

Agenda item: 5.2.2
Source: Qualcomm Europe
Title: RACH procedure
Document for: Discussion and Decision

1. Introduction

In this contribution we consider major remaining open issues for random access procedure for initial access [1].

2. RACH procedure

In Figure 1, we show a call flow that reflects current agreements in RAN 2 from [1].

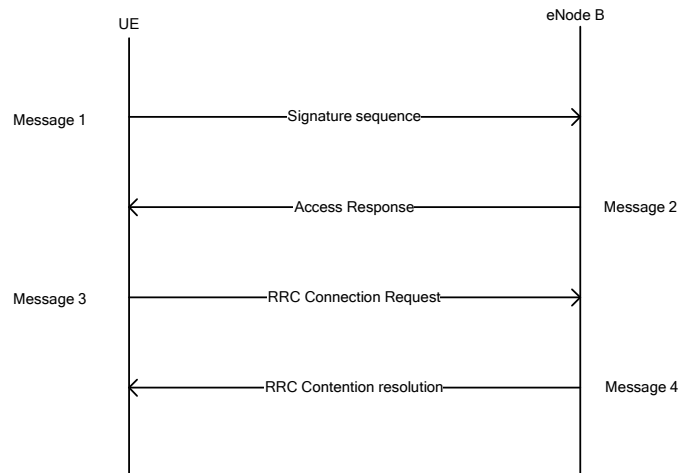


Figure 1: Basic procedure for initial access

2.1. Message 1

Message 1 or the access signature sequence conveys 6 bits of information, such as:

- Random ID and
- Possibly access cause and radio environment and buffer size related information.

2.2. Message 2

Message 2 or the access response is possibly a multicast message addressed to one or more UEs accessing the system over a single RACH. The message is sent in a similar fashion as all other DL-SCH messages, where RA-RNTI is used in the L1/L2 control channel and DL-SCH contains the message part.

Given that Message 2 is potentially a multicast message, including 1 bit CQI as part of Message 1 does not seem very efficient because the message would have to be power controlled for the worst user.

HARQ is not utilized and Message 2 must be transmitted within a predefined window of one or multiple TTIs. The transmission window for Message 2 need to be either fixed as defined by the standard or broadcast over BCH.

The purpose of Message 2 is to at least:

- Grant UL-SCH resources to the UE
- Conveys timing adjustment in order to prevent un-synchronized transmission over UL-SCH.

Given the fact that the size of Message 2 is flexible, there is enough space to convey more information than just UL-SCH assignment and timing adjustment. Message 2 could also contain other information such as:

- Power adjustments for Message 3
- Assignment of CQICH
- Assignment of C-RNTI

Power adjustment for Message 3 is important in order to control successful reception of Message 3. RAN 1 has agreed to employ open loop power control for the access signature sequence. These estimates are typically not very accurate and relying purely on the successful reception of the signature sequence would result into poor power control of Message 3.

Assignment of CQICH and C-RNTI are important for efficient support of link adaptation and HARQ for Message 4. Without CQICH, success rate of the initial transmission could be low or power inefficient. Without HARQ, transmission of Message 4 would not be as robust.

An argument for not including C-RNTI is that the contention is not yet resolved. However, this does not appear a real issue. Even though in case of collisions UEs that collide are assigned the same C-RNTI, only UEs that successfully resolve contention keep the assigned C-RNTI. UEs that need to access the system again obtain new C-RNTI when they repeat the access procedure.

Another argument for not including C-RNTI is that UE may have already C-RNTI assigned. In this case, one option is that signature sequence includes an access case indicating that UE has C-RNTI assigned, which would be the case of UEs accessing the system in the sleep mode of LTE_ACTIVE. Alternative is the eNode B assigns new C-RNTI and UE conveys old C-RNTI to eNode B as part of Message 3.

As shown in Figure 2, UE repeats access procedure if after transmitting Message 1, corresponding timer expires before receiving Message 2.

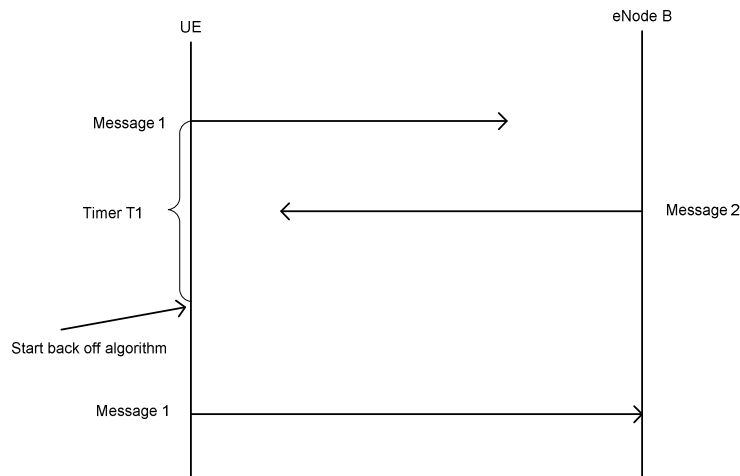


Figure 2: Basic procedure for initial access – Message 2 not received by UE

2.3. Message 3

RAN 2 agreed that Message 3 is dynamic in size and it supports HARQ. The size is dynamic due to short TTI and very low message size supported by UEs at cell edge. In order not to restrict the message size based on worst case scenario, RAN 2 agreed to have the message size dynamic.

In order to support appropriate selection of the resource block size and modulation and coding of Message 3, it is helpful that signature sequence conveys information about UE's power headroom and buffer information (possibly merged into a single bit).

2.4. Message 4

Message 4 serves as RRC contention resolution message. In our view, as shown in Figure 3, UE attempts access again if it does not receive contention resolution message before the timer triggered after transmitting Message 3 expires. Applying HARQ to Message 4 makes access procedure more robust.

In our view it is reasonable to allow merging RRC contention resolution message RRC connection set up message. In this case, however, it is necessary to design RACH for low residual collision probability after Message 2.

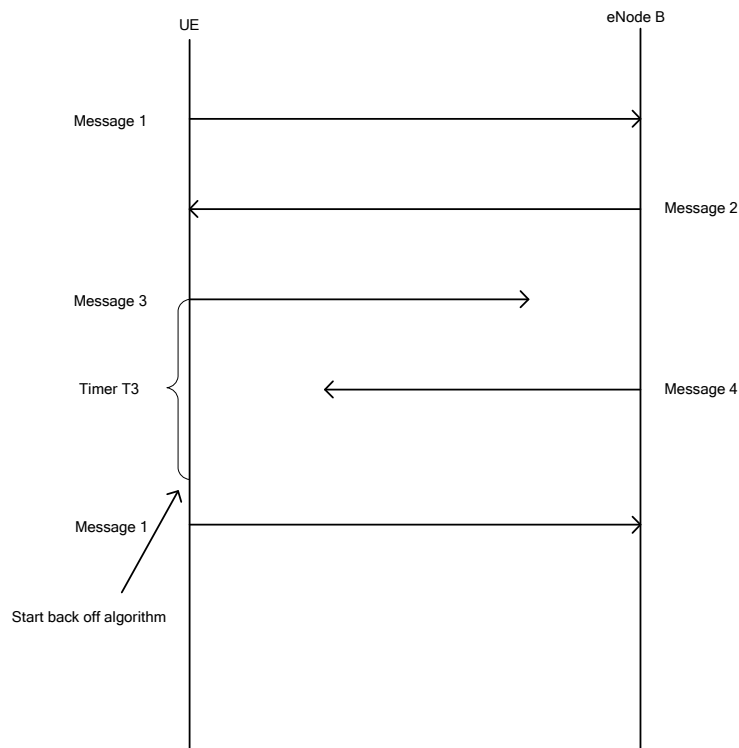


Figure 3: Basic procedure for initial access – Message 4 not received by UE

3. Conclusion

We conclude that:

- C-RNTI should be allocated in Message 2 to allow HARQ for Message 4
- Power headroom and potentially buffer info should be included into access signature sequence in order to facilitate appropriate selection of bandwidth resources and modulation and coding for Message 3

References

- [1] 3GPP TSG 36.300 E-UTRAN Stage 2 v031, November 2006.