TSG-RAN Working Group 2 (Radio layer 2 and Radio layer 3) ***TSGR2#2(99)132***
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Agenda Item: 7.2.3

Source: SONY International (Europe)

Title: Need for Segmentation / Reassembly when using the RACH Transport Channel

Document for: Decision

Introduction

Currently the possible use of segmentation upon the RACH is under consideration. This document supports the inclusion of segmentation upon the RACH. However, capacity on the RACH transport channel is limited. E.g. with a 32kpbs RACH, one RACH burst can carry only 10 octets of payload if convolutional coding with a rate R=1/3 is applied as preferred by TSG-RAN WG 1 Tdoc SMG2 UMTS-L23 013/99, Liaison statement to Layer 2/3, Source: SMG2 UMTS-L1. This should be considered in order to:

- reduce the requirements on accuracy of RACH payload size requirement analysis.
- have a future-proof solution for UMTS / UTRAN allowing forthcoming extensions of messages sent on the RACH

Consequently, a reassembly functionality is needed at the receiving side of the RACH, i.e. at the UTRAN.

Estimation of provided payload (L2, L3, NAS) capacity of RACH

The following table shows how many octets of payload can be conveyed by a single RACH burst for RACH channels of the different bit rate. A rate of R=1/3 for the convolutional coding, 8 tail bits and 16 bits for CRC are presumed for the calculation.

Rate [kbps]	payload size [octets]
16	3
32	10
64	23
128	50

This shows that the capacity in terms of payload which is available for L2/3 and NAS is quite limited unless we assume that each cell will use rather the high rate RACHs with

64kbps or 128kpbs. If we foresee that the size of L2/3 or NAS messages to be transferred on RACHs lower than 64kpbs can be larger than 10 octets, then segmentation is needed.

DCCH mapped to RACH

There are several factors speaking for the inclusion of segmentation:

Overhead for allocating and releasing the DCH

When a message to be sent on the DCCH does not fit into a single RACH burst and segmentation is not supported, then the transport channel has to be switched to a DCH. The associated overhead is (cf. 3GPP S2.03, UE Functions and Interlayer Procedures in Connected Mode, V0.0.1):

- modifications of L1 (establishment of DCH)
- signalling of PHYSICAL CHANNEL RECONFIGURATION (COMPLETE)
- reconfiguration of MAC and RLC.

Similarly, after transmission of the message on the DCCH:DCH the channel type switching back to the RACH/FACH loop will often be performed, resulting in the overhead:

- modification of L1 (release of DCH)
- signalling of PHYSICAL CHANNEL RECONFIGURATION (COMPLETE)
- reconfiguration of MAC and RLC.

Examples of RRC messages sent on DCCH:RACH

The following messages are examples of RRC messages which are sent on the DCCH using the transport channel RACH (under certain conditions). Such messages may not exceed the limits given by a single RACH burst unless segmentation is supported.

- MEASUREMENT REPORT
- RADIO ACCESS BEARER RELEASE COMPLETE
- RADIO ACCESS BEARER (AND SIGNALLING LINK) RECONFIGURATION COMPLETE

At least for the MEASUREMENT REPORT it is likely that RACH burst limits are exceeded.

NAS signalling

When a signalling connection is to be established, one option is to establish the required RRC connection without allocating a DCH. This is advisable when it is known from the initial access that the purpose of the RRC connection is to support a signalling connection which requires only the RACH/FACH loop but not a dedicated transport channel, e.g. because the expected signalling is very infrequent, of low volume and not time critical. Again, if the NAS messages are occasionally larger than a RACH burst, then either a DCH needs to be allocated permanently or channel type switching must be performed.

Segmentation already accepted for DCCH:DCH

Segmentation of signalling messages in the situation when the DCCH is mapped to DCH is already supported. Therefore, it is logical to support segmentation also when the DCCH is mapped to RACH, because otherwise requirements on the maximum size of higher layer messages (e.g. NAS) would depend on the type of transport channel used and the higher layer would need to have knowledge of the current transport channel type.

DTCH mapped to RACH

When a DTCH is mapped to RACH, then similar arguments like in the DCCH:RACH mapping case are valid:

- overhead for channel type switching which is required when user plane data does not fit into a single RACH burst anymore
- segmentation is already accepted for DTCH:DCH 3GPP S2.22, Description of the RLC protocol, V0.0.1 and support of segmentation would put less restrictions onto higher user plane layers.

CCCH mapped to RACH

Hard constraint on CCCH message size

The CCCH is always mapped in the uplink direction to the RACH, never to the DCH. Without segmentation on the RACH, this fact would lead to the very strict rule that no message which shall be transmitted on the CCCH may be larger than the payload capacity of a RACH burst. Each CCCH message would have to be designed carefully with respect to this limitation and restrict future expansion.

Examples of RRC messages sent on CCCH:RACH

At least the following two areas fall into the category for messages sent on CCCH:RACH:

- RRC Connection Establishment / Initial Access
  - RRC CONNECTION REQUEST
  - RRC CONNECTION RE-ESTABLISHMENT REQUEST
- RRC connection mobility
  - CELL UPDATE
  - URA UPDATE.

Proposed Changes to Permanent Documents

Changes to S2.22 3GPP S2.22, Description of the RLC protocol, V0.0.1

The tables 6-1 to 6-4 shall indicate that the functions Segmentation / Reassembly are used for the CCCH in the applicable mode. [Note that it is not finally decided whether transparent and/or unacknowledged data transfer service of RLC is applied for the CCCH.]

Conclusion

This proposal has outlined the need for segmentation and consequently reassembly on the RACH. Disallowing segmentation on the RACH is considered to be too restrictive and not future-proof. A situation like in GSM, where e.g. Supplementary Services could not be introduced in the way wished because the maximum size of a L3 messages was limited to 251 octets should be avoided.

It is proposed that segmentation on the RACH is taken as the working assumption and the changes outlined above are made.

References

[1] Tdoc SMG2 UMTS-L23 477/98, PRACH Structure and Uplink Access Procedures in UTRA FDD – Current Status of the Discussion and Identified Items for Further Study, Revision 2, Source: SMG2 UTMS-L1

[2] Tdoc SMG2 UMTS-L23 582/98, Liaison Statement to the L1 Expert Group, Source: SMG2 UMTS-L23

[3] Tdoc SMG2 UMTS-L23 013/99, Liaison statement to Layer 2/3, Source: SMG2 UMTS-L1

[4] Tdoc SMG2 UMTS-L23 056/99, Liaison statement to SMG2 UMTS L1 Expert Group, Source: SMG2 UMTS-L1

[5] 3GPP S2.03, UE Functions and Interlayer Procedures in Connected Mode, V0.0.1

[6] 3GPP S2.22, Description of the RLC protocol, V0.0.1

[7] 3GPP S2.31, RRC protocol specification, V0.0.1

[8] Tdoc SMG2 UMTS-L23 541/98, Initial UE identification and contention resolution, Source: Ericsson