

3GPP TSG-RAN WG2 #61bis
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 Shenzhen, China

R2-081559

Agenda item: 5.1.1.6
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Title: RA_WINDOW and RA-RNTI allocation
Document for: Discussion, Decision

1. Introduction

The random access response is not synchronized with the transmission of the random access preamble. The UE monitors for the random access response during a window [RA_WINDOW_BEGIN—RA_WINDOW_END] as defined in [1]. RA_WINDOW_BEGIN and RA_WINDOW_END need a definition.

As had been discussed, a unique RA-RNTI must be associated with each PRACH occasion. In addition the PDCCH indicating RA response is addressed to the RA-RNTI matching the PRACH occasion.

This paper proposes to progress the definition of begin and end of the window as well as discuss a method to assign RA-RNTI.

2. Discussion

2.1. *Random Access Occasion*

The MAC must be aware of when the PRACH is transmitted because the start and end of the response window are computed relative to that time. The MAC specification states “determine the next available Random Access occasion”.

Proposal 1: we propose to clarify 5.1.3 as follows:

“determine the next available Random Access occasion according to the PRACH configuration”

PRACH configuration is defined in section 5.7.1 of 36.211 .

2.2. *RA_WINDOW_BEGIN definition*

The value of RA_WINDOW_BEGIN may be fixed by the standard or configured. Offline discussions related to processing timeline have mentioned that 3ms is a reasonable minimum amount of time to process the PRACH. In the Reply LS [2] RAN 1 indicates that RA_WINDOW may start from 2 to 4 ms after PRACH transmission. We propose to discuss the above and agree on a fixed value (2, 3 or 4).

In order to cover the 3 possible PRACH transmission durations (1, 2 or 3 ms), RA_WINDOW_BEGIN is set relative to the end of the PRACH transmission

Figure 1 and Figure 2 illustrate how RA_WINDOW_BEGIN is set for FDD and TDD respectively assuming 3 subframes.

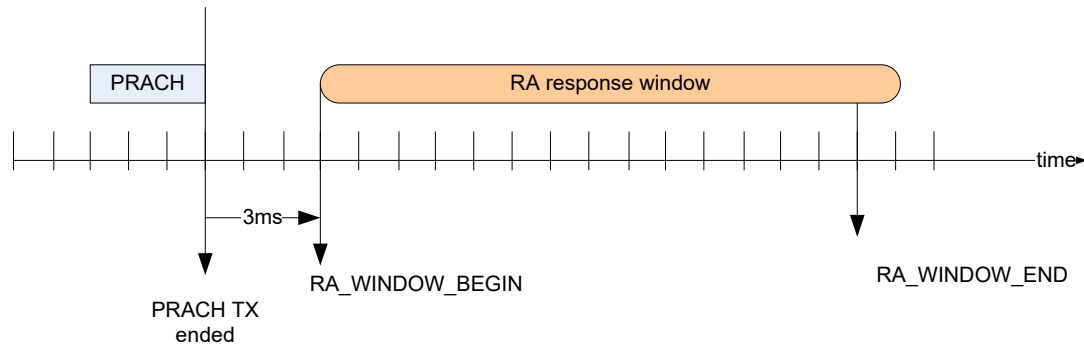


Figure 1 RA_WINDOW_BEGIN starting at least 3ms after PRACH transmission for FDD

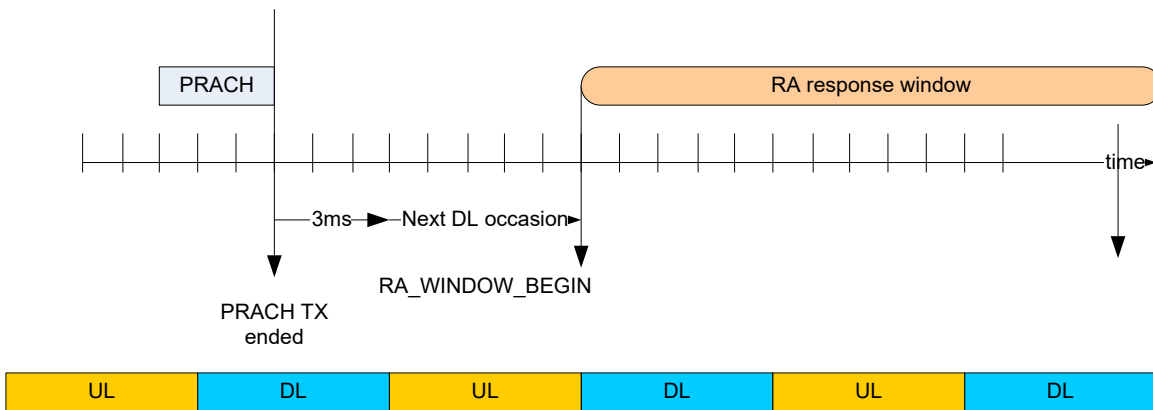


Figure 2 RA_WINDOW_BEGIN starting at least 3ms after PRACH transmission for TDD

If PRACH ends in subframe N, RA_WINDOW_BEGIN is the first DL subframe with subframe number equal to or larger than (N+3, N+4 or N+5).

Proposal 2: set RA_WINDOW_BEGIN as proposed above

Proposal 2bis: select one of (N+3, N+4, N+5) above

2.3. RA_WINDOW_END definition

The need to configure RA_WINDOW_END stems from the various operating conditions that can exist. When possible it is beneficial to reduce the response window size in order to allow for quick power ramping when RA response is missed. On the other hand, in larger cells RACH processing requires more time and the window must therefore be extended. Therefore we propose to have means to signal RA_WINDOW_END in the system information

Proposal 3: RA_WINDOW_END is computed using an IE in the system information (i.e. not hard-coded)

We propose to set RA_WINDOW_END relative to RA_WINDOW_BEGIN as follows

RA_WINDOW_END is set to the subframe occurring RA_WINDOW_WIDTH DL subframes after RA_WINDOW_BEGIN.

Proposal 4: RA_WINDOW_END is set as above

It is probably desirable to have millisecond granularity for RA_WINDOW_WIDTH since PRACH may be present every millisecond. The maximal duration of the response window should be discussed while taking into account the requirements on unique RA-RNTI within a window described in section 2.4.

2.4. RA-RNTI associated with PRACH occasion

RA-RNTI must allow to uniquely identify a PRACH occasion in time and frequency within a response window. In time, depending on PRACH configuration PRACH may be present every 1, 2, 3, 5, 10 or 20ms. In frequency: for FDD there is only one PRACH in each subframe. For TDD there may be more than 1.

RAN1 seems to not have decided on the maximal number of PRACH in a subframe for TDD, it should be related to the maximum asymmetry level which is 9:1. However, 9 PRACHs in one subframe would practically block the only UL subframe for PRACH use. We propose to have at most 4 PRACH in a subframe [4].

In [2] CATT provided a good summary of the RA-RNTI allocation problem and proposed a scheme to allocate RA-RNTI to each PRACH occasion within a RA response window. As a minor comment, SFN was used to refer to the subframe, instead of the usual radio frame, which may be confusing and the base RA_RNTI is 0x0000 and already captured in [1], therefore it is not required in RA_RNTI computation. We propose for a PRACH resource, the associated RA-RNTI is given by:

$$\text{RA-RNTI}(\text{SUFN}, i) = (\text{NUMBER_PRACH_IN_SUBFRAME}) * \text{SUFN} + i$$

Where :

- NUMBER_PRACH_IN_SUBFRAME is the maximal number of PRACHs in a subframe (we propose 4 For TDD). We can discuss if the value of NUMBER_PRACH_IN_SUBFRAME in the RA-RNTI assignment formula should be read from PRACH parameters in system information or hard-coded to its maximal value.
- SUFN is the number of the subframe where the PRACH is used ($0 \leq \text{SUFN} < 10$),
- i is the index of the specified PRACH resource within the subframe, in increasing order of frequency domain ($0 \leq i < 5$)

Proposal 5: set RA-RNTI (SUFN, i) as above

Proposal 6: discuss and agree on a value of maximum number of PRACH in a (TDD) subframe

3. Conclusion

We propose to agree on the definitions of RA_WINDOW_BEGIN, RA_WINDOW_END and a RA-RNTI allocation scheme inspired by the CATT document [3].

4. References

- [1] 36.321 MAC
- [2] R2-081420 Reply LS to R2-080621 on RACH retransmission delay requirements (R1-081160)
- [3] R2-080718 RA-RNTI design, CATT, RAN2#61 Sorrento
- [4] R2-081821 Number of PRACH per subframe – Qualcomm Europe