Agenda Item: 14

Source: Ericsson

Title: **Principles for specification of RRC procedures**

Document for: Discussion

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1   Introduction

Currently, the text in chapter 8, "Elementary Procedures" of TS 25.3331, gives only a high level description of the purpose and behaviour for each procedure. To finalise the RRC specification, the RRC procedures need to be specified in a more stringent way.

This contribution proposes that the RRC procedures shall be specified using states and text, and it gives some guidelines to be followed in the procedure specifications.

2   General

When specifying the RRC procedures, the following shall be taken into account:

- The procedure specification shall be made using text and the verbal forms ("shall", "may" etc) recommended by ETSI. This is believed as the best way to go forward in this stage since the current text anyway needs to be rewritten and everyone commonly understands text. However, care must be taken to limit the amount of text and to simplify readability and maintenance of the text.

- The specification shall focus on the UE requirements. On the UTRAN side, when to initiate a procedure, how to set the different IEs and how to respond in different situations can in many cases be open for the UTRAN node implementations.

- As discussed on the last RAN2 meeting, states shall be used in the RRC protocol specification. A companion contribution [1] contains a proposal of RRC protocol states, for insertion into the chapter 13 "Protocol states" of TS 25.331. The states are based on those in TS 25.303, but the number of substates have been reduced.

- All abnormal cases and allowed combinations of procedures must be covered.

- The timers, variables and constants and usage of them must be specified.

- The behaviour of the UE is in many procedures is controlled by the presence and the values of individual IEs. Therefore the procedure specification text shall specify how the UE shall handle the IEs, using exact naming from the logical description of messages (tabular format).

To further illustrate and facilitate the discussion about how the specification of RRC procedures could be written, companion contributions [2] [3] [4] proposes text for specification of some RRC procedures, using the principles outlined in this contribution.

3   Structure of RRC procedure specifications

Chapter 8, "Elementary Procedures" of TS 25.331, contains descriptions of RRC "elementary procedures". We have not defined the concept of "elementary procedures", but the author's understanding is, that it is the smallest building block on the procedure level.

Whether interactions and combinations of elementary procedures are specified separated from the elementary procedures themselves, or under each elementary procedure, is not clear.

It is proposed that chapter 8, "Elementary Procedures" of TS 25.331, is renamed to "RRC Procedures" and shall specify the UE behaviour each procedure that is triggered by the UE or UTRAN (e.g. by transmitting a given message). Chapter 8 may be structured in basically the same way as before. However, each subchapter shall specify a sequence of events,

that starts and ends with the protocol in a stable state and everything in between shall be contained into that subchapter (references to allow duplication of text is however allowed). Interactions of procedures are shown by specifying the behaviour for all possible received message, when one side has transmitted a message and waiting for a response.

For each RRC procedure, the specification text is written in chronological order and a selection of the following headings should be present. For some procedures, other headings nay be used also, e.g. with descriptive text to improve readability.

3.1   General

This subchapter is mandatory and contains a short (1-2 lines) description of the purpose and scope of the procedure.

A figure illustrating the normal, successful case, message flow, for the procedure like the figure below. If there are several possible "normal, successful cases" all of them are shown.
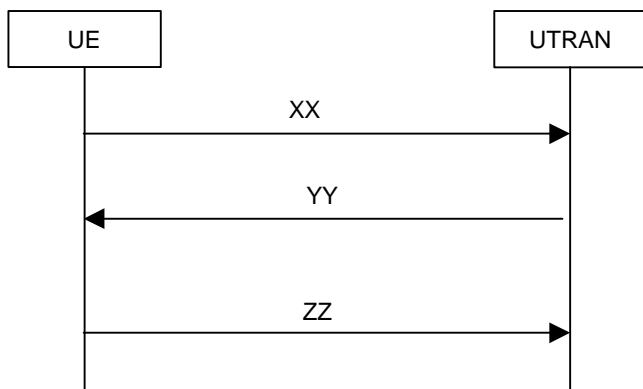

Figure 1. xxx procedure, normal flow

3.2   Initiation

This subchapter is mandatory and here is specified how the procedure is initiated.

If the procedure is initiated by UTRAN, the RRC message sent by UTRAN is specified. If the UE initiates the procedure, exact conditions shall be specified, and the message sent to UTRAN (if applicable).

Timers and counters affected are specified, if applicable.

3.2.1   Message XX contents to set

How the UE or UTRAN sets the IEs in the transmitted message, if any.

3.3   Reception of message XX by the UTRAN

When the UTRAN receives a message, actions are specified here, actions UTRAN may perform, like transmitting RRC messages. Specifically, timers and counters affected are specified.

3.3.1   Message XX contents to use

How the IEs of message XX are used in UTRAN.

3.3.2   Message YY contents to set

How any IEs in any transmitted message are set by the UTRAN.

3.4   Abnormal case: xx

Abnormal cases at this stage, connected to reception of message XX (e.g. timeout when NOT receiving this message).

3.5   Reception of message YY by the UE

When the UE receives message YY, all actions the UE performs, like transmitting RRC messages will be specified here. Specifically, timers and counters affected are specified.

3.5.1 Message YY contents to use

How the IEs of message YY are used by the UE. Specific actions connected to IEs, like timers and transmission of messages.

3.5.2 Message ZZ contents to set

How the UE sets the IEs in the transmitted message, if any.

3.6 Abnormal case: yy

Abnormal cases at this stage, connected to reception of message YY (e.g. timeout when NOT receiving this message).

3.7 Reception of message ZZ by the UTRAN

When the UTRAN receives a message, actions UTRAN performs are specified here.

3.7.1 Message ZZ contents to use

How the IEs of message ZZ are used in UTRAN.

3.8 Abnormal case: zz

Abnormal case at this stage, connected to reception of message ZZ (e.g. timeout when NOT receiving this message).

4 Example of an RRC procedure specification

Below an example of the RRC procedure "RRC connection establishment" is given, using the guidelines in this contribution. The text is an example that is very simplified and shortened compared to the real procedure, to illustrate only the principles. The details must be elaborated when real procedures are specified.

4.1 RRC connection establishment procedure

4.1.1 Purpose

The purpose with this procedure is to establish an RRC connection.
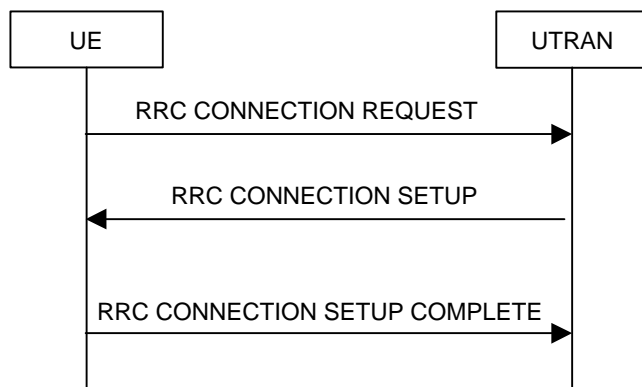

Figure 2. RRC connection establishment procedure, normal flow

4.1.2 Initiation

The non-access stratum in the UE may request establishment of an RRC connection.

When the UE is in idle mode, to establish an RRC connection, the UE shall transmit an RRC CONNECTION REQUEST message on the uplink CCCH, reset counter V300, and start timer T300.

4.1.2.1 Message RRC CONNECTION REQUEST contents to set

The IE "Establishment cause" may be set according to indications from the non-access stratum. The UE shall include an intra-frequency measurement report in the RRC CONNECTION REQUEST message, when instructed to do so in the system information.

4.1.3 Reception of RRC CONNECTION REQUEST by the UTRAN

UTRAN shall start timer T350 and transmit either an RRC CONNECTION SETUP message or an RRC CONNECTION REJECT message on the downlink CCCH.

4.1.3.1 Message RRC CONNECTION SETUP contents to set

The IE "Initial UE identity" shall be set to the same value as in the received message RRC CONNECTION REQUEST

4.1.3.2 Message RRC CONNECTION REJECT contents to set

The IE "Initial UE identity" shall be set to the same value as in the received message RRC CONNECTION REQUEST.

4.1.4 Reception of RRC CONNECTION SETUP by the UE

The UE shall compare the value of the IE "Initial UE identity" with the value of the IE "Initial UE identity" in the last RRC CONNECTION REQUEST message sent by the UE. If a match occurs, the UE shall stop timer T300, transmit an RRC CONNECTION SETUP COMPLETE message on DCCH and enter CELL_FACH or CELL_DCH state.

4.1.4.1 Message RRC CONNECTION SETUP contents to use

The UE shall

- store the values of the IEs "S-RNTI" and "SRNC identity" in that RRC CONNECTION SETUP message, and

- configure the signalling link according to the IEs "Signalling link type" and "RAB multiplexing info", and

- store the TFS for each transport channel included.

4.1.4.2 Message RRC CONNECTION SETUP COMPLETE contents to set

4.1.5 Abnormal case: T300 timeout

Upon expiry of timer T300, the UE shall

- if V300 is smaller or equal than N300, transmit a new RRC CONNECTION REQUEST message on the uplink CCCH, restart timer T300 and increase counter V300. The UE shall set the IEs in the RRC CONNECTION REQUEST message according to subclause 4.1.2.1.

4.1.6 Abnormal case: maximum number of re-attempts exceeded

4.1.7 Reception of RRC CONNECTION REJECT by the UE

4.1.7.1 Message RRC CONNECTION REJECT contents to use

4.1.8 Reception of RRC CONNECTION SETUP COMPLETE by the UTRAN

When UTRAN has received the RRC CONNECTION SETUP COMPLETE message, the procedure ends and timer T350 shall be stopped.

4.1.9 Abnormal case: T350 timeout

Upon expiry of timer T350, the procedure ends and all context information for this UE may be deleted in UTRAN.

5 Proposal

It is proposed that the principles outlined in this contribution shall be followed when the RRC procedures are specified. It is also proposed to change the structure of chapter 8 of TS 25.331 according to the following.

6 References

[1] TSGR2#6(99)807, RRC protocol states, source: Ericsson

[2] TSGR2#6(99)813, Specification of RRC procedure: RRC connection establishment, source: Ericsson

[3] TSGR2#6(99)814, Specification of RRC procedure: Cell update, source: Ericsson

[4] TSGR2#6(99)815, Specification of RRC procedure:, RNTI reallocation, source: Ericsson