**3GPP TSG-RAN Meeting #88e RP-200623**

**E-meeting, 29th June – 3rd July, 2020**

**Agenda Item:**  **<9.3.4>**

**Source: <ZTE Corporation>**

**Title:** **Summary for WI** **NR 2-step RACH**

**WI code(s): NR\_2step\_RACH-Core**

**Leading WG: RAN WG1**

**Release: Rel-16**

# 1 Introduction

The Rel-16 Work Item 2-step RACH for NR achieves the following objectives:

* A simplified random access procedure was developed. This reduces the number of interactions between the UE and network during the connection setup and connection resume, thereby enabling a lower control plane latency for IDLE and INACTIVE UEs. In case of connected mode, a small amount of data can be sent over the 2-step RACH channel thus enabling a lower latency for UL UP data for connected mode UEs.
* Channel structure of transmitting PRACH and PUSCH in one step (i.e. without an intermediate message from the network) was developed
* The above enhancements are applicable to both licensed spectrum and the shared spectrum (i.e. NR-U).

# 2 Description

The general procedure of 4-step RACH and 2-step RACH are depicted in Figure 1. The first step of 2-step RACH comprises an UL MSGA transmission which includes the equivalent contents of msg1 and msg3 of 4-step RACH. The second step of 2-step RACH is a DL MSGB transmission which includes the equivalent content of msg2 and msg4 of 4-step RACH.

 

(a) 4-step RACH (b) 2-step RACH

Figure 1 General procedure of 4-step RACH and 2-step RACH

# RA type selection

All the triggers for Rel-15 NR 4-step RACH are also applicable to 2-step RACH. However, contention free random access (CFRA) procedure with 2-step RACH is only supported for handover.

The UE selects the type of random access at initiation of the random access procedure based on network configuration:

* when CFRA resources are not configured, an RSRP threshold is used by the UE to select between 2-step RA type and 4-step RA type;
* when CFRA resources for 4-step RA type are configured, UE performs random access with 4-step RA type;
* when CFRA resources for 2-step RA type are configured, UE performs random access with 2-step RA type.

# MSGA structure: PRACH

The MSGA in 2-step RACH comprise a PRACH and a PUSCH. The PRACH resources for 2-step RACH in time/frequency domain can be either shared with 4-step RACH or can be configured to be separate. All the preamble formats and the PRACH configuration indexes defined in Rel-15 can be used. In case of shared time domain PRACH resources between 4-step RACH and 2-step RACH, different preambles are allocated to differentiate the RA types. The mapping between SSB and PRACH occasion reuses that for 4-step RACH.

# MSGA structure: PUSCH

2-step RACH uses a specified mapping rule to determine the PUSCH resource of MSGA that is associated with the selected PRACH resource. Each PRACH slot is mapped to a number of PUSCH occasions, once the UE selects a preamble in a PRACH occasion, the corresponding PUSCH occasion and DMRS resource can be determined by a predefined mapping order.

# MSGB

After MSGA transmission, the UE monitors the downlink for a response from the network within a configured window. This response from the network is called the MSGB. The contents of MSGB depend on whether or not the gNB is able to successfully detect both the PRACH and the PUSCH parts.

* If the PRACH is detected but the decoding of PUSCH fails, network will include a fallback indication in MSGB and the subsequent UE procedure will be similar to the 4 step RACH.
* If both preamble and PUSCH are decoded, network will include a successRAR and this completes the contention resolution. HARQ feedback is enabled for the successful reception of the successRAR.

# 3 References

1. RP-200085, Revised WID on 2 step RACH for NR
2. RP-200488, Status report for WI - NR 2-step RACH