**February 22nd – 26h, 2021**

**Source: Intel Corporation**

**Title: 5G-ACIA LS – Phase 3 input**

Introduction

RAN#89-e agreed to conduct evaluation and prepare a response to 5G-ACIA LS [RP-201279, RP-202069] by offline activity.

* The first phase of the activity resulted in initial agreements on evaluation assumptions including URLLC features to be included into the study.
* The second phase was dedicated to discussion on initial evaluation results and refinement of evaluation assumption.
* In the third phase, further updated evaluation are planned to be collected and discussed.

In this document, further updated results on DL and UL performance in FR1 according to the agreed assumptions are provided.

Initial Evaluation for FR1

In this section, further updated evaluation results for FR1 downlink and uplink are provided. The assumptions for DL and UL are summarized in Table 1.

Table 1. Evaluation assumptions

|  |  |
| --- | --- |
| Parameters | **Values** |
| Factory hall size | As per agreement |
| Room height | As per agreement |
| Inter-BS/TRP distance | As per agreement |
| BS/TRP antenna height | 8 m for InF-DH |
| Layout – BS/TRP deployment | As per agreement |
| Channel model | InF-DH |
| Carrier frequency and simulation bandwidth | As per agreement |
| TDD DL-UL configuration | 1:1 DL-to-UL  6 OS DL – 2 OS Gap – 6 OS UL |
| Number of UEs per service area | 10, 20, 30, 40 per service area  (120, 240, 360, 480 per factory hall) |
| UE distribution | As per agreement |
| Message size | As per agreement |
| DL traffic model | Periodic traffic every 1 ms  Option-1: all UEs’ DL messages arriving at NG-RAN node in the first transfer interval are  uniformly random distributed within the TI time window |
| UL traffic model | Periodic traffic every 1 ms  Option-1: DL and UL traffic arrival time instants are independent |
| CSA requirements | Output of simulation |
| E2E latency & air interface latency | As per agreement |
| UE speed | As per agreement |
| BS antenna mount | As per agreement |
| Handover margin | 1 dB |
| UE antenna configuration | 2 Tx/4 Rx antenna ports  Panel model 1: Mg=1, Ng=1, P=2, dH=0.5  (M, N, P, Mg, Ng; Mp, Np) = (1, 2, 2, 1, 1; 1, 2) for 4 Rx;  (M, N, P, Mg, Ng; Mp, Np) = (1, 1, 2, 1, 1; 1, 1) for 2 Tx; |
| UE maximum TX power | 23 dBm |
| UE noise figure | 9 dB |
| BS antenna configuration | 4 Tx/4 Rx antenna ports and 8 Tx/8 Rx antenna ports  (M, N, P, Mg, Ng; Mp, Np) = (1, 2, 2, 1, 1; 1, 2) for 4 Tx/4 Rx antenna ports;  (M, N, P, Mg, Ng; Mp, Np) = (2, 2, 2, 1, 1; 2, 2) for 8 Tx/8 Rx antenna ports;  dH = dV = 0.5 λ |
| BS antenna element gain + connector loss | 5 dBi |
| BS transmit power | 31 dBm |
| BS noise figure | 5 dB |
| Sub-carrier spacing | 30 kHz |
| PDSCH | 6 symbols, 2 of which are OH for PDCCH and RS  RA type 0, 8 PRB granularity |
| PUSCH | 6 symbols, 1 of which are OH for PUCCH and RS  RA type 1, 8 PRB granularity |
| UL power control | P0 to achieve 20 dB SNR, alpha = 0.8 |
| DL scheduling | Randomization of PDSCH allocation - changing frequency position over time per UE.  MCS (low SE 64QAM table) and resource allocation size is selected to achieve 1e-5 target BLER.  Outer-loop link adaptation: reduce effective SINR for the next scheduled PDSCH based on NACK; re-set effective SINR based on ACK. |
| UL scheduling | Randomization of PUSCH allocation - changing frequency position over time per UE.  MCS (low SE 64QAM table) and resource allocation size is selected to achieve 1e-3 target BLER. |
| Channel estimation | Ideal |
| Receiver | MMSE IRC |

Further, common geometry parameters are shown in Figure 1.

 

Figure 1. Channel path-gain CDF and geometry SINR CDF

For both DL and UL, the simulation time is equivalent to 1000 seconds (in the first phase it was 100 seconds), i.e. each UE receives 1 000 000 packets throughout the simulation. This may provide PER and CSA calculation accuracy down to 1e-5~1e-6. The number of evaluation trials is 6, 3, 2, and 2 for 10, 20, 30, and 40 UE/area respectively.

## Downlink

For DL, for different UE densities the distribution of PER per UE and CSA per UE is presented in Figure 2. Resource utilization for UL is presented in Table 2.





Figure 2. DL packet error rate CDF, communication service availability CDF, latency CDF

Table 2. DL resource utilization

|  |  |  |  |
| --- | --- | --- | --- |
| UE density | 10 UE/area | 20 UE/area | 30 UE/area |
| Resource utilization | 21.09 % | 41.63 % | 62.04 % |

## Uplink

For UL, for different UE densities the distribution of PER per UE and CSA per UE is presented in Figure 3. Resource utilization for UL is presented in Table 3.

 



Figure 3. UL packet error rate CDF, communication service availability CDF, latency CDF

Table 3. UL resource utilization

|  |  |  |  |
| --- | --- | --- | --- |
| UE density | 10 UE/area | 20 UE/area | 40 UE/area |
| Resource utilization | 14.71 % | 29.41 % | 58.82 % |

Conclusion

This document provides inputs to the third phase of the offline activity related to 5G-ACIA LS [RP-201279, RP-202069] regarding evaluation results.