

Source: InterDigital Comm. Corp.  
Title: Random Access Procedure  
Document for: Decision

---

## 1 Introduction

TS25.224, Section 4.7, Random access procedure, contained several inconsistencies. It referred to sub-channels, but did not define sub-channels for TDD. It also described overall process functionality without clearly segregating the Layer 1 functions from those of the higher layers. The assumed set of parameters to be defined by higher layers did not precisely track the descriptions in higher layer documents; e.g. TS25.302, TS25.331, TR25.922.

The corrections proposed in this CR have been coordinated with CRs to TS25.302, TS25.331, and TR922 to provide a consistent set of specifications.

At WG1#18 TDD changes to RACH procedures specified in 25.224 was agreed. In subsequent discussions it was pointed out the new proposed text for PRACH is a bit misleading since it states that “A PRACH is defined by a timeslot and a list of channelisation codes”. This contradicts the general definition of a physical channel that is associated with “a” channelisation code.

The PRACH text is updated to “A PRACH is defined by a timeslot and a channelisation code, which is randomly selected from the PRACH Channelisation Code List [Ref to 25.331] signaled by higher layers”.

This change is reflected in revision 1.

---

## 2 Specific Changes

- 1) Section 4.7 has been subdivided into
  - ?? 4.7.1 PRACH sub-channels
  - ?? 4.7.2 Physical random access procedure

- 2) Section 4.7.1 defines TDD RACH sub-channels. A PRACH may have 1,2,4, or 8 sub channels, configurable by higher layers. The pattern shall have a period of N, where N is the number of sub-channels. Each sub-channel shall be characterized by a different offset.

3) In 4.7.2, the procedure is documented, explicitly stating the functions performed by the physical layer, and identifying which parameters are sent by higher layers;

?? on configuration

?? at the time of service request

4) When the physical layer receives a request to send data it also is given the Access Service Class (ASC). It maps the ASC into the allowable sub-channels. It randomly selects, with uniform probabilities, a sub-channel and a channelization code.

CR-Formv3	
<b>CHANGE REQUEST</b>	
⚡ <b>25.224 CR 037</b> ⚡ rev <b>1</b> ⚡ Current version: <b>3.5.0</b> ⚡	

For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⚡ symbols.

Proposed change affects: ⚡ (U)SIM  ME/UE  Radio Access Network  Core Network

<b>Title:</b> ⚡	RACH random access procedure		
<b>Source:</b> ⚡	InterDigital Comm. Corp.		
<b>Work item code:</b> ⚡		<b>Date:</b> ⚡	28 February, 2001
<b>Category:</b> ⚡	F	<b>Release:</b> ⚡	R99
Use <b>one</b> of the following categories: <b>F</b> (essential correction) <b>A</b> (corresponds to a correction in an earlier release) <b>B</b> (Addition of feature), <b>C</b> (Functional modification of feature) <b>D</b> (Editorial modification)		Use <b>one</b> of the following releases: 2 (GSM Phase 2) R96 (Release 1996) R97 (Release 1997) R98 (Release 1998) R99 (Release 1999) REL-4 (Release 4) REL-5 (Release 5)	
Detailed explanations of the above categories can be found in 3GPP TR 21.900.			

<b>Reason for change:</b> ⚡	Current description of procedure is inconsistent, both internally and with higher layer Specification
<b>Summary of change:</b> ⚡	Procedure is rewritten to remove inconsistencies and to support alignment with other specifications. Sub-channels are defined for TDD. Parameters required from higher layers are clearly stated. Procedure for selection of sub-channel and channelization code are clearly stated.
<b>Consequences if not approved:</b> ⚡	Procedure will be ambiguous and incompatible with higher layer specifications

<b>Clauses affected:</b> ⚡	4.7.1 (new), 4.7.2	
<b>Other specs affected:</b> ⚡	<input checked="" type="checkbox"/> Other core specifications	⚡ 25.331, 25.922, 25.302
	<input type="checkbox"/> Test specifications	
	<input type="checkbox"/> O&M Specifications	
<b>Other comments:</b> ⚡		

**How to create CRs using this form:**

Comprehensive information and tips about how to create CRs can be found at: [http://www.3gpp.org/3G\\_Specs/CRs.htm](http://www.3gpp.org/3G_Specs/CRs.htm). Below is a brief summary:

- 1) Fill out the above form. The symbols above marked ⚡ contain pop-up help information about the field that they are closest to.

- 2) Obtain the latest version for the release of the specification to which the change is proposed. Use the MS Word "revision marks" feature (also known as "track changes") when making the changes. All 3GPP specifications can be downloaded from the 3GPP server under <ftp://www.3gpp.org/specs/> For the latest version, look for the directory name with the latest date e.g. 2000-09 contains the specifications resulting from the September 2000 TSG meetings.
- 3) With "track changes" disabled, paste the entire CR form (use CTRL-A to select it) into the specification just in front of the clause containing the first piece of changed text. Delete those parts of the specification which are not relevant to the change request.

## 4.7 Random access procedure

The physical random access procedure described below is invoked whenever a higher layer requests transmission of a message on the RACH. The physical random access procedure is controlled by primitives from RRC and MAC. Retransmission on the RACH in case of failed transmission (e.g. due to a collision) is controlled by higher layers. Thus, the backoff algorithm and associated handling of timers is not described here. The definition of the RACH in terms of PRACH sub-channels and associated Access Service Classes is broadcast on the BCH in each cell. Parameters for common physical channel uplink outer loop power control are also broadcast on the BCH in each cell. The UE needs to decode this information prior to transmission on the RACH.

### 4.7.1 PRACH sub-channels

A PRACH is defined by a timeslot and a channelization code, which is randomly selected from the PRACH Channelisation Code List [15] signaled by higher layers. In order to separate different ASCs each PRACH has N sub-channels associated with it (numbered from 0 to N-1). N may be assigned the value 1,2,4, or 8 by higher layer signaling. Sub-channel i for a PRACH defined in timeslot k is defined as the kth slot in the frames where  $SFN \bmod N = i$ . Therefore follows the definition:

?? Sub-channel i associated to a PRACH defined in timeslot k is defined as the kth timeslot in the frames where  $SFN \bmod N = i$ .

Figure 6 illustrates the eight possible subchannels for the case, N=8. For illustration, the figure assumes that the PRACH is assigned timeslot 3.

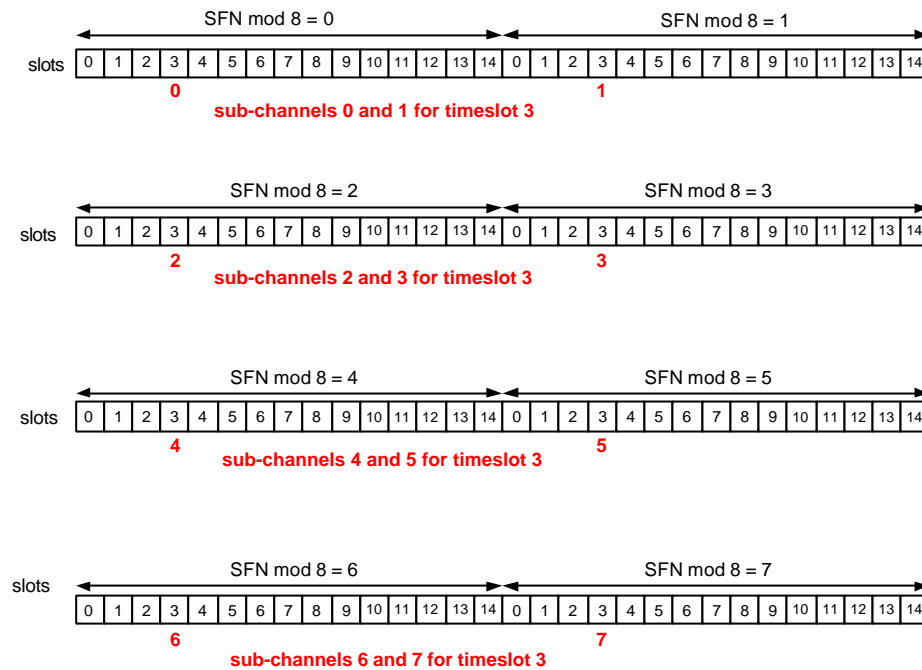


Figure 6. Eight sub-channels for timeslot 3

#### 4.7.24 Physical random access procedure

The physical random access procedure described in this subclause is initiated upon request of a PHY-Data-REQ primitive from the MAC sublayer (see [18] and [19]).

(Note: The selection of a PRACH is done by the RRC Layer.)

Before the physical random-access procedure can be initiated, Layer 1 shall receive the following information ~~by a CPHY-TrCH-Config-REQ~~ from the RRC layer: using the primitives CPHY-TrCH-Config-REQ and CPHY-RL-Setup/Modify-REQ.

- the available PRACH sub-channels and channelization codes (There is a 1:1 mapping between the channelization code and the midamble shift as defined by RRC) for each Access Service Class (ASC); ~~of the selected PRACH (the selection of a PRACH is done by the RRC).~~ CPHY-RL-Setup/Modify-REQ);
- the timeslot, spreading factor, ~~channelisation code, and midamble type (direct or inverted), repetition period and offset~~ for the selected, each PRACH sub-channel. (There is a 1:1 mapping between spreading code and midamble as defined by RRC); (CPHY-RL-Setup/Modify-REQ);
- ~~the RACH set of~~ Transport Format ~~parameters~~ (CPHY-TrCH-Config-REQ);
- the RACH transport channel identity (CPHY-TrCH-Config-REQ)
- the set of parameters for common physical channel uplink outer loop power control (CPHY-RL-Setup/Modify-REQ).

NOTE: 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 MAC higher layers (MAC):

~~the Transport Format to be used for the PRACH message;~~

- 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 PRACH sub-channel 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 N frames, defined by SFN, SFN+1, ..., SFN+N-1 for the selected PRACH sub-channel with the help of SFN (where N is the repetition period of the selected PRACH sub-channel). Randomly select an uplink 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 select one access slot from the available access slots in the following frame, defined by SFN+1. This search is performed for all frames in increasing order, defined by SFN, SFN+1, ..., SFN+N-1, until an available access slot is found. The random function shall be such that each of the allowed selections is chosen with equal probability.~~

~~3 Randomly select a one channelization spreading code from the available ones set of designated codes for the selected given ASC. The random function shall be such that each of the code allowed selections is chosen with equal probability.~~

~~2 Determine the midamble shift to use, based on the selected channelization code, is derived from the selected spreading code.~~

3 Randomly select a sub-channel from the set of available sub-channels. The random function shall be such that each of the allowed selections is chosen with equal probability.

4 Set the PRACH message transmission power level according to the specification for common physical channels in uplink (see subclause 4.2.2.2).

5 Transmit the RACH Transport Block Set (the random access message) with no timing advance in the selected sub-channel using the selected channelization code.

