3GPP TSG RAN WG1 email discussion [5G-ACIA]

October 12 – 16, 2020

**Source: Qualcomm CDMA Technologies**

**Title: Features and simulation assumption for 5G ACIA URLLC LS response**

**Document for: Discussion and Decision**

# Introduction

As a response to the following schedule set by the moderator (Ericsson) in the RAN1\_NR reflector, we list in Section 2 two features to be considered for factory automation under the framework required by ACIA and in Section 3 propose several simulation parameters which have not been finalized yet:

1. 12-16 October 2020
   * Discussion on which URLLC features to include in the evaluations and simulation assumptions
2. 14-18 December 2020
   * First round of simulation results
3. 22-26 February 2021
   * Second round of simulation results
4. 8-12 March 2021
   * Finalization of the report to RAN#91

# URLLC Features

The following URLLC features were introduced in Release 16 as stated in the “5G-ACIA WI042 Technical Report on Performance Evaluation of 3GPP eURLLC features for Industrial Automation”:

* flexibly configured downlink control information message for trading off between functionality and message size making it reasonably compact, and thus more reliable scheduling commands;
* increased downlink control channel monitoring capability to minimize scheduling blocking and delay;
* multiple physical uplink control channel (PUCCH) transmissions with potential different formats per slot carrying HARQ-ACK for enabling more often and more reliable HARQ feedback for faster triggering of retransmissions;
* intra-UE prioritization between control information and data when different services co-exist in one device;
* sub-slot back-to-back repetitions in UL with cross-slot-boundary scheduling support;
* dynamic change of repetition factor for slot- and non-slot-based repetitions;
* inter UE prioritization/multiplexing mechanisms in UL allowing the gNB either to interrupt data transmission from one user to accommodate higher-priority data from another user or power boost higher-priority data transmission to overcome interference from ongoing transmission;
* supporting multiple active pre-scheduling configurations in UL and DL to accommodate different service flows and to reduce the alignment time for URLLC UL transmissions;
* shorter pre-scheduling periodicities in DL down to one slot;
* multi panel scheduling techniques in downlink were introduced to improve reliability by transmission of data from different points (base stations).

We would like to highlight the last two features as they have high potential to enhance performance of Factory automation:

* Setting 1ms periodicity for configured scheduling (CS) of DL IIoT traffic is an effective method to reduce control overhead given that most of IIoT data traffic is deterministic and periodic.
* Using Multi-TRP as an optional feature to be considered, which has been shown useful if blocking is modeled

# Simulation Assumptions

#### **Service area deployment within a factory hall**

ACIA proposed to consider a factory hall of 120m x 50m x 10m, which is then fully covered by 12 service areas of 50m x 10m as shown in Figure 1. We propose to simulate one to two gNBs per service area to keep the simulation complexity low.



**Figure 1. Service areas deployment in factory hall**

#### **Channel model**

ACIA proposed to correlate the denseness of clutters with the UE density in order to reduce simulation complexity. Given that the maximum number of UEs to be simulated is 50 UEs per service area, we propose to simulate InF-SH and InF-SL if the number of UEs is less than 25 per service area and simulate InF-DH and InF-DL if the number of UEs is more than 25 per service area.

#### **UE moving speed**

Given the difficulty in simulating linear motion due to handling handover across different cells, we propose to simulate only rotational motion where the UE moving speed is to be agreed upon.

#### **DL and UL traffic arrival time**

ACIA have identified the following three options for DL traffic arrival time assumption, where our preference is highlighted:

* Option-1: All UEs’ DL messages arriving at NG-RAN node in the first transfer interval are uniformly randomly distributed within the TI time window.
* Option-2: All UEs’ DL messages arriving at NG-RAN node in the first transfer interval are in one burst.
* Option-3: All UEs in one service area are divided into several groups. DL messages of UEs in the same group will arrive at NG-RAN node in one burst with the following assumptions.
* Number of groups within a service area: 2.
* Number of UEs in a group: all groups have equal number of UEs.
* 3GPP can determine to use either a pre-defined value or a random value for the burst arrival time differences between different groups.

From a traffic burstiness point of view, option 1 yields the lowest burst traffic while option 2 yields maximum burst traffic. The radio resource scheduling algorithm needs to deal with burst traffic properly to meet service performance requirements, e.g. latency. For the DL-UL traffic arrival time relationship, two options can be considered.

* Option 1: DL and UL traffic arrival times are independent.
* Option 2: UL traffic arrives at some pre-defined time *x*, where *x* can be, e.g., half of the transfer interval, after the respective DL traffic arrival time.

More precisely, we propose to assume all DL messages to be transmitted in a slot are available at the same time and the UL message corresponding to a DL message is available after a fixed number of symbols, say 4 or 5 symbols, from the time when the DL message is transmitted. The whole DL-UL cycle should be completed in 1 ms.

# Conclusion

Our proposed URLLC features and simulation assumption have been highlighted. One missing aspect which was included in the Indoor Factory calibration document R1-1909337 is the spatial consistency for LOS state. We propose not to include spatial consistency for LOS state to keep the simulation complexity low. If spatial consistency is to be considered, then the simulation methodology must be uniform across companies to ensure fair comparison.