}(n)$	1	1	-1	-1	-1	-1	1	1	-1	-1	1	1	1	1	-1	-1
$P_{15}(n)$	1	-1	-1	1	-1	1	1	-1	-1	1	1	-1	1	-1	-1	1