3GPP TSG RAN WG1 email discussion[5G-ACIA] R1-20xxxxx

e-Meeting, October 12th –16th, 2020

Source: vivo

Title: 5G-ACIA URLLC features and simulation assumptions

Agenda Item:

Document for: Discussion and Decision

1. Introduction

In the RAN #89e meeting, the following was agreed for 5G-ACIA URLLC features performance evaluation [1][2]:

* Start an offline email-based activity to provide evaluation results for 5G-ACIA
* One company volunteers as moderator
  + Proposes a work plan to follow
  + Ericsson is willing do this
* Discussions are on the RAN1\_NR reflector
  + Email activity only during short periods (< week) distributed across the time allocated to the activity
  + No email activity in weeks before/during/after RAN1 meetings or RAN defined inactive periods
  + All companies should strive to limit email activity as much as possible
  + Outcome of the offline discussion will directly go to RAN without need for discussion in RAN1 nor need for LS from RAN1 to RAN
* Target completion by RAN#91
* At RAN#91, RAN will decide on a response LS to 5G-ACIA

In addition, the following work plan was made during email discussion:

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

In this contribution, we provide our views on simulation assumptions and preferred URLLC features to be included in the evaluations.

1. Use case, simulation assumptions and performance metric

In the LS from 5G-ACIA, the following motion control case is selected with high priority.

**Table 1. Service performance requirements for motion control**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Characteristic parameter** | | | | | **Influence quantity** | | | | |
| **Commu-nication service availabil-ity: target value** | **Communi-cation ser-vice relia-bility: mean time between failures** | **End-to-end latency: maximum** | **Service bit rate: user ex-peri-enced data rate** | **Mes-sage size [byte]** | **Transfer interval: target value** | **Survival time** | **UE speed** | **# of UEs** | **Service area** |
| 99,9999 % to 99,999999 % | ~ 10 years | < transfer in-terval value | – | 40 | 1 ms | 1 ms | ≤ 75 km/h | ≤ 50 | 50 m x 10 m x 10 m |

Taking into account the simulation assumptions in section A.2.2 in TR 38.824 and the LS from 5G-ACIA, our preferred the simulation assumptions for motion control use case 2 are summarized in Table 2 below.

**Table 2. System level simulation assumptions**

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| Factory hall size | 120x50m |
| Room height | 10m |
| BS/TRP antenna height | 1.5 m for InF-SL and InF-DL  8m for InF-SH and InF-DH |
| Inter-BS/TRP distance | 20m |
| Layout – BS/TRP deployment |  |
| Channel model | First priority: InF-DH, InF-DL  Second priority:InF-SH, InF-SL |
| Carrier frequency and simulation bandwidth | FR1: 4 GHz: 100 MHz  FR2: 30 GHz: 160 MHz |
| TDD DL-UL configuration | Option1: TDD, {S}, S={D6, G2, U6}  Option2: TDD, as per RAN4 agreements R4-1809555, {SU}, where S={D10, G2, U2} with SCS 30kHz is used for FR1; For FR2, {DSUU}, where S={D10,G2,U2} with SCS 120kHz is used  Option3: FDD |
| Number of UEs per service area | Up to 50, e,g., 10, 20, 40, 50 |
| UE distribution | All UEs randomly distributed within the respective service area |
| Message size | 48 bytes |
| E2E latency | 1ms, equal to transfer interval value |
| DL traffic model | Option-1 is preferred |
| UL traffic model | UL traffic is symmetric with DL, and the arrival time of DL and UL traffic are independent (Option-1) |
| CSA requirements | 99.9999% |
| Mobility | UE speed is 75km/h,  Only fast fading is modeled, no explicit mobility and handovers are modeled. |
| Other parameters | Reference section A.2.2 in TR 38.824 |

It should be noted that the assumption of TDD DL-UL configuration should be further discussed through email. In our understanding, the assumption on TDD DL-UL configuration will significantly affect URLLC transmission schemes that can be adopted to achieve the performance targets, i.e. by HARQ-based retransmission or repetition-based transmission or one-shot transmission. Take FR1 30KHz SCS as an example, HARQ-based retransmission cannot be performed within 1ms due to TDD DL-UL configuration, PDCCH/PDSCH alignment delay, PDCCH/PDSCH preparation time and etc. Therefore, only repetition or one-shot transmission can be considered. While there is no such issue for FR2 120KHz.

***Proposal 1:***

* ***Support the system level simulation assumptions in Table 2 for 5G-ACIA URLLC evaluation.***
* ***Further discuss TDD DL-UL configuration assumption and the corresponding transmission schemes to achieve the performance targets through email, with taking URLLC features into account.***

In addition, the following four performance metrics are provided:

**Table 3. Evaluation metrics**

|  |  |  |
| --- | --- | --- |
| **Parameters** | **Value** | **Reasons** |
| CSA requirement | 99.9999% |  |
| Performance metric | 1) CSA: single CDF of CSA distribution of all UEs in factory hall |  |
| 2) Latency: single CDF of latency distribution of all UEs in factory hall |  |
| 3) Percentage of UEs satisfying requirements and  4) resource utilization | Metric 3) and 4) are of low priority |

The parameter description of “*Communication service availability*” is provided in TS 22.104:

|  |
| --- |
| *Communication service availability*  *This parameter indicates if the communication system works as contracted ("available"/"unavailable" state). The communication system is in the "available" state as long as the availability criteria for transmitted packets are met. The service is unavailable if the packets received at the target are impaired and/or untimely (e.g. update time > stipulated maximum). If the survival time (see Table C.2.3-1) is larger than zero, consecutive impairments and/or delays are ignored until the respective time has expired.* |

The further explanation is provided in the 5G-ACIA LS:

|  |
| --- |
| *When a message carried by the respective TB has not been correctly received at the end of latency time window, survival time window starts and lasts for time duration of 𝑇S. At the end of survival time window, if a new message was correctly received, communication service is still deemed available (namely UP in the figure), and unavailable otherwise (namely DOWN in the figure). In the example illustrated in Figure 5.1-2, where the survival time window includes only one new message/TB transmission, in case of failed reception of two consecutive messages/TBs, the system shall be considered as unavailable for the duration equal to two TIs minus 𝑇S (just an example). It is noted that if only one isolated message/TB is missed or incorrectly received, the communication service is still considered as available. In this case, the CSA can be derived from the probability of occurrence of two or more consecutive message/TB reception errors.* |

From these descriptions, it can be observed that the CSA performance requirement can eliminate the *two or more consecutive message/TB reception errors* but not the *isolated message/TB reception error*. In some extreme case, for some UEs, if 50% message/TB are not correctly received with the isolated mode, the CSA metric is 100% but the message/TB reliability is only 50%, the motion control service for this UE maybe poor or invalid. From this observation, we proposed to discuss whether to increase the reliability as a performance metric or to further clarify the reliability requirement for the motion control use case.

***Proposal 2 : Further discuss the necessity of increasing reliability performance as an evaluation metric.***

1. URLLC features

For which URLLC features shall be taken into account for 5G-ACIA URLLC evaluation, in our point of view, the following Rel-16 URLLC features listed in Table 4 and UE capability #2 in Rel-15 should be included.

**Table 4. URLLC features to be evaluated**

|  |  |  |
| --- | --- | --- |
| **Rel-16 URLLC enhancement** | **Comment** | **Included** |
| CG PUSCH with one or multiple configuration(s) with one slot periodicity | CG PUSCHs with multiple configurations are beneficial to reduce the alignment delay for UL data transmission if the jitter and/or periodicity misalignment for the assumed traffic and CG is assumed. | TBD |
| DL SPS with one slot periodicity | This can reduce the alignment delay for DL data transmission | Yes |
| Sub-slot ACK/NACK | Sub-slot based HARQ-ACK feedback is beneficial for faster triggering of retransmissions if re-transmission is considered. | TBD |
| Span based PDCCH monitoring capability | Span based PDCCH monitoring capability is beneficial for improving scheduling latency. Rel-15 UE feature FG3-5b/Rel-16 UE feature FG 11-2 should be baseline. | Yes |
| Retransmission | For FR1,   * Whether re-transmission is considered in the simulation?   For each PDSCH or PUSCH transmission, whether re-transmission is considered should be clarified firstly. According to the conclusions in 38.824, only a single-shot transmission can meet 1ms latency requirement for SCS = 30 KHz considering Rel-15 timing capability. Re-transmission cannot be completed within 1ms. In evaluation assumption defined in 38.824, PDCCH/PDSCH/PUSCH preparation time and alignment delay are considered, which impacts the transmission latency. If these parameters can be simplified in the simulation, re-transmission can be completed within 1ms. For example, when data arrives, transmission can start immediately without preparation time. Thus, companies should align the number of transmissions applied in the simulation.   * + Option 1: only a single shot transmission is considered in the simulation for FR 1?   + Option 2: one re-transmission is considered in the simulation for FR 1? * Which frame structure is used in the simulation?   Frame structure influences the transmission latency, the aligned frame structure should be used in the companies’ simulation.  For FR 2, re-transmission can be completed within 1ms for both 60kHz and 120kHz [38.824]. Thus, only frame structure should be clarified. | TBD |

***Proposal 3: Support UE capability #2 in Rel-15 and discuss through email which and how Rel-16 URLLC features in Table 4 should be supported for 5G-ACIA URLLC evaluation.***

1. Conclusion

In this contribution, we provide our views for 5G-ACIA URLLC simulation assumptions and preferred URLLC features with the following proposals:

***Proposal 1:***

* ***Support the system level simulation assumptions in Table 2 for 5G-ACIA URLLC evaluation.***
* ***Further discuss TDD DL-UL configuration assumption and the corresponding transmission schemes to achieve the performance targets through email, with taking URLLC features into account.***

***Proposal 2 : Further discuss the necessity of increasing reliability performance as an evaluation metric.***

***Proposal 3: Support UE capability #2 in Rel-15 and discuss through email which and how Rel-16 URLLC features in Table 4 should be supported for 5G-ACIA URLLC evaluation.***

References

1. RP-202069, 3GPP TSG RAN Meeting #89e, September 14 - 18, 2020
2. RP-202097, 3GPP TSG RAN Meeting #89e, September 14 - 18, 2020