

Agenda Item: 6.4
Source: Ericsson
Title: **Contents of RRC Connection Request**
Document for: Decision

1 Introduction

This paper describes the details of what is included in the initial access message sent from a UE connecting to the UTRAN system. It also discusses details related to initial UE identification and required random access payload.

2 Discussion

2.1 Initial UE identity

The first message sent to UTRAN from a UE that is connecting to the system is the RRC Connection request message. When sending this message the UE has no UTRAN identity, no RNTI. The UE has to identify itself in another manner and a possible way is to use a non access stratum identity. Possible NAS identities are TMSI, P-TMSI, IMSI and IMEI. These identities and their lengths in bits are further described in the table below.

Identity	Bits	Note
TMSI	32	Temporary Mobile Subscriber Identity TMSI is usually valid within a Location Area. TMSI and LAI could therefore be assembled to a UE unique identity. TMSI could be stored on the USIM in the UE and be reused. This is also stored in the network and should always be available there, unless e.g. the database holding the information is lost due to malfunction.
IMSI	60	International Mobile Subscriber Identity IMSI is a global identity and should preferably only be used when assigning TMSI. The IMSI is composed by Mobile Country Code (MCC), Mobile Network Code (MNC) and a Mobile Subscriber Identity Number (MSIN). These have the lengths of 3 digits, 2 digits and up to 10 digits respectively.
IMEI	60	International Mobile Equipment Identity There is always a valid IMEI, and this identity could be used if neither TMSI nor IMSI is available. IMSI is only missing if there is no or a not valid USIM. The IMEI has a fixed length of 15 digits.
P-TMSI	32	Packet Temporary Mobile Subscriber Identity P-TMSI is only used in the IP domain and is valid within a Routing Area. This means that P-TMSI and a RAI give a UE unique global identity. P-TMSI could in the same way as TMSI be stored on the USIM. The P-TMSI is composed in the same way as the normal (PSTN/ISDN domain) TMSI and is 4 octets long.
LAI	36	Location Area Identity This is composed of Mobile Country Code (MCC), Mobile Network Code (MNC) and a Location Area Code (LAC). These have the lengths of 3 digits, 2 digits and 2 octets respectively.
RAI	44	Routing Area Identity The RAI is assumed to be composed by LAI and a 1 octet Routing Area Code (RAC). The RAC identifies the Routing Area within the Location Area. <i>[Note: In GSM a Routing Area is part of a Location Area and it is FFS if UMTS uses the same area division.]</i>

Temporary identities i.e. TMSI or P-TMSI should be preferred compared to IMSI or IMEI due to security reasons. Further, IMEI could only be used for emergency calls. Below follows a prioritisation for the use of initial UE identity:

1. TMSI (or P-TMSI). Should always be used if a valid TMSI is stored on the USIM.
2. IMSI. Should be used if no TMSI is available.
3. IMEI. Should be used when TMSI and IMSI are not available.

This means that TMSI or P-TMSI is the normal case initial UE identity.

2.2 Establishment cause

Each RRC connection request message is triggered by some event given from NAS. What triggered the RRC Connection message is stated in the establishment cause IE. Currently in 25.331 [4] the following cause values have been identified:

- Answer to paging. UE should use same identity as in page.
- Originating call. UE should use identity according to prioritisation above, first TMSI (or P-TMSI) and then IMSI. The possibility to use IMEI (i.e. there is no or a not valid USIM) as initial ID is only for emergency call.
- Emergency call. UE should use identity according to prioritisation above, TMSI (or P-TMSI), IMSI and IMEI.
- Location registration request.
- Forward inter-system handover. An RRC connection that is established when a UE performs an inter-system handover.
- Other services, e.g. SMS

RRC is using the different cause values to prioritise between different random accesses. Allowing 16 different cause values will require 4 bits in the random access message.

2.3 Initial UE capability

If extended capability is exchanged in a later stage than during the very first access to UTRAN, this initial UE capability does not have to be extensive. Instead this states e.g. capability to use a dedicated channel or possible rates on common channels. Initial UE capability should only be enough in order to assign a RNTI and setup the RRC connection to the UE.

According to [2] 8-16 bits should be enough to state the full UE capability. Since this is a limited amount of that capability 8 bits should be enough.

2.4 Measurement results

The initial access could optionally include measurement results performed by the UE in idle mode before the random access. These are used to set DL power and to initially have some limited neighbour cell measurements.

In [2] the measurement results are estimated to be in between 25 and 33 bits. Added to these bits are also a measurement identity number of approximately 4 bits. *[Note: If measurement identity is necessary in these results are FFS.]*

2.5 Initial Random Access Message Content

Below is an estimate of the total number of bits that has to be sent in the initial random access message.

Random Access Information	Possible Information Parts	Number of bits	Note
Message type		6	As stated in [2]
Initial UE identity	Identity type	2	Not an IE. Only in coded message.
	TMSI+LAI	68	One of these is used. Note that P-TMSI+RAI is the largest identity.
	IMSI	60	
	IMEI	60	
	P-TMSI+RAI	76	
Establishment cause		4	
Initial UE Capability		8	
Measurement results		29-37	Optional
Additional overhead	RRC	1	Stating optional measurement results
	MAC	1	C/D field

With this content of the initial random access this becomes as a worst case 135 bits or 17 octets.

3 Conclusion

With the current assumptions on the available payload on the random access channel there should be no problem to use NAS identities in the initial random access message. This also means that there is no need for a random number in the random access, and the required contention resolution to solve contention with this random number is unnecessary.

4 Proposal

It is proposed to update section 7.1.1 of 25.303 [3] and sections 8.2.1 and 10.2.3.5 of 25.331 [4] according to the text below.

4.1 CR to 25.303

7.1.1 RRC connection establishment – Case A

RRC connection establishment in common channel termination point case A (see /5/) is shown in Figure 7. The RRC layer in the UE leaves the idle mode and initiates an RRC connection establishment by sending an RRC Connection Request message using the MAC SAP for the CCCH logical channel. MAC transmits the L3 message on the RACH transport channel.

~~[Editor's Note: The L23 EG has adopted a working assumption to use an identity from the Non-Access Stratum (such as TMSI+LAI) included in the RRC Connection Request message. A PRACH physical random access channel capable of transmitting 32 kbps is estimated to be suitable for the message, guidance on the preferability of this data rate is sought from the physical layer EG. Other alternatives exist, such as a random number.]~~

A Non Access Stratum identity such as TMSI + LAI, P-TMSI + RAI, IMSI or IMEI is used as initial UE identity in the RRC Connection Request message.

On the network side, upon the reception of RRC Connection Request, the RRC layer performs admission control, assigns an s-RNTI for the RRC connection and selects radio resource parameters (such as transport channel type, transport format sets etc). If a DCH is to be established, a CPHY--RL-Setup request is sent to all Node B:s which would be involved in the channel establishment. The physical layer operation is started and a confirmation primitive is returned from each Node B. RRC configures parameters on layer 2 to establish the DCCH logical channel locally. The selected parameters including the RNTI, are transmitted to the UE in an RRC Connection Setup message using the MAC SAP for the CCCH logical channel.

Upon reception of the RRC Connection Setup message, the RRC layer in the UE configures the L1 and L2 using these parameters to locally establish the DCCH logical channel. In case of DCH, layer 1 indicates to RRC when it has reached synchronisation. The need for the synchronisation indication on the network side is FFS and depends on e.g. the method of L2 link establishment.

The RLC signalling link can be either implicitly established and used for the transmission of a complete message from L3, or the establishment can be done with explicit signalling triggered by an establish request from L3. The establishment can be mapped on either RACH / FACH, RACH+FAUSCH / FACH or DCH by MAC. The need for explicit establishment is FFS.

4.2 CR to 25.331

8.2.1 RRC Connection Establishment

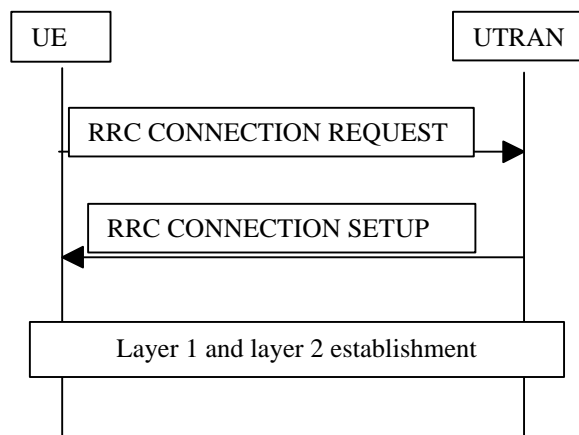


Figure 6) Procedure for RRC connection establishment

This procedure is initiated from the UE side to establish an RRC connection, as a result of either:

- (1) A request from the non-access stratum to establish the first signalling connection for the UE [Note: For a GSM-based Core Network some examples of reasons are: CM Establishment Request and Location Update Request.], or

(2) A received paging request. [Note: Whether the RRC connection is established with or without an explicit request from UE non-access stratum in this case is FFS.]

The RRC connection establishment is initiated by the UE, which leaves the idle mode and sends an RRC CONNECTION REQUEST message using unassured mode on the uplink CCCH. [Note: The initial identification of the UE is FFS.]

As initial identification in the RRC CONNECTION REQUEST the UE uses a unique Non access stratum identity. This NAS identity could be either TMSI + LAI, P-TMSI + RAI, IMSI or IMEI.

The UTRAN makes an assignment of radio resources and the Radio Network Temporary Identity (RNTI) to be used by the UE. The UTRAN sends an RRC CONNECTION SETUP message to the UE using unassured mode on the downlink CCCH. The message includes radio resource parameters and the RNTI.

The UE configures the layer 2 and layer 1 processing for the DCCH using the radio resource parameters. The procedure successfully ends when the layer 2 signalling link is established on the DCCH.

[Note: The necessity of an explicit RRC CONNECTION SETUP COMPLETE MESSAGE from the UE to the UTRAN on layer 3 is FFS. One assumption is, that there is an explicit layer 2 peer-to-peer signalling to establish the signalling link, making an explicit RRC CONNECTION SETUP COMPLETE message on layer 3 unnecessary.]

Note also that on receipt of an RRC CONNECTION REQUEST message, the RNC can allocate a FAUSCH channel for the UE for the particular cell, in which the UE is camping on, or FAUSCH channels for a number of cells of the URA, in which the UE is currently staying depending on the type of UE. The FAUSCH channels allocated are conveyed to the UE in the RRC CONNECTION SETUP message. The following procedure which could be used during RRC connection establishment is for further study:

On receipt of an RRC CONNECTION REQUEST message, the RNC may allocate a dedicated channel to the mobile station. It is also possible to setup macrodiversity at this point. To do so means that the RRC CONNECTION REQUEST message must contain a measurement report. In this case, the RNC executes branch addition (physical channel activation) to each cell (/NodeB) that will be included in the active set. After the physical channel(s) are setup on the UTRAN side, the RRC CONNECTION SETUP message is sent to the UE on the FACH channel.

10.2.3.5 Initial UE identity

This information element identifies the UE at a request of an RRC connection.

Parameters	REFERENCE	TYPE	NOTE
Random UE identity		O	A random number allocated by the UE.
			One of these two options is used. If both or only one if them is permitted is FFS.
IMSI		O	International Mobile Subscriber Identity
TMSI + LAI		O	Temporary Mobile Subscriber Identity and Location Area Identity
P-TMSI + RAI		O	Packet Temporary Mobile Subscriber Identity and Routing Area Identity
IMEI		O	International Mobile Subscriber Identity
			One of these NAS identities formats is used

Editor's note: In case of TMSI, a Location Area Code (LAC) and PLMN id, would be needed as addition, to make the UE identity unique. The addition of Routing Area Code (RAC) and PLMN id, is also proposed for P-TMSI.

5 References

- [1] GSM TS 03.03, "Digital cellular telecommunications system (Phase 2+); Numbering, addressing and identification", v 6.1.0
- [2] 3GPP TSGR2#3(99)235, "Random Access Payload", Source: Nokia
- [3] 3GPP TS 25.303, v 2.0.0 : UE Functions and Interlayer Procedures in Connected Mode
Source: Editor
- [4] 3GPP TS 25.331, v 1.0.0 : RRC Protocol specification
Source: Editor