3GPP TSG RAN WG1 #106b-e R1-xxxxxxx

e-Meeting, October 11th – 19th, 2021

Source: Moderator (Qualcomm)

Title: [DRAFT] Observations for XR capacity evaluations in TR

Agenda Item: 8.14.1

Document for: Information

1. Introduction

This document is to collect comments from companies regarding observations for XR capacity evaluation based on contributions under AI 8.14.1.

1. Discussions on Capacity evaluation
   1. Capacity performance
      1. FR1 DL

**Summary of FR1 DL capacity evaluation results for single-stream**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Scenario | App | PDB | Bit rate | Fps | MIMO | # of sources | Capacity | Note |
| DU | AR/VR | 10ms | 45Mbps | 60 | SU | 8 | [2.1~6] |  |
| MU | 7 | [2.4~8.4] |  |
| 120 | MU | 1 | [11.42] |  |
| 30 Mbps | 60 | SU | 12 | [1~10.06] |  |
| MU | 10 | [3.9~13.59] |  |
| 120 | MU | 1 | [20.78] |  |
| 7ms | 30 Mbps | 60 | MU | 1 | [6.3] |  |
| 13ms | 30 Mbps | 60 | MU | 1 | [14.6] |  |
| 15ms | 30 Mbps | 60 | SU | 1 | [10.2~10.3] |  |
| 45 Mbps | 60 | SU | 1 | [6.3~6.4] |  |
| CG | 15 ms | 30 Mbps | 60 | SU | 10 | [1~13] |  |
| MU | 9 | [5~19.65] |  |
| 8 Mbps | 60 | SU | 3 | [>20~>36] |  |
| MU | 2 | [>36~56.6] |  |
| InH | AR/VR | 10 ms | 45 Mbps | 60 | SU | 4 | [3.27~4.8] |  |
| MU | 6 | [3~12] |  |
| 120 | MU | 1 | [9.22] |  |
| 30 Mbps | 60 | SU | 6 | [1~8.5] |  |
| MU | 7 | [5~12] |  |
| 120 | MU | 1 | [16.53] |  |
| 60 Mbps | 60 | MU | 1 | [4] |  |
| 7 ms | 30 Mbps | 60 | MU | 1 | [8] |  |
| CG | 15 ms | 30 Mbps | 60 | SU | 6 | [1~10.5] |  |
| MU | 7 | [7~16.2] |  |
| 8 Mbps | 60 | SU | 3 | [>20~>38.7] |  |
| MU | 2 | [>38.7~44.1] |  |
| UMa | AR/VR | 10 ms | 45 Mbps | 60 | SU | 5 | [1.8~4.4] |  |
| MU | 6 | [2.9~6] |  |
| 120 | MU | 1 | [8.12] |  |
| 30 Mbps | 60 | SU | 6 | [4.4~7.24] |  |
| MU | 6 | [5.2~10] |  |
| 120 | MU | 1 | [14.59] |  |
| CG | 15 ms | 30 Mbps | 60 | SU | 6 | [4.08~10.33] |  |
| MU | 5 | [8~14.33] |  |
| 8 Mbps | 60 | SU | 3 | [17.5~32.9] |  |
| MU | 2 | [23.8~>36] |  |
|  | | | | | | | | |

**Summary of FR1 DL capacity evaluation results for multi-stream (I/P Frame Traffic Model)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Scenario | Traffic model | App | Bit rate | Alpha | MIMO | # of sources | Capacity | Note |
| DU | **GOP-Based I/P Frame** | VR/AR | 30Mbps | 1 | MU | 1 | [10] |  |
| 1.5 | MU | 2 | [6.39~12.80] |  |
| 2 | SU | 1 | [2~11] |  |
| MU | 3 | [4.74~12.2] |  |
| 3 | MU | 2 | [2.09~5.73] |  |
| 45 Mbps | 1.5 | SU | 1 | [2~6] |  |
| MU | 1 | [1.4~3.2] |  |
| 3 | SU | 1 | [<2~6] |  |
| **Slice-Based I/P Frame** | VR/AR | 30 Mbps | 1.5 | MU | 1 | [13.27~16.79] |  |
| 2 | MU | 3 | [12.7~17.3] |  |
| 3 | MU | 1 | [13.46~16.98] |  |
|  | | | | | | | | |

* + - 1. DU Scenario
         1. VR/AR

Single-stream traffic model

**For FR1, Dense Urban, DL**, 14 sources (Huawei, FUTUREWEI, OPPO, Xiaomi, MediaTek, Nokia, Ericsson, Qualcomm, vivo, CEWiT, ZTE, Intel, Interdigital, CATT) reported the evaluation results of capacity performance with 100MHz bandwidth for VR/AR single-stream traffic mode.

**General Observations**

* **For VR/AR, 30Mbps, 10ms PDB, 60 FPS**
  + According to 12 sources (Huawei, FUTUREWEI, OPPO, Xiaomi, MediaTek, Nokia, Ericsson, Qualcomm, vivo, CEWiT, Intel, CMCC), with SU-MIMO, the capacity performances are in the range of {1~10.6}.
  + According to 10 sources (Huawei, FUTUREWEI, ZTE, vivo, Interdigital, CATT, Ericsson, Qualcomm, Intel, CMCC), with MU-MIMO, the capacity performances are in the range of {3.9~13.59}.
* **For VR/AR, 45Mbps, 10ms PDB, 60 FPS**
  + According to 8 sources (Huawei, FUTUREWEI, OPPO, Xiaomi, MediaTek, Nokia, Ericsson, Qualcomm), with SU-MIMO, the capacity performances are in the range of {2.1~6}.
  + According to 7 sources (Huawei, FUTUREWEI, ZTE, vivo, Interdigital, Ericsson, Qualcomm), with MU-MIMO, the capacity performances are in the range of {2.4~8.4}.

Multi-stream traffic model

**For FR1 Dense Urban DL**, 4 sources (Huawei, ZTE, vivo, MediaTek) reported the evaluation results of capacity performance with 100MHz bandwidth for VR/AR multi-stream traffic model.

**General Observations**

* **For VR/AR, 30Mbps, [PDB\_I, PDB\_P] = [10ms, 10ms], [PER\_I, PER\_P] = [1%, 1%], GOP-Based I/P Frame Traffic Model** 
  + 1 source (Huawei) reported the capacity performances are {10} with alpha = 1 and MU-MIMO.
  + 2 sources (Huawei, vivo) reported the capacity performances are in the range of {6.74~8.5} with alpha = 1.5 and MU-MIMO.
  + 1 source (MediaTek) reported the capacity performances are {6} with alpha = 2 and SU-MIMO.
  + 3 sources (Huawei, ZTE, vivo) reported the capacity performances are in the range of {5.2~6.7} with alpha = 2 and MU-MIMO.
  + 2 sources (Huawei, vivo) reported the capacity performances are in the range of {2.21~4} with alpha = 3 and MU-MIMO.
* **For VR/AR, 45Mbps, [PDB\_I, PDB\_P] = [10ms, 10ms], [PER\_I, PER\_P] = [1%, 1%], GOP-Based I/P Frame Traffic Model** 
  + 1 source (MediaTek) reported the capacity performances are {2} with alpha = 1.5 and SU-MIMO.
  + 1 source (Huawei) reported the capacity performances are {1.4} with alpha = 1.5 and MU-MIMO.
  + 1 source (MediaTek) reported the capacity performances are {<2} with alpha = 3 and SU-MIMO.
* **For VR/AR, 30Mbps, [PDB\_I, PDB\_P] = [10ms, 10ms], [PER\_I, PER\_P] = [1%, 1%], Slice-Based I/P Frame Traffic Model** 
  + 1 source (vivo) reported the capacity performances are {13.78} with alpha = 1.5 and MU-MIMO.
  + 3 sources (Huawei, ZTE, vivo) reported the capacity performances are in the range of {12.7~14.9} with alpha = 2 and MU-MIMO.
  + 1 source (vivo) reported the capacity performances are {13.77} with alpha = 3 and MU-MIMO.
    - * 1. CG

**For FR1, Dense Urban, DL**, 12 sources (Huawei, CEWiT, vivo, Xiaomi, MediaTek, Nokia, Ericsson, Qualcomm, ZTE, Intel, Interdigital, CATT) reported the evaluation results of capacity performance with 100MHz bandwidth for CG.

**General Observations**

* **For CG, 8Mbps, 15ms PDB, 60 FPS**
  + According to 3 sources (MediaTek, Ericsson, Qualcomm), with SU-MIMO, the capacity performances are in the range of {>20~>36}.
  + According to 2 sources (Ericsson, Qualcomm), with MU-MIMO, the capacity performances are in the range of {>36~56.6}.
* **For CG, 30Mbps, 15ms PDB, 60 FPS**
  + According to 10 sources (Huawei, CEWiT, vivo, Xiaomi, MediaTek, Nokia, Ericsson, Qualcomm, Intel, CMCC), with SU-MIMO, the capacity performances are in the range of {1~13}.
  + According to 9 sources (Huawei, vivo, CATT, Ericsson, Qualcomm, ZTE, Intel, Interdigital, CMCC), with MU-MIMO, the capacity performances are in the range of {5~19.65}.
    - 1. InH Scenario
         1. VR/AR

Single stream traffic model

**For FR1, Indoor Hotspot, DL,** 9 sources (Nokia, Ericsson, Interdigital, Qualcomm, vivo, CATT, MediaTek, ZTE, ITRI) reported the evaluation results of capacity performance with 100MHz bandwidth for VR/AR single-stream traffic model.

**General Observations**

* **For VR/AR, 30Mbps, 10ms PDB, 60 FPS**
  + According to 6 sources (vivo, Nokia, Ericsson, ITRI, Qualcomm, CMCC), with SU-MIMO, the capacity performances are in the range of {1~8.5}.
  + According to 7 sources (ZTE, vivo, CATT, Interdigital, Ericsson, Qualcomm, CMCC), with MU-MIMO, the capacity performances are in the range of {5~12}.
* **For VR/AR, 45Mbps, 10ms PDB, 60 FPS**
  + According to 4 sources (MediaTek, Nokia, Ericsson, Qualcomm), with SU-MIMO, the capacity performances are in the range of {3.27~4.8}.
  + According to 6 sources (ZTE, vivo, CATT, Interdigital, Ericsson, Qualcomm), with MU-MIMO, the capacity performances are in the range of {3~12}.
* **For VR/AR, 60Mbps, 10ms PDB, 60 FPS**
  + According to 1 source (CATT), with MU-MIMO, the capacity performances are 4.

Multi-stream traffic model

* + - * 1. CG

**For FR1, Indoor Hotspot, DL,** 9 sources (Nokia, Ericsson, Interdigital, Qualcomm, vivo, CATT, MediaTek, ZTE, ITRI) reported the evaluation results of capacity performance with 100MHz bandwidth for CG.

**General Observations**

* **For CG, 8Mbps, 15ms PDB, 60 FPS**
  + According to 3 sources (MediaTek, Ericsson, Qualcomm), with SU-MIMO, the capacity performances are in the range of {>20~>38.7}.
  + According to 2 sources (Ericsson, Qualcomm), with MU-MIMO, the capacity performances are in the range of {>38.7~44.1}.
* **For CG, 30Mbps, 15ms PDB, 60 FPS**
  + According to 6 sources (vivo, Nokia, Ericsson, ITRI, Qualcomm, CMCC), with SU-MIMO, the capacity performances are in the range of {1~10.5}.
  + According to 7 sources (ZTE, vivo, CATT, Interdigital, Ericsson, Qualcomm, CMCC), with MU-MIMO, the capacity performances are in the range of {7~16.2}.
    - 1. UMa Scenario
         1. VR/AR

Single stream traffic model

**For** **FR1, Urban Macro, DL,** 8 sources (Huawei, FUTUREWEI, MediaTek, Ericsson, Qualcomm, vivo, ZTE, CEWiT) reported the evaluation results of capacity performance with 100MHz bandwidth for VR/AR single-stream traffic model.

**General Observations**

* **For VR/AR, 30Mbps, 10ms PDB, 60 FPS**
  + According to 6 sources (Huawei, FUTUREWEI, Ericsson, Qualcomm, vivo, CEWiT), with SU-MIMO, the capacity performances are in the range of {4.4~7.24}.
  + According to 6 sources (Huawei, FUTUREWEI, Ericsson, Qualcomm, vivo, ZTE), with MU-MIMO, the capacity performances are in the range of {5.2~10}.
* **For VR/AR, 45Mbps, 10ms PDB, 60 FPS**
  + According to 5 sources (Huawei, FUTUREWEI, MediaTek, Ericsson, Qualcomm), with SU-MIMO, the capacity performances are in the range of {1.8~4.4}.
  + According to 6 sources (Huawei, FUTUREWEI, Ericsson, Qualcomm, vivo, ZTE), the capacity performances are in the range of {2.9~6}.

Multi-stream traffic model

* + - * 1. CG

**For** **FR1, Urban Macro, DL**, 7 sources (Huawei, MediaTek, Ericsson, Qualcomm, vivo, ZTE, CEWiT) reported the evaluation results of capacity performance with 100MHz bandwidth for CG.

**General Observations**

* **For CG, 8Mbps, 15ms PDB, 60 FPS**
  + According to 3 sources (MediaTek, Ericsson, Qualcomm), with SU-MIMO, the capacity performances are in the range of {17.5, >20, 32.9}.
  + According to 2 sources (Ericsson, Qualcomm), with MU-MIMO, the capacity performances are in the range of {23.8, >36}.
* **For CG, 30Mbps, 15ms PDB, 60 FPS**
  + According to 6 sources (Huawei, CEWiT, vivo, MediaTek, Ericsson, Qualcomm), with SU-MIMO, the capacity performances are in the range of {4.08~10.33}.
  + According to 5 sources (Huawei, vivo, Ericsson, Qualcomm, ZTE), with MU-MIMO, the capacity performances are in the range of {8~14.33}.
    - 1. Summary of discussions

1. **Please provide your comment on the above observation.**

|  |  |
| --- | --- |
| Company | Comment |
| Futurewei | We highlighted above a few cases where the range of values are too big, and some harmonization/filtering of data is needed. |
| CMCC | It is easier to check data on graphs, so we played some visualization:   1. **FR1 DL (like 2.1.1) but only for SU-MIMO**   Note:   * Results on different bit rates and different PDB are placed in different charts, so what’s above is a “chart matrix” * Different color means different scenario (InH/DU/UMa) * Results from different sources are placed side by side in charts, company names can be seen on X-axis   Observation:   * The results from different sources look pretty solid, most of them are alike, with a few exceptions (e.g. CMCC. BTW we will update our SU-MIMO result) * The trend is expected: as bit rates goes up, capacity goes down  1. **FR1 DL (like 2.1.1) but only for MU-MIMO**     Observations:   * In general, results are still quite converged * There are quite many PDB choices though   **Suggestions:**   1. How to capture the results: capture all? Because there is almost no abnormity, after CMCC updates SU results. 2. Where and/or How to draw conclusion: we may do some consolidation, e.g. on PDB and scenario (InH, DU, Uma) because the results between these factors are similar. By consolidating, we can highlight the conclusion on the capacity and whether it is enough. |
| ZTE, Sanechips | 1. We suggest to change the title of section 2.1 into ‘Capacity baseline performance’ to make it clearer and distinguished from other sections. 2. In section 2.1.1.1.1.2, our evaluation results is 10.8 for VR/AR, 30Mbps, [PDB\_I, PDB\_P] = [10ms, 10ms], [PER\_I, PER\_P] = [1%, 1%], GOP-Based I/P Frame Traffic Model is not captured.   Therefore, the General Observations should be updated as below:   * **For VR/AR, 30Mbps, [PDB\_I, PDB\_P] = [10ms, 10ms], [PER\_I, PER\_P] = [1%, 1%], GOP-Based I/P Frame Traffic Model**    + 3 sources (Huawei, ZTE, vivo) reported the capacity performances are in the range of {5.2~~~6.7~~10.8} with alpha = 2 and MU-MIMO.   The results of multi-stream in Section 2.1.1 TABLE ‘Summary of FR1 DL capacity evaluation results for multi-stream (I/P Frame Traffic Model)’ for alpha =2 should also be updated accordingly.   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Scenario | Traffic model | App | Bit rate | Alpha | MIMO | # of sources | Capacity | Note | | DU | **GOP-Based I/P Frame** | VR/AR | 30Mbps | 1 | MU | 1 | [10] |  | | 1.5 | MU | 2 | [6.39~12.80] |  | | 2 | SU | 1 | [2~11] |  | | MU | 3 | ~~[4.74~12.2]~~  [5.2-10.8] |  | | 3 | MU | 2 | [2.09~5.73] |  | | 45 Mbps | 1.5 | SU | 1 | [2~6] |  | | MU | 1 | [1.4~3.2] |  | | 3 | SU | 1 | [<2~6] |  | | **Slice-Based I/P Frame** | VR/AR | 30 Mbps | 1.5 | MU | 1 | [13.27~16.79] |  | | 2 | MU | 3 | [12.7~17.3] |  | | 3 | MU | 1 | [13.46~16.98] |  | |  | | | | | | | | |  1. In section 2.1.1.3.1.1, we suggest to add ‘with MU-MIMO’ as follows.  * **For VR/AR, 45Mbps, 10ms PDB, 60 FPS**   + According to 5 sources (Huawei, FUTUREWEI, MediaTek, Ericsson, Qualcomm), with SU-MIMO, the capacity performances are in the range of {1.8~4.4}.   + According to 6 sources (Huawei, FUTUREWEI, Ericsson, Qualcomm, vivo, ZTE) with MU-MIMO, the capacity performances are in the range of {2.9~6}.  1. In section 2.1.1.2.2, the capacity range for CG, 30Mbps, 15ms PDB, 60 FPS in FR1 Indoor should be {7.2,1 6.2}.   The update is as below  **General Observations**   * **For CG, 8Mbps, 15ms PDB, 60 FPS**   + According to 3 sources (MediaTek, Ericsson, Qualcomm), with SU-MIMO, the capacity performances are in the range of {>20~>38.7}.   + According to 2 sources (Ericsson, Qualcomm), with MU-MIMO, the capacity performances are in the range of {>38.7~44.1}. * **For CG, 30Mbps, 15ms PDB, 60 FPS**   + According to 6 sources (vivo, Nokia, Ericsson, ITRI, Qualcomm, CMCC), with SU-MIMO, the capacity performances are in the range of {1~10.5}.   + According to 7 sources (ZTE, vivo, CATT, Interdigital, Ericsson, Qualcomm, CMCC), with MU-MIMO, the capacity performances are in the range of {7.2~16.2}.   Also the change change in Summary TABLE   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | InH | CG | 15 ms | 30 Mbps | 60 | SU | 6 | [1~10.5] |  | | MU | 7 | [7.2~16.2] |  | | 8 Mbps | 60 | SU | 3 | [>20~>38.7] |  | | MU | 2 | [>38.7~44.1] |  | |
| MTK | We suggest to change the title of section 2.1 into ‘Capacity baseline performance’ to make it clearer and distinguished from other sections.  We think the visualized graph provided by CMCC can assist to make conclusions in the TR and can be captured.  How to capture the results: We think providing a median value additionally as suggested by Apple in the GTW session would be good.  Where and/or How to draw conclusion: Same view with CMCC. |
| CATT | CATT’s results (R1-2109200) in section 2.1.1.1.1 DU scenario for single stream VR/AR 30 Mbps/10 ms PDB and 2.1.1.1.2 with 30 Mbps/15 ms PDB are based on SU-MIOMO not MU-MIMO.  The results in section 2.1.1.2.1.1 InH scenario VR/AR 45 Mbps, 10ms PDB, 60 FPS should be 3- 8   According to 6 sources (ZTE, vivo, CATT, Interdigital, Ericsson, Qualcomm), with MU-MIMO, the capacity performances are in the range of {3~~~12~~ 8}. |
| Huawei, HiSilicon | We suggest to change Section 2.1 title as “Capacity baseline performance” to be clearer.  Regarding the case where the value range is large: generally, we think all companies’ simulation results are appreciated and respected. RAN1 can discuss them case-by-case if necessary. As long as they can be explained, we think it’s ok to keep such values. For example, if necessary, RAN1 can add an asterisk mark (\*) around such value range, and give some brief explanations as a note.  If RAN1 simply applies some filtering mechanism (e.g., remove some values, takes the median value, etc.), it’s still unclear why companies have such different values. So we think more discussions are needed to find out the reasons.  For example, for Section 2.1.1.4.1 (copied below), the yellow highlighted yellow range seems large. In our simulation, we simulated two schemes as below, and the capacity results are 1.5 and 5.6 for S1 and S2, respectively (more details can be found in our Tdoc R1-2108736 section 4.2). So maybe companies have some different assumptions in their simulations. If this can be clarified, RAN1 can better know whether this large value range is reasonable or not.   * Scheme 1 (S1, UE is not aware of traffic difference): UE is not aware of the current packet belongs to UL pose/control or UL video, so that UL pose/control and UL video are transmitted in a first-in-first-out manner. * Scheme 2 (S2, UE is aware of traffic difference): UE is aware of the current packet belongs to UL pose/control or UL video, so that UE prioritizes the transmission of UL pose/control since it has tighter PDB requirement.   ==   * + - * 1. AR (2 streams: Pose/control-stream + scene/video/data/voice-stream)   **For FR1, Dense Urban UL**, 6 sources (vivo, Qualcomm, Interdigital, Huawei, Ericsson, Intel), reported the evaluation results of capacity performance with DU, 100MHz bandwidth for AR (pose/control-stream + scene/video/data/voice-stream).  **General Observations**   * **For 2 streams: UL pose/control-stream, 0.2Mbps, 10ms PDB, 250 FPS + UL scene/video/data/voice-stream, 10Mbps, 30ms PDB, 60FPS**   + According to 4 sources (vivo, Qualcomm, Ericsson, Intel), with SU-MIMO, the capacity performances are in the range of {2.6, 7.43}.   + According to 4 sources (Qualcomm, Interdigital, Huawei, Intel), with MU-MIMO, the capacity performances are in the range of {0, 5.8}. |
| LGE | We also think providing a median value would be useful especially when the results are diverging.  Under General Observations, some observations are from one or a small number of companies. In this case, we should not say it is general, and for those source-specific observations it should be discussed whether they need to be captured in the TR and how they will be captured if agreed. |
| InterDigital | Share similar understanding with HW that applying filtering (e.g. simple removal, median-based removal) without understanding the assumptions/parameters that could have caused such range will not be useful nor resolve any issues. Rather, capturing further granular details (e.g. as suggested by HW), can be beneficial for explaining the results and the range. |
| QC | Thanks for the great effort for collecting results.  This comment applies to all cases in this document.   1. In the following example General Observations, since MIMO scheme is the last important parameter used for categorizing results, it is better to have MIMO scheme in the beginning of the sentence as follows. 2. In summary table and observations, can we have mean or median between # of source column and range column?   **General Observations**   * **For VR/AR, 30Mbps, 10ms PDB, 60 FPS, S**   + With SU-MIMO, according to 12 sources (Huawei, FUTUREWEI, OPPO, Xiaomi, MediaTek, Nokia, Ericsson, Qualcomm, vivo, CEWiT, Intel, CMCC), the capacity performances are in the range of {1~10.6}.   + With MU-MIMO, according to 10 sources (Huawei, FUTUREWEI, ZTE, vivo, Interdigital, CATT, Ericsson, Qualcomm, Intel, CMCC), the capacity performances are in the range of {3.9~13.59}. |
| Ericsson | We agree with HW and IDC that filtering should not be applied.  We also fail to see the benefit of a median value. |
| Nokia, NSB | We agree with companies that some of the values are too large or too small as compared to the majority. Those numbers should be carefully revised. If we look at the range from the current observations, it is not clear whether MU-MIMO gives any real benefits as compared to SU-MIMO. That might be a misleading observation.  The tables with results should contain the Source information since some of the results are from single company only. |

* + 1. FR1 UL

**Summary of UL capacity evaluation results in FR1**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Scenario** | **App** | **PDB (ms)** | **Bit rate (Mbps)** | **FPS** | **MIMO** | **# of sources** | **Capacity** | **Note** |
| **DU** | **VR/CG (1 stream: Pose)** | 10 | 0.2 | 250 | SU | 6 | [20 ~ 224.9] |  |
| MU | 3 | [8 ~ >240] |  |
| **AR (1 stream: Scene)** | 30 | 10 | 60 | SU | 6 | [4.5 ~ 9.49] |  |
| MU | 5 | [2.3 ~ 10.9] |  |
| 10 |  |  |  |  |
| MU | 1 | [<1] |  |
| 15 | MU | 1 | [5.4] |  |
| 60 | MU | 1 | [8.3] |  |
| **AR (2 streams: Pose + Scene)** | 10 (Pose),  30 (Scene) | 0.2 (Pose)  10 (Scene) | 250 (Pose)  60 (Scene) | SU | 4 | [2.6 ~ 7.43] |  |
| MU | 4 | [0 ~ 5.8] |  |
| **InH** | **VR/CG (1 stream: Pose)** | 10 | 0.2 | 250 | SU | 6 | [>12 ~ 198] |  |
| MU | 3 | [20 ~ >240] |  |
| **AR (1 stream: Scene)** | 30 | 10 | 60 | SU | 6 | [4.4 ~ 13.95] |  |
| MU | 2 | [7.1 ~ 11.5] |  |
| 10 |  |  |  |  |
| **2 streams: Pose + Scene** | 10 (Pose),  30 (Scene) | 0.2 (Pose)  10 (Scene) | 250 (Pose)  60 (Scene) | SU | 4 | [4.05 ~ 12.71] |  |
| MU | 2 | [7.2 ~ 7.4] |  |
| 10 (Pose),  10 (Scene) |  |  |  |  |
| **UMa** | **VR/CG (1 stream: Pose)** | 10 | 0.2 | 250 | SU | 5 | [17.4 ~ 143] |  |
| MU | 2 | [>15 ~ >240] |  |
| **AR (1 stream: Scene)** | 30 | 10 | 60 | SU | 4 | [0 ~ 1.34] |  |
| MU | 2 | [0 ~ <1] |  |
| **AR (2 streams: pose + scene)** | 10 (Pose),  30 (Scene) | 0.2 (Pose)  10 (Scene) | 250 (Pose)  60 (Scene) | SU | 2 | [0 ~ <1] |  |
| MU | 1 | [0] |  |
| Note: | | | | | | | | |

* + - 1. DU Scenario
         1. VR/CG (Pose/control-stream)

**For FR1, Dense Urban UL**, 8 sources (vivo, Qualcomm, Nokia, MediaTek, Interdigital, Huawei, FUTUREWEI, Ericsson), reported the evaluation results of capacity performance with DU, 100MHz bandwidth for VR/CG (Pose/control-stream).

**General Observations**

* **For UL pose/control-stream, 0.2Mbps, 10ms PDB, 250 FPS**
  + According to 6 sources (vivo, Qualcomm, Nokia, MediaTek, FUTUREWEI, Ericsson), with SU-MIMO, the capacity performances are in the range of {20, 224.9}.
  + According to 3 sources (Qualcomm, Interdigital, Huawei), with MU-MIMO, the capacity performances are in the range of {8, >240}
    - * 1. AR (1 stream: Scene/video/data/voice-stream)

**For FR1, Dense Urban UL**, 9 sources (ZTE, vivo, Qualcomm, Nokia, MediaTek, Interdigital, Huawei, Ericsson, Intel), reported the evaluation results of capacity performance with DU, 100MHz bandwidth for AR (scene/video/data/voice-stream).

**General Observations**

* **For UL scene/video/data/voice-stream, 10Mbps, 30ms PDB, 60FPS**
  + According to 6 sources (vivo, Qualcomm, MediaTek, Ericsson, Intel, Nokia), with SU-MIMO, the capacity performances are in the range of {4.5, 9.49}.
  + According to 5 sources (ZTE, Qualcomm, Interdigital, Huawei, Intel), with MU-MIMO, the capacity performances are in the range of {2.3, 10.97}.
* **For UL scene/video/data/voice-stream, 10Mbps, 10ms PDB, 60FPS**
  + According to 1 source (Huawei), with MU-MIMO, the capacity performance is <1.
* **For UL scene/video/data/voice-stream, 10Mbps, 15ms PDB, 60FPS**
  + According to 1 source (Huawei), with MU-MIMO, the capacity performance is 5.4.
* **For UL scene/video/data/voice-stream, 10Mbps, 60ms PDB, 60FPS**
  + According to 1 source (Huawei), with MU-MIMO, the capacity performance is 8.3
    - * 1. AR (2 streams: Pose/control-stream + scene/video/data/voice-stream)

**For FR1, Dense Urban UL**, 6 sources (vivo, Qualcomm, Interdigital, Huawei, Ericsson, Intel), reported the evaluation results of capacity performance with DU, 100MHz bandwidth for AR (pose/control-stream + scene/video/data/voice-stream).

**General Observations**

* **For 2 streams: UL pose/control-stream, 0.2Mbps, 10ms PDB, 250 FPS + UL scene/video/data/voice-stream, 10Mbps, 30ms PDB, 60FPS**
  + According to 4 sources (vivo, Qualcomm, Ericsson, Intel), with SU-MIMO, the capacity performances are in the range of {2.6, 7.43}.
  + According to 4 sources (Qualcomm, Interdigital, Huawei, Intel), with MU-MIMO, the capacity performances are in the range of {0, 5.8}.
    - 1. InH Scenario
         1. VR/CG (Pose/control-stream)

**For FR1, Indoor Hotspot UL**, 8 sources (ZTE, vivo, Qualcomm, Nokia, MediaTek, Interdigital, Ericsson, CATT), reported the evaluation results of capacity performance with InH, 100MHz bandwidth for VR/CG (pose/control-stream).

**General Observations**

* **For UL pose/control-stream, 0.2Mbps, 10ms PDB, 250 FPS**
  + According to 6 sources (vivo, Qualcomm, Nokia, MediaTek, Ericsson, CATT), with SU-MIMO, the capacity performances are in the range of {>12, 198}.
  + According to 3 sources (Qualcomm, Interdigital, ZTE), with MU-MIMO, the capacity performances are in the range of {20, >240}
    - * 1. AR (1 stream: Scene/video/data/voice-stream)

**For FR1, Indoor Hotspot UL**, 7 sources (vivo, Qualcomm, Nokia, MediaTek, Interdigital, Ericsson, CATT), reported the evaluation results of capacity performance with InH, 100MHz bandwidth for AR (scene/video/data/voice-stream).

**General Observations**

* **For UL scene/video/data/voice-stream, 10Mbps, 30ms PDB, 60FPS**
  + According to 6 sources (vivo, Qualcomm, MediaTek, Ericsson, CATT, Nokia), with SU-MIMO, the capacity performances are in the range of {4.4, 13.95}.
  + According to 2 sources (Qualcomm, Interdigital), with MU-MIMO, the capacity performances are in the range of {7.1, 11.5}.
    - * 1. AR (2 streams: Pose/control-stream + scene/video/data/voice-stream)

**For FR1, Indoor Hotspot UL**, 5 sources (vivo, Qualcomm, Nokia, Interdigital, Ericsson), reported the evaluation results of capacity performance with InH, 100MHz bandwidth for AR (pose/control-stream + scene/video/data/voice-stream).

**General Observations**

* **For 2 streams: UL pose/control-stream, 0.2Mbps, 10ms PDB, 250 FPS + UL scene/video/data/voice-stream, 10Mbps, 30ms PDB, 60FPS**
  + According to 4 sources (vivo, Qualcomm, Ericsson, Nokia), with SU-MIMO, the capacity performances are in the range of {4.05, 12.71}.
  + According to 2 sources (Qualcomm, Interdigital), with MU-MIMO, the capacity performances are in the range of {7.2, 7.4}.
    - 1. UMa Scenario
         1. VR/CG (Pose/control-stream)

**For FR1, Urban Macro UL**, 6 sources (vivo, Qualcomm, MediaTek, Huawei, FUTUREWEI, Ericsson), reported the evaluation results of capacity performance with Uma, 100MHz bandwidth for VR/CG (Pose/control-stream).

**General Observations**

* **For UL pose/control-stream, 0.2Mbps, 10ms PDB, 250 FPS**
  + According to 5 sources (vivo, Qualcomm, MediaTek, Ericsson, FUTUREWEI), with SU-MIMO, the capacity performances are in the range of {17.4, 143}.
  + According to 2 sources (Qualcomm, Huawei), with MU-MIMO, the capacity performances are in the range of {>15, >240}
    - * 1. AR (1 stream: Scene/video/data/voice-stream)

**For FR1, Urban Macro UL**, 5 sources (vivo, Qualcomm, MediaTek, Huawei, Ericsson), reported the evaluation results of capacity performance with Uma, 100MHz bandwidth for AR (Scene/video/data/voice-stream).

**General Observations**

* **For UL scene/video/data/voice-stream, 10Mbps, 30ms PDB, 60FPS**
  + According to 4 sources (vivo, Qualcomm , MediaTek, Ericsson), with SU-MIMO, the capacity performances are in the range of {0, 1.34}.
  + According to 2 sources (Qualcomm , Huawei), with MU-MIMO, the capacity performances are in the range of {0, <1}.
    - * 1. AR (2 streams: Pose/control-stream + scene/video/data/voice-stream)

**For FR1, Urban Macro UL**, 2 sources (Qualcomm , Ericsson), reported the evaluation results of capacity performance with Uma, 100MHz bandwidth for AR (Pose/control-stream + Scene/video/data/voice-stream).

**General Observations**

* **For 2 streams: UL pose/control-stream, 0.2Mbps, 10ms PDB, 250 FPS + UL scene/video/data/voice-stream, 10Mbps, 30ms PDB, 60FPS**
  + According to 2 sources (Qualcomm , Ericsson), with SU-MIMO, the capacity performances are in the range of {0, <1}.
  + According to 1 source (Qualcomm ), with MU-MIMO, the capacity performance is 0.
    - 1. Summary of discussions

1. **Please provide your comment on the above observation.**

|  |  |
| --- | --- |
| Company | Comment |
| Futurewei | We highlighted above a few cases where the range of values are too big, and some harmonization/filtering of data is needed. |
| ZTE,  Sanechips | In section 2.1.2.1.2, the capacity value range for ‘UL scene/video/data/voice-stream, 10Mbps, 30ms PDB, 60FPS’ using MU-MIMO should be (2.3, 10.9).  The suggested update is as below.  **General Observations**   * **For UL scene/video/data/voice-stream, 10Mbps, 30ms PDB, 60FPS**   + According to 5 sources (vivo, Qualcomm, MediaTek, Ericsson, Intel), with SU-MIMO, the capacity performances are in the range of {4.5, 9.49}.   According to 5 sources (ZTE, Qualcomm, Interdigital, Huawei, Intel), with MU-MIMO, the capacity performances are in the range of {2.3, 10.9~~7~~}. |
| MTK | We suggest to change the title of section 2.1 into ‘Capacity baseline performance’ to make it clearer and distinguished from other sections.  We think providing a median value additionally for each scenario as suggested by Apple in the GTW session would be good. |
| Huawei, HiSilicon | Our comments in Section 2.1.1.4 also applies here.  There might be some typo errors:   * In the general observations of 2.1.2.1.1, “For UL pose/control-stream, 0.2Mbps, 10ms PDB, 250 FPS”: “{8, >240}” should be changed to “{>8, >240}.   + We also notice similar typos in other places, e.g., [>20 ~ >240]   + This also impacts the summary table under Section 2.1.2. * In the general observations of 2.1.2.1.2、2.1.2.2.2、2.1.2.2.3, it seems the simulation setting PDB of Nokia is 30ms, not 10ms. Please could Nokia help double check? Thanks. |
| LGE | Same comment as above.  Under General Observations, some observations are from one or a small number of companies. In this case, we should not say it is general, and for those source-specific observations it should be discussed whether they need to be captured in the TR and how they will be captured if agreed. |
| InterDigital | Same comment as that provided for Q1 |
| Ericsson | Same comment as provided for Q1. |
| Nokia, NSB | We moved some of Nokia results for AR to another line since it was PDB = 30 ms not 10 ms as initially given in this document. |

* + 1. FR2 DL

**Summary of FR2 DL capacity evaluation results for single stream (100MHz bandwidth)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Scenario | App | PDB (ms) | Bit rate | Fps | MIMO | # of sources | Capacity | Note |
| DU | AR/VR | 10 | 45 | 60 | SU | 5 | [1.8~8.2] |  |
| 30 | 60 | SU | 5 | [4~13.44] |  |
| CG | 15 | 30 | 60 | SU | 5 | [5.1~16.16] |  |
| 8 | 60 | SU | 2 | [>20~24] |  |
| InH | AR/VR | 10 | 45 | 60 | SU | 4 | [2.5~6.13] |  |
| 30 | 60 | SU | 5 | [4.5~>10] |  |
| CG | 15 | 30 | 60 | SU | 5 | [6~11] |  |
| 8 | 60 | SU | 2 | [>20~27.5] |  |
|  | | | | | | | | |

**Summary of FR2 DL capacity evaluation results for single stream (400MHz bandwidth)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Scenario | App | PDB (ms) | Bit rate | Fps | MIMO | # of sources | Capacity | Note |
| DU | AR/VR | 10 | 45 | 60 | SU | 2 | [15~43.89] |  |
| 30 | 60 | SU | 1 | [15~23.5] |  |
| CG | 15 | 30 | 60 | SU | 1 | [25] |  |
| 8 | 60 | SU | 1 | [>30] |  |
| InH | AR/VR | 10 | 45 | 60 | SU | 1 | [16~20.5] |  |
| 30 | 60 | SU | 1 | [15.5~26] |  |
| CG | 15 | 30 | 60 | SU | 1 | [28] |  |
| 8 | 60 | SU | 1 | [>30] |  |
|  | | | | | | | | |

**Summary of FR2 DL capacity evaluation results for multi stream (Video + Audio/data)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Scenario | Video data rate | Video PDB (ms) | Audio data rate | Audio PDB  (ms) | MIMO | # of sources | Capacity | Note |
| DU | 30Mbps | 10 | 0.756Mbps | 30 | SU | 1 | [5~5.5] |  |
| InH | 30Mbps | 10 | 0.756Mbps | 30 | SU | 1 | [2.5~5.4] |  |
|  | | | | | | | | |

**Summary of FR2 DL capacity evaluation results for multi stream (I/P Frame Traffic Model)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Scenario | Traffic model | App | Bit rate | Alpha | MIMO | # of sources | Capacity | Note |
| InH | **GOP-Based I/P Frame** | VR/AR | 30 Mbps | 1.5 | SU | 1 | [4.98~7.43] |  |
| 2 | SU | 1 | [2.73~5.53] |  |
| 3 | SU | 1 | [2.03~3.29] |  |
| **Slice-Based I/P Frame** | VR/AR | 30 Mbps | 1.5 | SU | 1 | [8.14~10.77] |  |
| 2 | SU | 1 | [8.18~10.73] |  |
| 3 | SU | 1 | [8.22~10.63] |  |
|  | | | | | | | | |

* + - 1. DU Scenario
         1. VR/AR

Single stream traffic model

**For FR2 Dense Urban DL**, 5 sources (Nokia, Qualcomm, vivo, MediaTek, Ericsson) reported the evaluation results of capacity performance with DU, 100MHz bandwidth, DDDSU TDD format.

**General Observations**

* **For VR/AR, 30Mbps, 10ms PDB, 60 FPS**
  + According to 5 sources (Nokia, Qualcomm, vivo, MediaTek, Ericsson), with SU-MIMO, the capacity performances are in the range of {4~13.44}.
* **For VR/AR, 45Mbps, 10ms PDB, 60 FPS**
  + According to 5 sources (Nokia, Qualcomm, vivo, MediaTek, Ericsson), with SU-MIMO, the capacity performances are in the range of {1.8~8.2}.

Multi-stream traffic model

**For FR2 Dense Urban DL**, 1 source (Qualcomm) reported the evaluation results of capacity performance with DU, 100MHz bandwidth, DDDSU TDD format.

**General Observations**

* **For Video, 30Mbps, 10ms PDB, 60 FPS, + Audio/data, 0.756Mbps, 30ms PDB, 100FPS Traffic Model** 
  + 1 source (Qualcomm) reported the capacity performances are in the range of {2.5~5.4}
    - * 1. CG

**For FR2 Dense Urban DL**, 5 sources (Nokia, Qualcomm, vivo, MediaTek, Ericsson) reported the evaluation results of capacity performance with DU, 100MHz bandwidth, DDDSU TDD format.

**General Observations**

* **For CG, 30Mbps, 15ms PDB, 60 FPS**
  + According to 5 sources (Nokia, Qualcomm, vivo, MediaTek, Ericsson), with SU-MIMO, the capacity performances are in the range of {5.1~16.16}.
* **For CG, 8Mbps, 15ms PDB, 60 FPS**
  + According to 2 sources (MediaTek, Qualcomm), with SU-MIMO, the capacity performances are in the range of {>20, 24}.
    - 1. InH Scenario
         1. VR/AR

Single-stream traffic model

**For FR2 Indoor Hotspot DL**, 5 sources (Nokia, Qualcomm, vivo, MediaTek, ZTE) reported the evaluation results of capacity performance with InH, 100MHz bandwidth, DDDSU TDD format.

**General Observations**

* **For VR/AR, 30Mbps, 10ms PDB, 60 FPS**
  + According to 5 sources (Nokia, Qualcomm, vivo, MediaTek, ZTE), with SU-MIMO, the capacity performances are in the range of {4.5~10.17}.
* **For VR/AR, 45Mbps, 10ms PDB, 60 FPS**
  + According to 4 sources (Nokia, Qualcomm, vivo, MediaTek), with SU-MIMO, the capacity performances are in the range of {2.5~6.13}.

Multi-stream traffic model

**For FR2 Dense Urban DL**, 2 sources (Qualcomm, vivo) reported the evaluation results of capacity performance with DU.

**General Observations**

* **For VR/AR, 30Mbps, [PDB\_I, PDB\_P] = [10ms, 10ms], [PER\_I, PER\_P] = [1%, 1%], GOP-Based I/P Frame Traffic Model** 
  + 1 source (vivo) reported the capacity performances are {5.73} with alpha = 1.5.
  + 1 source (vivo) reported the capacity performances are {3.53} with alpha = 2.
  + 1 source (vivo) reported the capacity performances are {2.29} with alpha = 3.
* **For VR/AR, 30Mbps, 10ms PDB, 60 FPS, [PDB\_I, PDB\_P] = [10ms, 10ms], [PER\_I, PER\_P] = [1%, 1%], Slice-Based I/P Frame Traffic Model** 
  + 1 source (vivo) reported the capacity performances are {8.23} with alpha = 1.5.
  + 1 source (vivo) reported the capacity performances are {8.24} with alpha = 2.
  + 1 source (vivo) reported the capacity performances are {8.23} with alpha = 3.
* **For Video, 30Mbps, 10ms PDB, 60 FPS, + Audio/data, 0.756Mbps, 30ms PDB, 100FPS Traffic Model** 
  + 1 source (Qualcomm) reported the capacity performances are in the range of {5~5.5}
    - * 1. CG

**For FR2 Indoor Hotspot DL**, 5 sources (Nokia, Qualcomm, vivo, MediaTek, ZTE) reported the evaluation results of capacity performance with InH, 100MHz bandwidth, DDDSU TDD format.

**General Observations**

* **For CG, 30Mbps, 15ms PDB, 60 FPS**
  + According to 5 sources (Nokia, Qualcomm, vivo, MediaTek, ZTE), with SU-MIMO, the capacity performances are in the range of {6~11}.
* **For CG, 8Mbps, 15ms PDB, 60 FPS**
  + According to 2 sources (MediaTek, Qualcomm), with SU-MIMO, the capacity performances are in the range of {>20, 27.5}.
    - 1. Summary of discussions

1. **Please provide your comment on the above observation.**

|  |  |
| --- | --- |
| Company | Comment |
| MTK | Fine with the results. |
| Huawei, HiSilicon | Our comments in Section 2.1.1.4 also applies here.  Maybe some typos below, please can relevant companies help double check?   * In 2.1.3.1.1.2, it seems the range of the result was captured from InH, not DU? The range should be changed to {5~5.5}? * In 2.1.3.2.1.2, it seems the range of the result was captured from DU, not InH? The range should be changed to {2.5~5.4}? |
|  |  |

* + 1. FR2 UL

**Summary of UL capacity evaluation results in FR2**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Scenario** | **App** | **PDB (ms)** | **Bit rate (Mbps)** | **Fps** | **MIMO** | **# of sources** | **Capacity** | **Note** |
| **DU** | **VR/CG (1 stream: Pose)** | 10 | 0.2 | 250 | SU | 3 | [7.5~>30] |  |
| **AR (1 stream)**  **AR (1 stream: Scene)** | 30 | 10 | 60 | SU | 3 | [1.29~9] |  |
| 15 | 20 | SU | 1 | [3.5] | Note 1 |
| 30 | SU | 1 | [5] | Note 1 |
| 60 | SU | 1 | [5] | Note 1 |
| **AR (2 streams: pose + scene)** | 10 (Pose),  30 (Scene) | 0.2 (Pose)  10 (Scene) | 250 (Pose)  60 (Scene) | SU | 1 | [1.5] |  |
| 0.2 (Pose)  20 (Scene) | SU | 1 | [2] |  |
| **InH** | **VR/CG (1 stream: Pose)** | 10 | 0.2 | 250 | SU | 3 | [7~26] |  |
| **AR (1 stream)**  **AR (1 stream: Scene)** | 30 | 10 | 60 | SU | 3 | [1~10] |  |
| 15 | 20 | SU | 1 | [5] | Note 1 |
| 30 | SU | 1 | [6] | Note 1 |
| 60 | SU | 1 | [6] | Note 1 |
| **AR (2 streams: pose + scene)** | 10 (Pose),  30 (Scene) | 0.2 (Pose)  10 (Scene) | 250 (Pose)  60 (Scene) | SU | 1 | [2.5~7.5] |  |
| 0.2 (Pose)  20 (Scene) | SU | 1 | [3.5] |  |
| Note 1: DDDUU | | | | | | | | |

* + - 1. DU Scenario
         1. VR/CG (Pose/control-stream)

**For FR2, Dense Urban UL**, 3 sources (vivo, Qualcomm, MediaTek), reported the evaluation results of capacity performance with DU, 100MHz bandwidth for VR/CG (Pose/control-stream).

**General Observations**

* **For VR/CG pose/control-stream, 0.2Mbps data rate, 10ms PDB, 250 FPS,**
  + According to 3 sources (vivo, MediaTek, Qualcomm), the capacity performances are in the range of {7.5~>30} with 100MHz bandwidth
  + According to 1 source (Qualcomm), the capacity performance is 8.5 with 400MHz bandwidth
    - * 1. AR (1 stream: Scene/video/data/voice-stream)

**For FR2, Dense Urban UL**, 3 sources (vivo, Qualcomm, MediaTek), reported the evaluation results of capacity performance with DU, 100MHz bandwidth for AR (scene/video/data/voice-stream).

**General Observations**

* **For AR 1-stream scene/video/data/voice-stream, 10Mbps data rate, 30ms PDB, 60FPS**
  + According to 3 sources (vivo, MediaTek, Qualcomm), the capacity performances are in the range of {1.29~9}.
* **For AR 1-stream scene/video/data/voice-stream, 20Mbps data rate, 30ms PDB, 60FPS**
  + According to 1 source (Qualcomm), the capacity performance is 5.
    - * 1. AR (2 streams: Pose/control-stream + scene/video/data/voice-stream)

**For FR2, Dense Urban UL**, 1 source (Qualcomm), reported the evaluation results of capacity performance with DU, 100MHz bandwidth for AR (pose/control-stream + scene/video/data/voice-stream).

**General Observations**

* **For AR 2-stream pose/control-stream with 0.2Mbps data rate, 10ms PDB, 250FPS and scene/video/ data/voice-stream with 10Mbps data rate, 30ms PDB, 60FPS,**
  + According to 1 source (Qualcomm), the capacity performance is 1.5 with TDD frame structure DDDSU and 4.5 with TDD frame structure DDDUU.
* **For AR 2-stream pose/control-stream with 0.2Mbps data rate, 10ms PDB, 250FPS and scene/video/ data/voice-stream with 20Mbps data rate, 30ms PDB, 60FPS,**
  + According to 1 source (Qualcomm), the capacity performance is 2 with TDD frame structure DDDUU.
    - 1. InH Scenario
         1. VR/CG (Pose/control-stream)

**For FR2, Indoor Hotspot UL**, 3 sources (vivo, Qualcomm, MediaTek), reported the evaluation results of capacity performance with InH, 100MHz bandwidth for VR/CG (Pose/control-stream).

**General Observations**

* **For VR/CG pose/control-stream with 0.2Mbps data rate, 10ms PDB, 250 FPS, for 100MHz bandwidth**
  + According to 3 sources (vivo, MediaTek, Qualcomm), the capacity performances are in the range of {7~26}.
    - * 1. AR (1 stream: Scene/video/data/voice-stream)

**For FR2, Indoor Hotspot UL**, 3 sources (vivo, Qualcomm, MediaTek), reported the evaluation results of capacity performance with InH, 100MHz bandwidth for AR (scene/video/data/voice-stream).

**General Observations**

* **For AR 1-stream scene/video/data/voice-stream, 10Mbps data rate, 30ms PDB, 60FPS**
  + According to 3 sources (vivo, MediaTek, Qualcomm), the capacity performances are in the range of {1~10}.
* **For AR 1-stream scene/video/data/voice-stream, 20Mbps data rate, 30ms PDB, 60FPS**
  + According to 1 source (Qualcomm), the capacity performance is 6.
    - * 1. AR (2 streams: Pose/control-stream + scene/video/data/voice-stream)

**For FR2, Indoor Hotspot UL**, 1 source (Qualcomm), reported the evaluation results of capacity performance with InH, 100MHz bandwidth for AR (pose/control-stream + scene/video/data/voice-stream).

**General Observations**

* **For AR 2-stream pose/control-stream with 0.2Mbps data rate, 10ms PDB, 250FPS and scene/video/ data/voice-stream with 10Mbps data rate, 30ms PDB, 60FPS**
  + According to 1 source (Qualcomm), the capacity performance is 2.5 with TDD frame structure DDDSU and 5 with TDD frame structure DDDUU.
* **For AR 2-stream pose/control-stream with 0.2Mbps data rate, 10ms PDB, 250FPS and scene/video/ data/voice-stream with 20Mbps data rate, 30ms PDB, 60FPS**
  + According to 1 source (Qualcomm), the capacity performance is 3.5 with TDD frame structure DDDUU.
    - 1. Summary of discussions

1. **Please provide your comment on the above observation.**

|  |  |
| --- | --- |
| Company | Comment |
| Futurewei | We highlighted above a few cases where the range of values are too big, and some harmonization/filtering of data is needed. |
| MTK | Fine with the results. |
| Huawei, HiSilicon | Our comments in Section 2.1.1.4 also applies here.  In 2.1.4.1.2, it seems the result of vivo and MediaTeK is based on DDDSU while QC is based on DDDUU. Maybe it’s better to capture separately? Btw, is this one of the possible reason for the large value range? |

* 1. Capacity Comparison for Different Parameters/Configurations
     1. Capacity Comparison for Different Data-rate

**General Observations**

* It is identified that the increase of data rate decreases VR/AR/CG system capacity.
  + It is observed that for VR/AR/CG, the system capacity is significantly decreased with data rate increase from 30 Mbps to 45 Mbps

**Detailed Observations:**

* **For FR1, Dense Urban, DL**
  + For VR/AR, 60FPS, 10ms PDB, with data rate increase from 30 Mbps to 45 Mbps,
    - 8 sources (Huawei, FUTUREWEI, OPPO, Xiaomi, MediaTek, Nokia, Ericsson, Qualcomm) reported the capacity performances are decreased from [5.1~10.6] to [2.1~6] by about [28.57%~58.82%] with SU-MIMO.
    - 7 sources (Huawei, FUTUREWEI, ZTE, vivo, Ericsson, Qualcomm, Interdigital) reported the capacity performances are decreased from [3.9~13.59] to [2.4~8.4] by about [37.31%~51.82%] with MU-MIMO.
* **For FR1, Indoor Hotspot, DL**
  + For VR/AR, 60FPS, 10ms PDB, with data rate increase from 30 Mbps to 45 Mbps,
    - 3 sources (Nokia, Ericsson, Qualcomm) reported the capacity performances are decreased from [5.2~8.5] to [3.27~4.8] by about [37.12%~43.53%] with SU-MIMO.
    - 6 sources (ZTE, vivo, CATT, Ericsson, Qualcomm, Interdigital) reported the capacity performances are decreased from [5.8~12] to [3~12] by about [0%~48.28%] with MU-MIMO.
* **For FR1, Urban Macro, DL**
  + For VR/AR, 60FPS, 10ms PDB, with data rate increase from 30 Mbps to 45 Mbps,
    - 4 sources (Huawei, FUTUREWEI, Ericsson, Qualcomm) reported the capacity performances are decreased from [4.4~7.24] to [1.8~4.4] by about [37.14%~60.00%] with SU-MIMO.
    - 6 sources (Huawei, FUTUREWEI, ZTE, vivo, Ericsson, Qualcomm) reported the capacity performances are decreased from [5.2~10] to [2.9~6] by about [36.36%~56.99%] with MU-MIMO.
* **For FR2, Dense urban, DL**
  + For VR/AR, 60FPS, 10ms PDB, with data rate increase from 30 Mbps to 45 Mbps
    - 1 source (vivo) reported the capacity performances are decreased from [13.44] to [8.2] by about [39.0%]
    - 1 source (MediaTek) reported the capacity performances are decreased from [10] to [4.7] by about [53.0%]
    - 1 source (Nokia) reported the capacity performances are decreased from [6.35] to [3.94] by about [38.0%]
    - 1 source (Ericsson) reported the capacity performances are decreased from [4.2] to [2] by about [52.4%]
    - 1 source (Qualcomm) reported
      * the capacity performances are decreased from [5.5] to [2] by about [63.6%] with 100MHz bandwidth
      * the capacity performances are decreased from [23.5] to [19] by about [19.1%] with 400MHz bandwidth
  + For CG, 60FPS, 15ms PDB, with data rate increase from 8 Mbps to 30 Mbps,
    - 1 source (MediaTek) reported the capacity performances are decreased from [>20] to [11]
    - 1 source (Qualcomm) reported
      * the capacity performances are decreased from [24] to [6] by about [75%] with 100MHz bandwidth
      * the capacity performances are decreased from [>30] to [25] with 400MHz bandwidth
* **For FR2, Indoor hotspot, DL**
  + For VR/AR, 60FPS, 10ms PDB, with data rate increase from 30 Mbps to 45 Mbps
    - 1 source (vivo) reported the capacity performances are decreased from [8.72] to [4.67] by about [46.4%]
    - 1 source (MediaTek) reported the capacity performances are decreased from [10] to [4.7] by about [53.0%]
    - 1 source (Nokia) reported the capacity performances are decreased from [10.17] to [6.09]
    - 1 source (Qualcomm) reported
      * the capacity performances are decreased from [5.5] to [3] by about [45.5%] with 100MHz bandwidth
      * the capacity performances are decreased from [26] to [20.5] by about [21.2%] with 400MHz bandwidth
  + For CG, 60FPS, 15ms PDB, with data rate increase from 8 Mbps to 30 Mbps,
    - 1 source (MediaTek) reported the capacity performances are decreased from [>20] to [11]
    - 1 source (Qualcomm) reported
      * the capacity performances are decreased from [27.5] to [6] by about [78.2%] with 100MHz bandwidth
      * the capacity performances are decreased from [>30] to [28] with 400MHz bandwidth
* **For FR2, Dense Urban UL,** 
  + For AR 1-stream scene/video/data/voice-stream, with data rate increase from 10 Mbps to 20 Mbps
    - 1 source (Qualcomm) reported the capacity performances are decreased from [9] to [5] by about [44.44%]
  + AR 2-stream pose/control-stream and scene/video/ data/voice-stream, with data rate increase from 10 Mbps to 20 Mbps for scene/video/ data/voice-stream
    - 1 source (Qualcomm) reported the capacity performances are decreased from [4.5] to [2] by about [55.56%]
* **For FR2, Indoor Hotspot UL,** 
  + For AR 1-stream scene/video/data/voice-stream, with data rate increase from 10 Mbps to 20 Mbps
    - 1 source (Qualcomm) reported the capacity performances are decreased from [10] to [6] by about [40%]
  + AR 2-stream pose/control-stream and scene/video/ data/voice-stream, with data rate increase from 10 Mbps to 20 Mbps for scene/video/ data/voice-stream
    - 1 source (Qualcomm) reported the capacity performances are decreased from [5] to [3.5] by about [30%]
      1. Summary of discussions

1. **Please provide your comment on the above observation.**

|  |  |
| --- | --- |
| Company | Comment |
| Futurewei | We highlighted above a few cases where the range of values are too big, and some harmonization/filtering of data is needed. |
| ZTE,  Sanechips | 1. For general observations, we suggest to separate description about VR/AR and CG. The reason is that the data rate of VR/AR includes 30Mbps and 45Mbps, while the data rate of CG includes 30Mbps and 8Mbps. Suggested modification is shown as below:   **General Observations**   * It is identified that the increase of data rate decreases VR/AR/CG system capacity.   + It is observed that for VR/AR~~/CG~~ the system capacity is significantly decreased with data rate increase from 30 Mbps to 45 Mbps   + It is observed that for CG the system capacity is significantly decreased with data rate increase from 8 Mbps to 30 Mbps   For FR1, the results of multiple companies are consolidated into one observation, while the results of each companies in FR2 are formulated into separate observations. We prefer to align the form about observation in FR2 and FR1. |
| MTK | * **For FR1, Indoor Hotspot, DL**   + For VR/AR, 60FPS, 10ms PDB, with data rate increase from 30 Mbps to 45 Mbps, * **For FR1, Urban Macro, DL**   + For VR/AR, 60FPS, 10ms PDB, with data rate increase from 30 Mbps to 45 Mbps,   MTK also has results in our contribution:  ***Observation 6: The downlink capacity result for AR/VR in FR1 is 6, 4 and 4 with 45Mbps data rates for Dense Urban, UMa and Indoor Hotspot****.* |
| Huawei, HiSilicon | We share similar view with ZTE to separate VR/AR (30-->45 Mbps) with CG (8 Mbps --> 30 Mbps). |
| LGE | It would be good to have the same number of decimal places for consistency. |
| QC | **I**t would be nice if we could have summary table showing capacity numbers for different rates. |
| Ericsson | Overall, the value of this comparison seems limited.  Having 2 decimal places in the gain/loss numbers seem excessive. The results are not that accurate. |
| Nokia, NSB | Please, revise the general observation given that CG was modeled for 8 and 30 mbps. |

* + 1. Capacity Comparison for Different PDB/PER Values

**General Observations**

* For single-stream DL or UL traffic,
  + the increase of PDB increases VR/AR/CG system capacity.
  + the increase of PER increases VR/AR/CG system capacity.
* For DL GOP-based I/P frame multi-stream traffic model,
  + the increase of PDB of I-frame significantly increases VR/AR/CG system capacity.
  + the decrease of PDB of P-frame slightly decreases VR/AR/CG system capacity.
  + the increase of PER of P-frame slightly increases VR/AR/CG system capacity.
  + the decrease of PER of I-frame significantly decreases VR/AR/CG system capacity.
* For DL slice-based I/P frame multi-stream traffic model,
  + the increase of PDB of I-frame slightly increases VR/AR/CG system capacity.
  + the decrease of PDB of P-frame slightly decreases VR/AR/CG system capacity.
  + the increase of PER of P-frame significantly increases VR/AR/CG system capacity.
  + the decrease of PER of I-frame slightly decreases VR/AR/CG system capacity.
    - 1. Single-stream traffic model

**Detailed Observations:**

* **For FR1, Dense Urban DL**
  + For single stream traffic model, 30Mbps, 60FPS
    - 1 source (Huawei) reported the capacity performances are decreased from [11.5] with 10ms PDB to [6.3] with 7ms PDB by about [45.22%] with MU-MIMO
    - 1 source (Huawei) reported the capacity performances are increased from [11.5] with 10ms PDB to [14.6] with 13ms PDB by about [26.96%] with MU-MIMO
    - 10 sources (Huawei, CEWiT, vivo, OPPO, Xiaomi, MediaTek, Nokia, Ericsson, Qualcomm, Intel) reported the capacity performances are increased from [4.05~10.6] with 10ms PDB (VR/AR) to [5.57~13] with 15ms PDB (CG) by about [11.96%~49.02%] with SU-MIMO.
    - 8 sources (Huawei, ZTE, vivo, CATT, Interdigital, Ericsson, Qualcomm, Intel) reported the capacity performances are increased from [3.9~13.59] with 10ms PDB (VR/AR) to [5~19.65] with 15ms PDB (CG) by about [11.96%~49.02%] with MU-MIMO.
    - 1 source (Huawei) reported the capacity performances are decreased from [11.5] with PER = 1% to [9.9] PER = 0.5% by about [13.91%] with MU-MIMO.
    - 1 source (Huawei) reported the capacity performances are increased from [11.5] with PER = 1% to [16.8] PER = 5% by about [46.09%] with MU-MIMO.
  + For single stream traffic model, 45Mbps, 60FPS
    - 1 source (OPPO) reported the capacity performances are increased from [4.4~5.2] with 10ms PDB to [6.3~6.4] with 15ms PDB by about [16.67%~45.45%] with SU-MIMO.
* **For FR1, Indoor Hotspot DL**
  + For single stream traffic model, 30Mbps, 60FPS,
    - 1 source (CATT) reported the capacity performances are decreased from [12] with 10ms PDB to [8] with 7ms PDB by about [33.33%] with MU-MIMO
    - 5 sources (vivo, Nokia, Ericsson, ITRI, Qualcomm) reported the capacity performances are increased from [4.85~8.5] with 10ms PDB (VR/AR) to [5.96~10.95] with 15ms PDB (CG) by about [14.62%~93.81%] with SU-MIMO.
    - 6 sources (ZTE, vivo, CATT, Interdigital, Ericsson, Qualcomm) reported the capacity performances are increased from [5.8~12] with 10ms PDB (VR/AR) to [7.2~16.2] with 15ms PDB (CG) by about [24.14%~50.00%] with MU-MIMO.
* **For FR1, Urban Macro DL,** 
  + For single stream traffic model, 30Mbps, 60FPS,
    - 5 sources (Huawei, CEWiT, vivo, Ericsson, Qualcomm) reported the capacity performances are increased from [4.4~7.24] with 10ms PDB (VR/AR) to [4.08~10.33] with 15ms PDB (CG) by about [22.73%~44.44%] with SU-MIMO.
    - 5 sources (Huawei, vivo, Ericsson, Qualcomm, ZTE) reported the capacity performances are increased from [5.2~10] with 10ms PDB (VR/AR) to [8~14.33] with 15ms PDB (CG) by about [16.00%~62.47%] with MU-MIMO.
* **For FR1, Dense Urban, UL,**
  + For AR 1-stream scene/video/data/voice-stream, 10Mbps, 60FPS,
    - 1 source (Huawei) reported the capacity performances are decreased from [8.1] with 30ms PDB to [<1] with 10ms PDB by about [87.65%]
    - 1 source (Huawei) reported the capacity performances are decreased from [8.1] with 30ms PDB to [5.4] with 15ms PDB by about [33.33%]
    - 1 source (Huawei) reported the capacity performances are increased from [8.1] with 30ms PDB to [8.3] with 60ms PDB by about [2.5%]
  + For AR 1-stream scene/video/data/voice-stream, 10Mbps, PDB 30ms, 60FPS,
    - 1 source (Huawei) reported the capacity performances are increased from [8.1] with 1% PER to [8.3] with 5% PER by about [2.5%]
    - 1 source (Huawei) reported the capacity performances are increased from [8.1] with 1% PER to [8.4] with 10% PER by about [3.7%]
* **For FR2, Dense urban, DL**
  + For single stream traffic model, 30Mbps, with PDB increase from 10ms (VR/AR) to 15ms (CG)
    - 1 source (vivo) reported the capacity performances are increased from [13.44] to [16.16] by about [20.2%]
    - 1 source (MediaTek) reported the capacity performances are increased from [10] to [11] by about [10.0%]
    - 1 source (Nokia) reported the capacity performances are increased from [8.25] to [6.35] by about [23.0%]
    - 1 source (Ericsson) reported the capacity performances are increased from [4.2] to [5.1] by about [21.4%] with DDDUU TDD format
    - 1 source (Qualcomm) reported
      * + the capacity performances are increased from [5.5] to [6] by about [9.1%] with 100MHz bandwidth
        + the capacity performances are increased from [23.5] to [25] by about [6.4%] with 400MHz bandwidth
* **For FR2, Indoor Hotspot, DL**
  + For single stream traffic model, 30Mbps, with PDB increase from 10ms (VR/AR) to 15ms (CG)
    - 1 source (ZTE) reported the capacity performances are both [7.8]
    - 1 source (vivo) reported the capacity performances are increased from [8.72] to [9.91] by about [13.7%]
    - 1 source (MediaTek) reported the capacity performances are increased from [10] to [11] by about [13.6%]
    - 1 source (Nokia) reported the capacity performances are increased from [10.17] to [11.45]
    - 1 source (Qualcomm) reported
      * + the capacity performances are increased from [5.5] to [6] by about [9.1%] with 100MHz bandwidth
        + the capacity performances are increased from [26] to [28] by about [7.69%] with 400MHz bandwidth
* **For FR2, Dense Urban UL**
  + For AR 1-stream scene/video/data/voice-stream, 20Mbps, 60FPS, with PDB decrease from 30 ms to 15ms,
    - 1 source (Qualcomm) reported the capacity performances are decreased from [5] with 30 ms PDB to [3.5] with 15 ms PDB by [30%]
    - 1 source (Qualcomm) reported the capacity performances are not affected with PDB increase from 30 ms to 60ms
* **For FR2, Indoor Hotspot UL,**
  + For AR 1-stream scene/video/data/voice-stream, 20Mbps, 60FPS, with PDB decrease from 30 ms to 15ms,
    - 1 source (Qualcomm) reported the capacity performances are decreased from [6] with 30 ms PDB to [5] with 15 ms PDB by [16.67%]
    - 1 source (Qualcomm) reported the capacity performances are not affected with PDB increase from 30 ms to 60ms
      1. Multi-stream traffic model

**Detailed Observations:**

* **For FR1, Dense Urban, DL**
  + For VR/AR, 30Mbps, 60 FPS, **GOP-Based I/P Frame multi-stream Traffic Model**,
    - With P\_PDB = 10ms and I\_PDB increase from 10ms to 15ms,
      * 1 source (vivo) reported the capacity performances are increased from [6.74] to [12.58] by about [31.7%] with I\_PER = 1% and P\_PER = 1%, with alpha = 1.5
      * 1 source (Huawei) the capacity performances are increased from [6.7] to [9.1] by about [35.82%] with I\_PER = 1% and P\_PER = 1%, with alpha = 2
      * 1 source (vivo) the capacity performances are increased from [5.2] to [10.06] by about [93.46%] with I\_PER = 1% and P\_PER = 1%, with alpha = 2
      * 1 source (MediaTek) the capacity performances are increased from [6] to [10] by about [66.67%] with I\_PER = 1% and P\_PER = 1%, with alpha = 2
      * 1 source (vivo) reported the capacity performances are increased from [2.21] to [5.73] by about [43.7%] with I\_PER = 1% and P\_PER = 1%, with alpha = 3
    - With I\_PDB = 15ms and P\_PDB decrease from 10ms to 9ms,
      * 1 source (vivo) reported the capacity performances are decreased from [12.58] to [12.39] by about [2.3%] with I\_PER = 1% and P\_PER = 1%, with alpha = 1.5
      * 1 source (Huawei) the capacity performances are decreased from [9.1] to [8.8] by about [3.30%] with I\_PER = 1% and P\_PER = 1%, with alpha = 2
      * 1 source (vivo) the capacity performances are decreased from [10.06] to [9.19] by about [8.65%] with I\_PER = 1% and P\_PER = 1%, with alpha = 2
      * 1 source (vivo) reported the capacity performances are decreased from [5.73] to [5.69] by about [2.3%] with I\_PER = 1% and P\_PER = 1%, with alpha = 3
    - With I\_PER = 1% and P\_PER increase from 1% to 5%,
      * 1 source (vivo) reported the capacity performances are bith [6.74] with I\_PDB = 10ms and P\_PDB = 10ms, with alpha = 1.5
      * 1 source (Huawei) the capacity performances are both [6.7] with I\_PER = 1% and P\_PER = 1%, with alpha = 2
      * 1 source (ZTE) the capacity performances are [10.8~10.9] with I\_PER = 1% and P\_PER = 1%, with alpha = 2
      * 1 source (vivo) the capacity performances are both [5.2] with I\_PER = 1% and P\_PER = 1%, with alpha = 2
      * 1 source (MediaTek) the capacity performances are both [6] with I\_PER = 1% and P\_PER = 1%, with alpha = 2
      * 1 source (vivo) reported the capacity performances are both [2.21] with I\_PDB = 10ms and P\_PDB = 10ms, with alpha = 3
    - With I\_PER decrease from 1% to 0.5% and P\_PER = 5%,
      * 1 source (vivo) reported the capacity performances are decreased from [6.74] to [6.39] by about [7.3%] with I\_PDB = 10ms and P\_PDB = 10ms, with alpha = 1.5
      * 1 source (Huawei) the capacity performances are decreased from [6.7] to [6] by about [10.45%] with I\_PER = 1% and P\_PER = 1%, with alpha = 2
      * 1 source (vivo) the capacity performances are decreased from [5.2] to [4.74] by about [8.85%] with I\_PER = 1% and P\_PER = 1%, with alpha = 2
      * 1 source (MediaTek) the capacity performances are decreased from [6] to [2] by about [66.67%] with I\_PER = 1% and P\_PER = 1%, with alpha = 2
      * 1 source (vivo) reported the capacity performances are decreased from [2.21] to [2.09] by about [11.4%] with I\_PDB = 10ms and P\_PDB = 10ms, with alpha = 3
  + For VR/AR, 45Mbps, 60 FPS, GOP-Based I/P Frame multi-stream Traffic Model,
    - With P\_PDB = 10ms and I\_PDB increase from 10ms to 15ms,
      * 1 source (MediaTek) the capacity performances are increased from [2] to [4] by about [100%] with I\_PER = 1% and P\_PER = 1%, with alpha = 2
    - With I\_PER = 1% and P\_PER increase from 1% to 5%,
      * 1 source (MediaTek) the capacity performances are both [2] with I\_PER = 1% and P\_PER = 1%, with alpha = 2
* **For FR1, Dense Urban, DL**
  + For VR/AR, 30Mbps, 60 FPS, **Slice-Based I/P Frame multi-stream Traffic Model**,
    - With P\_PDB = 10ms and I\_PDB = 10ms or 15ms
      * 1 source (vivo) reported the capacity performances are increased from [13.78] to [13.93] by about [1.09%] with I\_PER = 1% and P\_PER = 1%, with alpha = 1.5
      * 1 source (vivo) reported the capacity performances are increased from [13.69] to [13.73] by about [0.29%] with I\_PER = 1% and P\_PER = 1%, with alpha = 2
      * 1 source (vivo) reported the capacity performances are increased from [13.77] to [13.84] by about [0.51%] with I\_PER = 1% and P\_PER = 1%, with alpha = 3
    - With I\_PDB = 15ms and P\_PDB decrease from 10ms to 9ms
      * 1 source (vivo) reported the capacity performances are decreased from [13.93] to [13.27] by about [4.74%] with I\_PER = 1% and P\_PER = 1%, with alpha = 1.5
      * 1 source (vivo) reported the capacity performances are decreased from [13.73] to [13.36] by about [2.69%] with I\_PER = 1% and P\_PER = 1%, with alpha = 2
      * 1 source (vivo) reported the capacity performances are decreased from [13.84] to [13.46] by about [2.75%] with I\_PER = 1% and P\_PER = 1%, with alpha = 3
    - With I\_PER = 1% and P\_PER increase from 1% to 5%,
      * 1 source (vivo) reported the capacity performances are increased from [13.78] to [16.74] by about [21.48%] with I\_PDB = 10ms and P\_PDB = 10ms, with alpha = 1.5
      * 1 source (Huawei) reported the capacity performances are increased from [14.9] to [17.3] by about [16.11%] with I\_PDB = 10ms and P\_PDB = 10ms, with alpha = 2
      * 1 source (ZTE) reported the capacity performances are increased from [12.7] to [14.6] by about [14.96%] with I\_PDB = 10ms and P\_PDB = 10ms, with alpha = 2
      * 1 source (vivo) reported the capacity performances are increased from [13.69] to [16.84] by about [23.01%] with I\_PDB = 10ms and P\_PDB = 10ms, with alpha = 2
      * 1 source (vivo) reported the capacity performances are increased from [13.77] to [16.89] by about [22.66%] with I\_PDB = 10ms and P\_PDB = 10ms, with alpha = 3
    - With I\_PER decrease from 1% to 0.5% and P\_PER = 5%,
      * 1 source (vivo) reported the capacity performances are both [16.74] with I\_PDB = 10ms and P\_PDB = 10ms, with alpha = 1.5
      * 1 source (Huawei) reported the capacity performances are decreased from [17.3] to [15.7] by about [9.25%] with I\_PDB = 10ms and P\_PDB = 10ms, with alpha = 2
      * 1 source (vivo) reported the capacity performances are decreased from [16.84] to [16.59] by about [1.48%] with I\_PDB = 10ms and P\_PDB = 10ms, with alpha = 2
      * 1 source (vivo) reported the capacity performances are both [16.89%] with I\_PDB = 10ms and P\_PDB = 10ms, with alpha = 3
* **For FR2, Indoor Hotspot, DL**
  + For VR/AR, 30Mbps, 60 FPS, GOP-Based I/P Frame multi-stream Traffic Model,
    - 1 source (vivo) reported with P\_PDB = 10ms and I\_PDB increase from 10ms to 15ms,
      * the capacity performances are increased from [5.37] to [7.07] by about [31.7%] with I\_PER = 1% and P\_PER = 1%, with alpha = 1.5
      * the capacity performances are increased from [3.53] to [5.23] by about [48.2%] with I\_PER = 1% and P\_PER = 1%, with alpha = 2
      * the capacity performances are increased from [2.29] to [3.29] by about [43.7%] with I\_PER = 1% and P\_PER = 1%, with alpha = 3
    - 1 source (vivo) reported with I\_PDB = 15ms and P\_PDB decrease from 10ms to 9ms,
      * the capacity performances are decreased from [7.07] to [6.91] by about [2.3%] with I\_PER = 1% and P\_PER = 1%, with alpha = 1.5
      * the capacity performances are decreased from [5.23] to [4.99] by about [4.6%] with I\_PER = 1% and P\_PER = 1%, with alpha = 2
      * the capacity performances are both [3.29] with I\_PER = 1% and P\_PER = 1%, with alpha = 3
    - 1 source (vivo) reported with I\_PER = 1% and P\_PER increase from 1% to 5%,
      * the capacity performances are increased from [5.37] to [5.43] by about [1.1%] with I\_PDB = 10ms and P\_PDB = 10ms, with alpha = 1.5
      * the capacity performances are increased from [3.53] to [3.87] by about [9.6%] with I\_PDB = 10ms and P\_PDB = 10ms, with alpha = 2
      * the capacity performances are both [2.29] with I\_PDB = 10ms and P\_PDB = 10ms, with alpha = 3
    - 1 source (vivo) reported with I\_PER decrease from 1% to 0.5% and P\_PER = 5%,
      * the capacity performances are decreased from [5.37] to [4.98] by about [7.3%] with I\_PDB = 10ms and P\_PDB = 10ms, with alpha = 1.5
      * the capacity performances are decreased from [3.53] to [2.73] by about [22.7%] with I\_PDB = 10ms and P\_PDB = 10ms, with alpha = 2
      * the capacity performances are decreased from [2.29] to [2.03] by about [11.4%] with I\_PDB = 10ms and P\_PDB = 10ms, with alpha = 3
* **For FR2, Indoor Hotspot, DL**
  + For VR/AR, 30Mbps, 60 FPS, Slice-Based I/P Frame multi-stream Traffic Model,
    - 1 source (vivo) reported with P\_PDB = 10ms and I\_PDB = 10ms or 15ms
      * the capacity performances are [8.23~8.24] with I\_PER = 1% and P\_PER = 1%, with alpha = 1.5
      * the capacity performances are [8.24] with I\_PER = 1% and P\_PER = 1%, with alpha = 2
      * the capacity performances are [8.23~8.28] with I\_PER = 1% and P\_PER = 1%, with alpha = 3
    - 1 source (vivo) reported with I\_PDB = 15ms and P\_PDB decrease from 10ms to 9ms
      * the capacity performances are decreased from [8.24] to [8.14] by about [1.2%] with I\_PER = 1% and P\_PER = 1%, with alpha = 1.5
      * the capacity performances are decreased from [8.24] to [8.18] by about [0.7%] with I\_PER = 1% and P\_PER = 1%, with alpha = 2
      * the capacity performances are decreased from [8.28] to [8.22] by about [0.7%] with I\_PER = 1% and P\_PER = 1%, with alpha = 3
    - 1 source (vivo) reported with I\_PER = 1% and P\_PER increase from 1% to 5%,
      * the capacity performances are increased from [8.23] to [10.61] by about [28.9%] with I\_PDB = 10ms and P\_PDB = 10ms, with alpha = 1.5
      * the capacity performances are increased from [8.24] to [10.73] by about [30.2%] with I\_PDB = 10ms and P\_PDB = 10ms, with alpha = 2
      * the capacity performances are increased from [8.23] to [10.61] by about [28.9%] with I\_PDB = 10ms and P\_PDB = 10ms, with alpha = 3
    - 1 source (vivo) reported with I\_PER decrease from 1% to 0.5% and P\_PER = 5%,
      * the capacity performances are decreased from [10.61] to [10.46] by about [1.4%] with I\_PDB = 10ms and P\_PDB = 10ms, with alpha = 1.5
      * the capacity performances are decreased from [10.73] to [10.46] by about [2.5%] with I\_PDB = 10ms and P\_PDB = 10ms, with alpha = 2
      * the capacity performances are decreased from [10.61] to [10.38] by about [2.2%] with I\_PDB = 10ms and P\_PDB = 10ms, with alpha = 3
      1. Summary of discussions

1. **Please provide your comment on the above observation.**

|  |  |
| --- | --- |
| Company | Comment |
| ZTE,Sanechips | 1. In section 2.2.2.1, our results for ‘For single stream traffic model, 30Mbps, with PDB increase from 10ms (VR/AR) to 15ms (CG) in FR2, Indoor Hotspot, DL’ are increased from [7.8] to [9.9] by about [26.9%], which are not correctly captured. The suggested modification is as below:  * **For FR2, Indoor Hotspot, DL**   + For single stream traffic model, 30Mbps, with PDB increase from 10ms (VR/AR) to 15ms (CG)     - 1 source (ZTE) reported the capacity performances are ~~both [7.8]~~increased from [7.8] to [9.9] by about [26.9%]  1. In our contribution R1-2108889, our simulation results for [PER\_I, PER\_P, PDB\_I, PDB\_P] = [10%, 1%, 10 ms, 10 ms] are not captured.   We suggest to add the following observation in section 2.2.2.2:   * **For FR1, Dense Urban, DL**   + For VR/AR, 30Mbps, 60 FPS, **GOP-Based I/P Frame multi-stream Traffic Model**,     - With P\_PER = 1% and I\_PER increase from 1% to 10%,       * 1 source (ZTE) reported the capacity performances are increased from [10.8] to [12.2] by about [12.96%] with I\_PDB = 10ms and P\_PDB = 10ms, with alpha = 2 |
| MTK | * **For FR1, Indoor Hotspot DL**   + For single stream traffic model, 30Mbps, 60FPS, * **For FR1, Urban Macro DL,**    + For single stream traffic model, 30Mbps, 60FPS,   MTK also has results in our contribution:  ***Observation 1: The downlink capacity result for Cloud gaming in FR1 is larger than 20 with 8Mbps data rates for all evaluated scenarios and is 13, 9 and 9 with 30Mbps data rates for Dense Urban, UMa and Indoor Hotspot, respectively.*** |
| LGE | Under General Observations, it would be very subjective to say “significantly” and “slightly”. We may need to think about whether/how to quantify them. |
| QC | It would be nice if we could summary table capturing performance increases/decrease. |
| Ericsson | Overall, the value of this exercise feels limited. The conclusion could be there is a significant gain of increasing the PDB and/or the PER – but what will RAN1 do with that information? |
| Nokia, NSB | 1. For single-stream DL or UL traffic    * the increase of PER increases VR/AR/CG system capacity.   That is not general observation as modeled by one company only. Please move it to Source specific observations. Moreover, this was shown for only a subset of applications and scenarios so the observation should reflect the details.  2) For DL GOP-based I/P frame multi-stream traffic model,   * + the increase of PDB of I-frame significantly increases VR/AR/CG system capacity.   + the decrease of PDB of P-frame slightly decreases VR/AR/CG system capacity.   There is no CG for this type of model, please remove it (applicable to all the cases below). Also, word “slightly” does not really meaningful here since the PDB was also just slight decreased. With larger decrease of PDB the conclusion could be different. Please, consider revisiting it by adding more results or removing it.  3) For DL GOP-based I/P frame multi-stream traffic model   * + the increase of PER of P-frame slightly increases VR/AR/CG system capacity.   From the numerical results, in DU there is no increase at all. Please, consider revising this observation.  4) For DL GOP-based I/P frame multi-stream traffic model   * the decrease of PER of I-frame significantly decreases VR/AR/CG system capacity.   Please, consider revising this observation since from the results the increase is really minor.  5) For DL slice-based I/P frame multi-stream traffic model,   * + the increase of PDB of I-frame slightly increases VR/AR/CG system capacity.   + the decrease of PDB of P-frame slightly decreases VR/AR/CG system capacity.   Please, move these observations to source specific since only one company modeled it. For the second subbulet, the concern is similar as earlier. The PDB is decreased from 10 ms to 9 ms, it is not obvious that further decrease in PDB will not make the conclusion to be different from the current one. Please, consider revisiting it. |

* + 1. Capacity Comparison for SU-MIMO and MU-MIMO

**General Observations**

* MU-MIMO can increase XR capacity performance compared to SU-MIMO, for InH/DU/UMa in DL and InH/DU in UL.

**Detailed Observations:**

* **For FR1, Dense Urban, DL**
  + For CG, 8Mbps, 60FPS, 15ms PDB,
    - 1 source (Ericsson) reported the capacity performances are both equal to [>36] with SU-MIMO and with MU-MIMO
    - 1 source (Qualcomm) reported the capacity performances are increased from [24.4] with SU-MIMO to [56.6] with MU-MIMO by about [131.97%]
  + For CG, 30Mbps, 60FPS, 15ms PDB,
    - 5 sources (Huawei, vivo, Ericsson, Qualcomm, Intel) reported the capacity performances are increased from [6.17~11.68] with SU-MIMO to [7.47~19.65] with MU-MIMO by about [21.07%~111.84%]
  + For VR/AR, 30Mbps, 60FPS, 10ms PDB,
    - 6 sources (Huawei, FUTUREWEI, vivo, Ericsson, Qualcomm, Intel) reported the capacity performances are increased from [5.1~9.7] with SU-MIMO to [7.15~13.59] with MU-MIMO by about [19.35%~115.69%]
  + For VR/AR, 45Mbps, 60FPS, 10ms PDB,
    - 1 source (Huawei) reported the capacity performances are increased from [2.1] with SU-MIMO to [5.3] with MU-MIMO by about [152.38%]
    - 1 source (Futurewei) reported the capacity performances are increased from [6] with SU-MIMO to [7.6] with MU-MIMO by about [26.67%]
    - 1 source (Ericsson) reported the capacity performances are increased from [5.3] with SU-MIMO to [6.4] with MU-MIMO by about [20.75%]
    - 1 source (Qualcomm) reported the capacity performances are increased from [5.2] with SU-MIMO to [8.4] with MU-MIMO by about [61.54%]
* **For FR1, Indoor Hotspot, DL**
  + For CG, 8Mbps, 60FPS, 15ms PDB,
    - 1 source (Ericsson) reported the capacity performances are both equal to [>38.7] with SU-MIMO and with MU-MIMO
    - 1 source (Qualcomm) reported the capacity performances are increased from [22.3] with SU-MIMO to [44.1] with MU-MIMO by about [97.76%]
  + For CG, 30Mbps, 60FPS, 15ms PDB,
    - 1 source (vivo) reported the capacity performances are increased from [10.14] with SU-MIMO to [16.2] with MU-MIMO by about [59.76%]
    - 1 source (Ericsson) reported the capacity performances are increased from [10.5] with SU-MIMO to [12.3] with MU-MIMO by about [17.14%]
    - 1 source (Qualcomm) reported the capacity performances are increased from [8.4] with SU-MIMO to [12.8] with MU-MIMO by about [52.38%]
  + For VR/AR, 30Mbps, 60FPS, 10ms PDB,
    - 1 source (vivo) reported the capacity performances are increased from [8.27] with SU-MIMO to [10.8] with MU-MIMO by about [30.59%]
    - 1 source (Ericsson) reported the capacity performances are increased from [8.5] with SU-MIMO to [9.2] with MU-MIMO by about [8.24%]
    - 1 source (Qualcomm) reported the capacity performances are increased from [7] with SU-MIMO to [10.3] with MU-MIMO by about [47.14%]
  + For VR/AR, 45Mbps, 60FPS, 10ms PDB,
    - 1 source (Ericsson) reported the capacity performances are increased from [4.8] with SU-MIMO to [5.4] with MU-MIMO by about [12.50%]
    - 1 source (Qualcomm) reported the capacity performances are increased from [4.3] with SU-MIMO to [6.4] with MU-MIMO by about [48.84%]
* **For FR1, Urban Macro, DL**
  + For CG, 8Mbps, 60FPS, 15ms PDB,
    - 1 source (Ericsson) reported the capacity performances are increased from [32.9] with SU-MIMO to [>36] with MU-MIMO by about [9.42%]
    - 1 source (Qualcomm) reported the capacity performances are increased from [17.5] with SU-MIMO to [23.8] with MU-MIMO by about [36.00%]
  + For CG, 30Mbps, 60FPS, 15ms PDB,
    - 1 source (Huawei) reported the capacity performances are increased from [6.5] with SU-MIMO to [12.4] with MU-MIMO by about [90.77%]
    - 1 source (vivo) reported the capacity performances are increased from [10.33] with SU-MIMO to [14.33] with MU-MIMO by about [38.72%]
    - 1 source (Ericsson) reported the capacity performances are increased from [9.2] with SU-MIMO to [12.1] with MU-MIMO by about [31.52%]
    - 1 source (Qualcomm) reported the capacity performances are increased from [5.4] with SU-MIMO to [8] with MU-MIMO by about [48.15%]
  + For VR/AR, 30Mbps, 60FPS, 10ms PDB,
    - 1 source (Futurewei) reported the capacity performances are increased from [7] with SU-MIMO to [7.7] with MU-MIMO by about [10%]
    - 1 source (vivo) reported the capacity performances are increased from [7.24] with SU-MIMO to [8.82] with MU-MIMO by about [21.82%]
    - 1 source (Ericsson) reported the capacity performances are increased from [7.2] with SU-MIMO to [8.7] with MU-MIMO by about [20.83%]
    - 1 source (Qualcomm) reported the capacity performances are increased from [4.4] with SU-MIMO to [5.2] with MU-MIMO by about [18.18%]
  + For VR/AR, 45Mbps, 60FPS, 10ms PDB,
    - 1 source (Huawei) reported the capacity performances are increased from [1.8] with SU-MIMO to [4] with MU-MIMO by about [122.22%]
    - 1 source (Futurewei) reported the capacity performances are increased from [4.4] with SU-MIMO to [4.9] with MU-MIMO by about [11.36%]
    - 1 source (Ericsson) reported the capacity performances are increased from [3.7] with SU-MIMO to [4.6] with MU-MIMO by about [24.32%]
    - 1 source (Qualcomm) reported the capacity performances are increased from [2.4] with SU-MIMO to [2.9] with MU-MIMO by about [20.83%]
* **For FR1, Dense Urban, UL**
  + For UL pose/control-stream, 0.2Mbps, 250 FPS, 10ms PDB,
    - 1 source (Qualcomm) reported the capacity performances are increased from [224.9] with SU-MIMO to [>240] with MU-MIMO by about [6.7%]
  + For UL scene/video/data/voice-stream, 10Mbps, 60FPS, 30ms PDB,
    - 1 source (Qualcomm) reported the capacity performances are increased from [4.5] with SU-MIMO to [7.3] with MU-MIMO by about [62.2%]
    - 1 source (Intel) reported the capacity performances are increased from [7.8] with SU-MIMO to [10.49] with MU-MIMO by about [34.5%]
  + For 2 streams: UL pose/control-stream, 0.2Mbps, 250 FPS, 10ms PDB + UL scene/video/data/voice-stream, 10Mbps, 60FPS, 30ms PDB,
    - 1 source (Qualcomm) reported the capacity performances are increased from [4.1] with SU-MIMO to [5.8] with MU-MIMO by about [41.46%]
    - 1 source (Intel) reported the capacity performances are increased from [3.35] with SU-MIMO to [4.57] with MU-MIMO by about [36.4%]
* **For FR1, Indoor Hotspot, UL**
  + For UL pose/control-stream, 0.2Mbps, 250 FPS, 10ms PDB,
    - 1 source (Qualcomm) reported the capacity performances are increased from [198] with SU-MIMO to [>240] with MU-MIMO by about [21.2%]
  + For UL scene/video/data/voice-stream, 10Mbps, 60FPS, 30ms PDB,
    - 1 source (Qualcomm) reported the capacity performances are increased from [4.4] with SU-MIMO to [7.1] with MU-MIMO by about [61.36%]
  + For 2 streams: UL pose/control-stream, 0.2Mbps, 250 FPS, 10ms PDB + UL scene/video/data/voice-stream, 10Mbps, 60FPS, 30ms PDB,
    - 1 source (Qualcomm) reported the capacity performances are increased from [4.1] with SU-MIMO to [7.4] with MU-MIMO by about [80.5%]
* **For FR1, Urban Macro, UL**
  + For UL pose/control-stream, 0.2Mbps, 250 FPS, 10ms PDB,
    - 1 source (Qualcomm) reported the capacity performances are increased from [143] with SU-MIMO to [>240] with MU-MIMO by about [67.8%]
  + For UL scene/video/data/voice-stream, 10Mbps, 60FPS, 30ms PDB,
    - 1 source (Qualcomm) reported the capacity performances are [0] with SU-MIMO and [0] with MU-MIMO
  + For 2 streams: UL pose/control-stream, 0.2Mbps, 250 FPS, 10ms PDB + UL scene/video/data/voice-stream, 10Mbps, 60FPS, 30ms PDB,
    - 1 source (Qualcomm) reported the capacity performances are [0] with SU-MIMO and [0] with MU-MIMO
      1. Summary of discussions

1. **Please provide your comment on the above observation.**

|  |  |
| --- | --- |
| Company | Comment |
| MTK | Fine with the results. |
| QC | Having summary table would help. |
| Ericsson | Overall, the value of this exercise feels limited. The conclusion could be there is a significant gain of MU-MIMO compared to SU-MIMO – but what will RAN1 do with that information? |
| Nokia, NSB | The range for gains from MU-MIMO as compared to SU-MIMO can vary from 8% to 152%. This is quite large range, and more clarifications are required to properly capture the gains from MU-MIMO. Current list of results does not show whether the gains from MU-MIMO motivate its complexity or not. |

* + 1. Capacity Comparison: DL vs UL

**General Observations**

* It is observed that DL capacity is lower than UL capacity
  + For VR/CG DL 30/45MBps vs. UL 0.2 Mbps
* It is observed that DL capacity and UL capacity are roughly in the same range
  + For CG DL 8MBps vs. UL 0.2 Mbps
  + For AR DL 30/45MBps vs. UL AR (1 stream: Scene/video/data/voice-stream 10Mbps, or 2 streams: Pose/control-stream + scene/video/data/voice-stream 10Mbps) for InH/DU
* It is observed that UL capacity is lower than DL capacity
  + For AR DL 30/45MBps vs. UL AR (1 stream: Scene/video/data/voice-stream 10Mbps, or 2 streams: Pose/control-stream + scene/video/data/voice-stream 10Mbps) for UMa
    - 1. Summary of discussions

1. **Please provide your comment on the above observation.**

|  |  |
| --- | --- |
| Company | Comment |
| MTK | For AR DL 45MBps vs. UL AR for InH/DU, we think the DL capacity is lower than UL capacity. |
| Huawei, HiSilicon | Since the source set of DL and UL might be different, such comparison might be inaccurate.  We suggest to remove this sub-section. |
| QC | It would be beneficial to capture how much low and how much high for DL and UL?  It would be good to have summary table. |
| Ericsson | We partially agree with Huawei – there is no point in comparing AR/VR DL with AR UL, since they are different services. The comparison between AR/VR DL and UL 0.2Mbps is relevant, since the DL and UL traffic will be present at the same time. |

* + 1. Impact of Jitter on Capacity

**General Observations**

* For DL, Jitter degrades XR capacity performance.
* For UL, Jitter may or may not affect XR capacity performance

**Detailed Observations:**

* **For FR1, Dense Urban DL,** 
  + For CG, 30Mbps, 60FPS, 15ms PDB,
    - 1 source (Intel) reported the capacity performances are increased from [7.47] with jitter to [8.20] without jitter by about [9.77%] with MU-MIMO.
  + For VR/AR, 30Mbps, 60FPS, 10ms PDB,
    - 1 source (Huawei) reported the capacity performances are increased from [11.5] with jitter to [11.6] without jitter by about [0.87%] with MU-MIMO.
    - 1 source (Intel) reported the capacity performances are increased from [7.15] with jitter to [7.5] without jitter by about [4.90%] with MU-MIMO.
    - 1 source (OPPO) reported the capacity performances are decreased from [7.4] with jitter to [7.1] without jitter by about [4.05%] with SU-MIMO.
    - 1 source (OPPO) reported the capacity performances are increased from [8.4~9.2] with jitter to [9~10.5] without jitter by about [7.14%~14.13%] with SU-MIMO.
  + For VR/AR, 30Mbps, 60FPS, 15ms PDB,
    - 1 source (OPPO) reported the capacity performances are decreased from [10.3] with jitter to [10.1] without jitter by about [1.94%] with SU-MIMO.
    - 1 source (OPPO) reported the capacity performances are increased from [10.2~10.3] with jitter to [10.5~11] without jitter by about [2.94%~6.80%] with SU-MIMO.
  + For VR/AR, 45Mbps, 60FPS, 11ms PDB,
    - 1 source (OPPO) reported the capacity performances are increased from [4.4~5.4] with jitter to [4.4~6.6] without jitter by about [0%~38.46%] with SU-MIMO.
  + For VR/AR, 45Mbps, 60FPS, 15ms PDB,
    - 1 source (OPPO) reported the capacity performances are decreased from [6.4] with jitter to [6.3] without jitter by about [1.56%] with SU-MIMO.
    - 1 source (OPPO) reported the capacity performances are increased from [6.3] with jitter to [6.7~7.1] without jitter by about [6.35%~12.70%] with SU-MIMO.
* **For FR2, Dense Urban UL,** 
  + For AR 2-stream pose/control-stream and scene/video/ data/voice-stream with 10Mbps,
    - 1 source (Qualcomm) reported the capacity performances are both equal to [4.5] with or without jitter, with SU-MIMO.
* **For FR2, Dense Urban UL,** 
  + For AR 2-stream pose/control-stream and scene/video/ data/voice-stream with 20Mbps,
    - 1 source (Qualcomm) reported the capacity performances are both equal to [2] with or without jitter, with SU-MIMO.
* **For FR2, Indoor Hotspot UL,** 
  + For AR 2-stream pose/control-stream and scene/video/ data/voice-stream with 10Mbps,
    - 1 source (Qualcomm) reported the capacity performances are increased from [5] with jitter to [5.5] without jitter by about [10%] with SU-MIMO.
* **For FR2, Indoor Hotspot UL,** 
  + For AR 2-stream pose/control-stream and scene/video/ data/voice-stream with 10Mbps,
    - 1 source (Qualcomm) reported the capacity performances are both equal to [3.5] with or without jitter, with SU-MIMO.
      1. Summary of discussions

1. **Please provide your comment on the above observation.**

|  |  |
| --- | --- |
| Company | Comment |
| Futurewei |  |
| LGE | We think more results are needed to draw a general observation out of UL. |
| QC | In general observation, it would be nice to capture how much capacity is degraded.  It would be good to have a summary table. |
| Nokia, NSB | **General Observations**   * For DL, Jitter degrades XR capacity performance. * For UL, Jitter may or may not affect XR capacity performance   The floor capacity from some of the results is not changing when comparing the cases with or without jitter. It seems that the observations are not well capturing the numerical results. This section should be revised. |

* + 1. Impact of Dual-eye Buffer Staggering

**General Observations**

* Dual-eye buffer staggering can increase XR capacity performance compared to dual-eye buffer simultaneously.

**Detailed Observations:**

* **For FR1, Dense Urban, DL**
  + For VR/AR, 30Mbps, 10ms PDB, with 60 FPS increase to 120 FPS
    - 1 source (vivo) reported the capacity performances are increased from [13.59] to [20.78] by about [52.91%]
  + For VR/AR, 45Mbps, 10ms PDB, with 60 FPS increase to 120 FPS
    - 1 source (vivo) reported the capacity performances are increased from [6.91] to [11.42] by about [65.27%]
* **For FR1, Indoor Hotspot, DL**
  + For VR/AR, 30Mbps, 10ms PDB, with 60 FPS increase to 120 FPS
    - 1 source (vivo) reported the capacity performances are increased from [10.80] to [16.53] by about [63.99%]
  + For VR/AR, 45Mbps, 10ms PDB, with 60 FPS increase to 120 FPS
    - 1 source (vivo) reported the capacity performances are increased from [5.91] to [9.22] by about [56.01%]
* **For FR1, Urban Macro, DL**
  + For VR/AR, 30Mbps, 10ms PDB, with 60 FPS increase to 120 FPS
    - 1 source (vivo) reported the capacity performances are increased from [8.82] to [14.59] by about [65.24%]
  + For VR/AR, 45Mbps, 10ms PDB, with 60 FPS increase to 120 FPS
    - 1 source (vivo) reported the capacity performances are increased from [4.68] to [8.12] by about [73.50%]
* **For FR2, Dense Urban, DL**
  + For VR/AR, 30Mbps, 10ms PDB, with 60 FPS increase to 120 FPS
    - 1 source (vivo) reported the capacity performances are increased from [13.44] to [16.28] by about [21.13%]
  + For VR/AR, 45Mbps, 10ms PDB, with 60 FPS increase to 120 FPS
    - 1 source (vivo) reported the capacity performances are increased from [8.20] to [10.32] by about [25.85%]
* **For FR2, Indoor Hotspot, DL**
  + For VR/AR, 30Mbps, 10ms PDB, with 60 FPS increase to 120 FPS
    - 1 source (vivo) reported the capacity performances are increased from [8.72] to [10.23] by about [17.32%]
  + For VR/AR, 45Mbps, 10ms PDB, with 60 FPS increase to 120 FPS
    - 1 source (vivo) reported the capacity performances are increased from [4.67] to [6.03] by about [29.12%]
      1. Summary of discussions

1. **Please provide your comment on the above observation.**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei, HiSilicon | We suggest to change “general observation” to “source specific observation”. Please see our full reply in section 2.4. |
| LGE | We think more results are needed to draw a general observation out of dual-eye buffer staggering. |
| QC | In current text, hyphen “-“ is used between “Dual” and “eye”. This could be misleading since it could mean two “eyes” rather than two “buffers”. This naming could be more problematic for the baseline case where only single buffer is considered. We don’t want to call it “single-eye buffer”.  We recommend using “dual eye-buffers” and “single eye-buffer” to avoid misinterpretation. |
| Nokia, NSB | Please, consider moving the general observations to Source specific observations since only one company modeled it. |

* + 1. Impact of TDD Frame Format

**General Observations**

* Compared to DDDSU, DDDUU could provide higher UL capacity.

**Detailed Observations:**

* **For FR1, Dense Urban DL,** 
  + For VR/AR 30Mbps, 60FPS, 10ms PDB
    - 1 source (FUTUREWEI) reported the capacity performances are [9.7] with DDDSU TDD format and [7.6] with DDDUU TDD format, with SU-MIMO.
    - 1 source (FUTUREWEI) reported the capacity performances are [12.3] with DDDSU TDD format and [8.7] with DDDUU TDD format, with MU-MIMO.
  + For VR/AR 45Mbps, 60FPS, 10ms PDB
    - 1 source (MediaTek) reported the capacity performances are [6] with DDDSU TDD format, [0] with DDDDD DDDUU (2.6GHz) TDD format and [4.2] with DSUDD SUUDD (4.9GHz) TDD format, with SU-MIMO.
* **For FR1, Urban Macro DL,** 
  + For VR/AR 30Mbps, 60FPS, 10ms PDB
* **For FR2, Dense urban, DL**
  + For VR/AR, 30Mbps, 10ms PDB
    - * 1 source (Ericsson) reported the capacity performances are [4.2] with DDDUU TDD format
      * 1 source (Qualcomm) reported
        + the capacity performances are [5.5] with DDDSU TDD format and [2] with DDDUU TDD format, with 100MHz bandwidth
        + the capacity performances are [23.5] with DDDSU TDD format and [15] with DDDUU TDD format, with 400MHz bandwidth
  + For VR/AR, 45Mbps, 10ms PDB
    - * 1 source (Ericsson) reported the capacity performances are [2] with DDDUU TDD format
* **For FR2, Indoor hotspot, DL**
  + For VR/AR, 30Mbps, 10ms PDB,
    - * 1 source (Ericsson) reported the capacity performances are [4.2] with DDDUU TDD format
      * 1 source (Qualcomm) reported
        + the capacity performances are [5.5] with DDDSU TDD format and [3] with DDDUU TDD format, with 100MHz bandwidth
        + the capacity performances are [26] with DDDSU TDD format and [15.5] with DDDUU TDD format, with 400MHz bandwidth
  + For VR/AR, 30Mbps, 10ms PDB + Audio/data, 30Mbps, 30ms PDB
    - * 1 source (Qualcomm) reported the capacity performances are [4.5] with DDDSU TDD format and [2.5] with DDDUU TDD format, with 100MHz bandwidth
* **For FR2, Dense Urban UL,** 
  + for VR/CG pose/control-stream, 0.2Mbps, 250FPS, 15ms PDB,
    - * 1 source (Qualcomm) reported the capacity performances are [7.5] with DDDSU TDD format and [18.5] with DDDUU TDD format, with 100MHz bandwidth
  + For AR 2-stream pose/control-stream with 0.2Mbps data rate and scene/video/ data/voice-stream with 10Mbps data rate,
    - * 1 source (Qualcomm) reported the capacity performances are [1.5] with DDDSU TDD format and [4.5] with DDDUU TDD format, with 100MHz bandwidth
* **For FR2, Indoor Hotspot UL,** 
  + for VR/CG pose/control-stream, 0.2Mbps, 250FPS, 15ms PDB,
    - * 1 source (Qualcomm) reported the capacity performances are [7] with DDDSU TDD format and [19] with DDDUU TDD format, with 100MHz bandwidth
  + For AR 2-stream pose/control-stream with 0.2Mbps data rate and scene/video/ data/voice-stream with 10Mbps data rate,
    - * 1 source (Qualcomm) reported the capacity performances are [2.5] with DDDSU TDD format and [5] with DDDUU TDD format, with 100MHz bandwidth
      1. Summary of discussions

1. **Please provide your comment on the above observation.**

|  |  |
| --- | --- |
| Company | Comment |
| Futurewei | For our results for FR1, the 3rd and 4th bullet should be classified under “Urban Macro DL”, and “For VR/AR 30Mbps, 60FPS, 10ms PDB” |
| Huawei, HiSilicon | We suggest to change “general observation” to “source specific observation”. Please see our full reply in section 2.4. |
| QC | Thanks for the great efforts.  Summary table would be helpful.  Capturing % increase in general observation could be also helpful. Switching DDDSU to DDDUU increases UL capacity but it also decreases DL capacity. So, these two things needs to be captured together. |
| Ericsson | Agree with HW. |

* + 1. Impact of Bandwidth

**General Observations**

* It is identified that the increase of bandwidth increases XR system capacity.

**Detailed Observations:**

* **For FR2, Dense urban, DL**
  + For VR/AR, 30 Mbps, 10ms PDB, with bandwidth increase from 100 MHz to 400 MHz
    - 1 source (Qualcomm) reported the capacity performances are increased from [5.5] to [23.5]
  + For VR/AR, 45 Mbps, 10ms PDB, with bandwidth increase from 100 MHz to 400 MHz
    - 1 source (Qualcomm) reported the capacity performances are increased from [2] to [19]
  + For CG, 8Mbps, 15ms PDB, with bandwidth increase from 100 MHz to 400 MHz,
    - 1 source (Qualcomm) reported the capacity performances are increased from [24] to [>30]
  + For CG, 30Mbps, 15ms PDB, with bandwidth increase from 100 MHz to 400 MHz,
    - 1 source (Qualcomm) reported the capacity performances are decreased from [6] to [25]
* **For FR2, InH, DL**
  + For VR/AR, 30 Mbps, 10ms PDB, with bandwidth increase from 100 MHz to 400 MHz
    - 1 source (Qualcomm) reported the capacity performances are increased from [5.5] to [26]
  + For VR/AR, 45 Mbps, 10ms PDB, with bandwidth increase from 100 MHz to 400 MHz
    - 1 source (Qualcomm) reported the capacity performances are increased from [3] to [20.3]
  + For CG, 8Mbps, 15ms PDB, with bandwidth increase from 100 MHz to 400 MHz,
    - 1 source (Qualcomm) reported the capacity performances are increased from [27.5] to [>30]
  + For CG, 30Mbps, 15ms PDB, with bandwidth increase from 100 MHz to 400 MHz,
    - 1 source (Qualcomm) reported the capacity performances are increased from [6] to [28]
* **For FR2, Dense Urban UL,** 
  + 1 source (Qualcomm) reported the evaluation results of capacity performance for VR/CG pose/control-stream with 0.2Mbps data rate, 10ms PDB, 250 FPS, with bandwidth increase from 100MHz to 400MHz,
    - the capacity performances are increased by 13.33% from 7.5 to 8.5.
  + 1 source (Qualcomm) reported the evaluation results of capacity performance for AR 2-stream pose/control-stream with 0.2Mbps data rate, 10ms PDB, 250FPS and scene/video/ data/voice-stream with 10Mbps data rate, 30ms PDB, 60FPS, with bandwidth increase from 100MHz to 400MHz,
    - the capacity performances are increased by 55.56% from 4.5 to 7.
* **For FR2, Indoor Hotspot UL,** 
  + 1 source (Qualcomm) reported the evaluation results of capacity performance for AR 2-stream pose/control-stream with 0.2Mbps data rate, 10ms PDB, 250FPS and scene/video/ data/voice-stream with 10Mbps data rate, 30ms PDB, 60FPS, with bandwidth increase from 100MHz to 400MHz,
    - the capacity performances are increased by 50% from 5 to 7.5.
      1. Summary of discussions

1. **Please provide your comment on the above observation.**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei, HiSilicon | We suggest to change “general observation” to “source specific observation”. Please see our full reply in section 2.4. |
| QC | The impact of the 1 stream InH VR/CG pose/control-stream with 0.2Mbps data rate, 10ms PDB, 250 FPS, with bandwidth increase from 100MHz to 400MHz was not captured.   * + 1 source (Qualcomm) reported the evaluation results of capacity performance for VR/CG pose/control-stream with 0.2Mbps data rate, 10ms PDB, 250 FPS, with bandwidth increase from 100MHz to 400MHz,     - the capacity performances are increased by 0%.   We propose that the “General Observations” should be update as follows:    **General Observations**   * It is identified that most cases there is an increase of bandwidth increases XR system capacity. For FR2 InH, with 1-stream VR/CG pose/control-stream no capacity increase was observed with capacity from 100 MHz and 400 MHz. |
| Ericsson | Overall, the value of this exercise feels limited. The conclusion could be there is a significant gain of increasing the bandwidth – but what will RAN1 do with that information? |
| Nokia, NSB | * + For VR/AR, 45 Mbps, 10ms PDB, with bandwidth increase from 100 MHz to 400 MHz     - 1 source (Qualcomm) reported the capacity performances are increased from [2] to [19]   Please, clarify the following for DU and InH: how is it possible that the capacity is increased by 8 times while the bandwidth is increased just by 4. This trend is only for that particular case. Other cases are showing more intuitive behavior. |

* + 1. Impact of Carrier Aggregation

**General Observations**

* It is identified that carrier aggregation increases XR system capacity.

**Detailed Observations:**

* **For FR1, Dense Urban, DL**
  + For VR/AR, 45Mbps, 60FPS, 10ms PDB,
    - 1 source (MediaTek) reported the capacity performances are increased from [4.2] with DSUDD SUUDD (4.9GHz) or [0] with DSUDD SUUDD (4.9GHz) to [10.3] with CA with enhancements DDDDD DDDUU (2.6GHz) + DSUDD SUUDD (4.9GHz)
    - 1 source (MediaTek) reported the capacity performances are increased from [4.2] with DSUDD SUUDD (4.9GHz) or [0] with DSUDD SUUDD (4.9GHz) to [12.3] with CA DDDDD DDDUU (2.6GHz) + DSUDD SUUDD (4.9GHz)
      1. Summary of discussions

1. **Please provide your comment on the above observation.**

|  |  |
| --- | --- |
| Company | Comment |
| MTK | We think this section belongs to potential capacity enhancement and belongs to 2.3. |
| Huawei, HiSilicon | We suggest to change “general observation” to “source specific observation”. Please see our full reply in section 2.4. |
| QC | If MTK has used any enhanced CA schemes, then, it needs to be moved to enhancements sections with considered enhancements be captured. |
| Ericsson | This does not feel like a general conclusion – it is an extremely particular scenario. At least part of the CA results require *significant* specification changes (in RAN1 and RAN2) and should be in section 2.3. |
| Nokia, NSB | We want to clarify why TDD configurations that was not agreed were chosen here. Some of the TDD configurations show 0 UE supported while our agreed configs shows much better results. Companies are kindly encouraged to consider modeling the agreed TDD configurations. There is also the result for enhanced CA included which we believe is not intended for this section. We cannot support the observation in its current form and kindly ask to provide more results to be in line with the agreements we made earlier. It is also not a general observation but rather source specific observation. |

* + 1. Impact of FDM/SDM and mini-slot

**General Observations**

* It is identified that FDM/SDM, mini-slot and combination of them increase XR system capacity.

**Detailed Observations:**

* **For FR2, Dense Urban UL,** 
  + For UL pose/control-stream, 0.2Mbps, 250 FPS, 10ms PDB,
    - 1 source (Qualcomm) reported the capacity performances are increased from [7.5] to [15] with FDM/SDM by about [100%]
    - 1 source (Qualcomm) reported the capacity performances are increased from [7.5] to [18] with mini-slot by about [146.67%]
    - 1 source (Qualcomm) reported the capacity performances are increased from [7.5] to [26.5] with combination of FDM/SDM and mini-slot by about [253.33%]
* **For FR2, Indoor Hotspot UL,** 
  + For UL pose/control-stream, 0.2Mbps, 250 FPS, 10ms PDB,
    - 1 source (Qualcomm) reported the capacity performances are increased from [7] to [11.5] with FDM/SDM by about [64.29%]
    - 1 source (Qualcomm) reported the capacity performances are increased from [7] to [20] with mini-slot by about [185.71%]
    - 1 source (Qualcomm) reported the capacity performances are increased from [7] to [26] with combination of FDM/SDM and mini-slot by about [271.43%]
      1. Summary of discussions

1. **Please provide your comment on the above observation.**

|  |  |
| --- | --- |
| Company | Comment |
| Futurewei | The observation should be more specific that this is only for UL pose/control-stream as that’s what the simulations are for. In addition, what is the baseline that FDM/SDM compared with? No FDM/SDM? |
| Huawei, HiSilicon | We suggest to change “general observation” to “source specific observation”. Please see our full reply in section 2.4. |
| Futurewei | The observation should be more specific that this is only for UL pose/control-stream as that’s what the simulations are for. In addition, what is the baseline that FDM/SDM compared with? No FDM/SDM? |

* 1. Potential Capacity Enhancements
     1. Staggering of packet arrivals at gNB among UEs

*(Moderator’s note: This section is located under capacity enhancements because the capacity improvements from the staggering may motivate coordination/collaboration between application server and gNB that can be facilitated by spec enhancements, e.g., frame-level QoS, ADU-based QoS, other new signaling, etc.)*

**General Observations**

* It is identified that staggering of UE’s packet arrival at the gNB can increase XR capacity.

**Detailed Observations:**

* **For FR1, Dense Urban, DL**
  + For VR/AR, 30Mbps, 60FPS, 10ms PDB,
    - 1 source (OPPO) reported the capacity performances are are increased from [7.4] with zero packet arrival interval among UEs to [8.4] with random packet arrival interval among UEs by about [13.51%]
    - 1 source (OPPO) reported the capacity performances are are increased from [7.4] with zero packet arrival interval among UEs to [9.2] with equal packet arrival interval among UEs by about [24.32%]
  + For VR/AR, 45Mbps, 60FPS, 10ms PDB,
    - 1 source (OPPO) reported the capacity performances are are increased from [4.4] with zero packet arrival interval among UEs to [5.2] with random packet arrival interval among UEs by about [18.18%]
    - 1 source (OPPO) reported the capacity performances are are increased from [4.4] with zero packet arrival interval among UEs to [5.4] with equal packet arrival interval among UEs by about [22.73%]
* **For FR2, Dense Urban, DL**
  + For VR/AR, 30Mbps, 60FPS, 10ms PDB,
    - 1 source (Qualcomm) reported the capacity performances are are increased from [4] with zero packet arrival interval among UEs to [5.5] with equal packet arrival interval among UEs by about [37.5%] with 100MHz bandwidth
    - 1 source (Qualcomm) reported the capacity performances are are increased from [17.5] with zero packet arrival interval among UEs to [23.5] with equal packet arrival interval among UEs by about [34.29%] with 400MHz bandwidth
  + For VR/AR, 45Mbps, 60FPS, 10ms PDB,
    - 1 source (Qualcomm) reported the capacity performances are are increased from [1.8] with zero packet arrival interval among UEs to [2] with equal packet arrival interval among UEs by about [11.11%] with 100MHz bandwidth
    - 1 source (Qualcomm) reported the capacity performances are are increased from [15] with zero packet arrival interval among UEs to [19] with equal packet arrival interval among UEs by about [26.67%] with 400MHz bandwidth
* **For FR2, Indoor Hotspot, DL**
  + For VR/AR, 30Mbps, 60FPS, 10ms PDB,
    - 1 source (Qualcomm) reported the capacity performances are are increased from [4.5] with zero packet arrival interval among UEs to [5.5] with equal packet arrival interval among UEs by about [22.22%] with 100MHz bandwidth
    - 1 source (Qualcomm) reported the capacity performances are are increased from [18] with zero packet arrival interval among UEs to [26] with equal packet arrival interval among UEs by about [44.44%] with 400MHz bandwidth
  + For VR/AR, 45Mbps, 60FPS, 10ms PDB,
    - 1 source (Qualcomm) reported the capacity performances are are increased from [2.5] with zero packet arrival interval among UEs to [3] with equal packet arrival interval among UEs by about [20%] with 100MHz bandwidth
    - 1 source (Qualcomm) reported the capacity performances are are increased from [16] with zero packet arrival interval among UEs to [20.5] with equal packet arrival interval among UEs by about [28.13%] with 400MHz bandwidth
      1. Summary of discussions

1. **Please provide your comment on the above observation.**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei, HiSilicon | We suggest to change “general observation” to “source specific observation”. Please see our full reply in section 2.4.  Typo: “…performances are ~~are~~ increased …” |
| QC | Summary table would be helpful.  It would be good to have short description on the background for this section and some references for further details. |
| Ericsson | Agree with Huawei – this should be source-specific observations. |
| Nokia, NSB | Some further details are desired for this enhancement, as well as some alignment between the descriptions has to be made, as there are deviations between the description of the approach provided by OPPO and by QC. Particularly, from R1-2100218, it looks like that “staggering of UE packets” means replacing the agreed random traffic model with another (not 100% realistic) traffic model, where the packets to the same UE somehow arrive in groups. Are these then enhancement-related results or just results for another setup/traffic model? Seems to be beyond the setups agreed to be evaluated in RAN1. |

* + 1. Delay Aware/Frame Level Integrated Transmission Scheduler

*(Moderator’s note: This section is located under capacity enhancements because the capacity improvements from such schedulers that can be facilitated by spec enhancements, e.g., frame-level QoS, ADU-based QoS, other new signaling, etc.)*

**General Observations**

* It is identified that Delay Aware/Frame Level Integrated Transmission Scheduler can increase XR capacity performance compared to PF scheduler.

**Detailed Observations:**

* **For FR1, Dense Urban, DL,** 
  + For CG, 30Mbps, 60FPS, 15ms PDB,
    - 1 source (vivo) reported the capacity performances are increased from [11.68] with PF scheduler to [13.58] with delay-aware scheduler by about [16.27%] with SU-MIMO.
    - 1 source (vivo) reported the capacity performances are increased from [19.65] with PF scheduler to [19.75] with delay-aware scheduler by about [0.51%] with MU-MIMO.
  + For VR/AR, 30Mbps, 60FPS, 10ms PDB,
    - 1 source (vivo) reported the capacity performances are increased from [9.49] with PF scheduler to [12.67] with delay-aware scheduler by about [33.51%] with SU-MIMO.
    - 1 source (vivo) reported the capacity performances are increased from [13.59] with PF scheduler to [14.40] with delay-aware scheduler by about [5.96%] with MU-MIMO.
    - 1 source (Huawei) reported the capacity performances are increased from [5.1] with PF scheduler to [6.4] with Frame Level Integrated Transmission (FLIT) scheduler by about [25.49%] with SU-MIMO.
    - 1 source (Huawei) reported the capacity performances are increased from [11.5] with PF scheduler to [14] with Frame Level Integrated Transmission (FLIT) scheduler by about [21.74%] with MU-MIMO.
  + For VR/AR, 45Mbps, 60FPS, 10ms PDB,
    - 1 source (Huawei) reported the capacity performances are increased from [2.1] with PF scheduler to [2.7] with Frame Level Integrated Transmission (FLIT) scheduler by about [28.579%] with SU-MIMO.
    - 1 source (Huawei) reported the capacity performances are increased from [5.3] with PF scheduler to [6.6] with Frame Level Integrated Transmission (FLIT) scheduler by about [24.53%] with MU-MIMO.
* **For FR1, Indoor Hotspot, DL,** 
  + For CG, 30Mbps, 60FPS, 15ms PDB,
    - 1 source (vivo) reported the capacity performances are increased from [10.14] with PF scheduler to [11.43] with delay-aware scheduler by about [12.72%] with SU-MIMO.
    - 1 source (vivo) reported the capacity performances are increased from [16.20] with PF scheduler to [16.67] with delay-aware scheduler by about [2.90%] with MU-MIMO.
  + For VR/AR, 30Mbps, 60FPS, 10ms PDB,
    - 1 source (vivo) reported the capacity performances are increased from [8.27] with PF scheduler to [10.77] with delay-aware scheduler by about [30.23%] with SU-MIMO.
    - 1 source (vivo) reported the capacity performances are increased from [10.80] with PF scheduler to [12.40] with delay-aware scheduler by about [14.81%] with MU-MIMO.
* **For FR1, Urban Macro, DL,** 
  + For CG, 30Mbps, 60FPS, 15ms PDB,
    - 1 source (vivo) reported the capacity performances are increased from [10.33] with PF scheduler to [11.94] with delay-aware scheduler by about [15.59%] with SU-MIMO.
    - 1 source (vivo) reported the capacity performances are increased from [14.33] with PF scheduler to [14.45] with delay-aware scheduler by about [0.84%] with MU-MIMO.
  + For VR/AR, 30Mbps, 60FPS, 10ms PDB,
    - 1 source (vivo) reported the capacity performances are increased from [7.24] with PF scheduler to [8.56] with delay-aware scheduler by about [18.23%] with SU-MIMO.
    - 1 source (vivo) reported the capacity performances are increased from [8.82] with PF scheduler to [9.55] with delay-aware scheduler by about [8.28%] with MU-MIMO.
* **For FR1, Dense Urban UL,** 
  + For 2 streams: UL pose/control-stream, 0.2Mbps, 10ms PDB, 250 FPS + UL scene/video/data/voice-stream, 10Mbps, 30ms PDB, 60FPS,
    - 1 source (Huawei) reported the capacity performances are increased from [1.5] with PF scheduler to [5.6] with aware-traffic scheduler by about [273.3%] with MU-MIMO.
* **For FR2, Dense urban, DL**
  + For VR/AR, 30Mbps, 10ms PDB,
    - 1 source (vivo) reported the capacity performances are increased from [13.44] with PF scheduler to [14.16] with delay-aware scheduler by about [5.4%] with SU-MIMO
  + For VR/AR, 45Mbps, 10ms PDB,
    - 1 source (vivo) reported the capacity performances are increased from [8.2] with PF scheduler to [10.32] with delay-aware scheduler by about [25.9%] with SU-MIMO
  + For CG, 30 Mbps, 15ms PDB,
    - 1 source (vivo) reported the capacity performances are increased from [16.16] with PF scheduler to [16.82] with delay-aware scheduler by about [4.1%] with SU-MIMO
  + For VR/AR, 30Mbps, 10ms PDB + Audio/data, 30Mbps, 30ms PDB
    - 1 source (Qualcomm) reported the capacity performances are increased from [5] with PF scheduler to [5.5] with delay-aware scheduler by about [10.0%] with SU-MIMO
* **For FR2, Indoor hotspot, DL**
  + For VR/AR, 30Mbps, 10ms PDB,
    - 1 source (vivo) reported the capacity performances are increased from [8.72] with PF scheduler to [8.83] with delay-aware scheduler by about [1.3%] with SU-MIMO
  + For VR/AR, 45Mbps, 10ms PDB,
    - 1 source (vivo) reported the capacity performances are increased from [4.67] with PF scheduler to [6.03] with delay-aware scheduler by about [29.1%] with SU-MIMO
  + For CG, 15ms PDB,with data rate increase from 8 Mbps to 30 Mbps,
    - 1 source (vivo) reported the capacity performances are increased from [9.13] with PF scheduler to [10.23] with delay-aware scheduler by about [12.0%] with SU-MIMO
  + For VR/AR, 30Mbps, 10ms PDB + Audio/data, 30Mbps, 30ms PDB
    - 1 source (Qualcomm) reported the capacity performances are increased from [4.5] with PF scheduler to [5.4] with delay-aware scheduler by about [20.0%] with SU-MIMO
* **For FR2, InH UL,** 
  + For 2 streams: UL pose/control-stream, 0.2Mbps, 10ms PDB, 250 FPS + UL scene/video/data/voice-stream, 10Mbps, 30ms PDB, 60FPS,
    - 1 source (Qualcomm) reported the capacity performances are increased from [5] with PF scheduler to [6.5] with delay-aware scheduler by about [30.0%] with SU-MIMO.
      1. Summary of discussions

1. **Please provide your comment on the above observation.**

|  |  |
| --- | --- |
| Company | Comment |
| MTK | We also provided results in our contribution for delay aware (DA) scheduling: (using SU-MIMO)   * **For FR1, Dense Urban, DL,**    + For XR, 30Mbps, 60FPS, α=2, various (PER\_I, PER\_P, PDB\_I, PDB\_P) results:   + Ref. Case: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [1%, 1%, 10ms, 10ms]     - Capacity performances are increased from [6] with PF scheduler to [8.7] with delay-aware scheduler by about [45%] with SU-MIMO   + Case 1: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [0.5%, 5%, 10ms, 10ms]     - Capacity performances are increased from [6] with PF scheduler to [8.7] with delay-aware scheduler by about [45%] with SU-MIMO   + Case 2: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [1 %, 1%, 17ms, 9ms]     - Capacity performances are increased from [9] with PF scheduler to [11] with delay-aware scheduler by about [22.2%] with SU-MIMO   + Case 3: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [1 %, 5%, 10ms, 10ms]     - Capacity performances are increased from [6.5] with PF scheduler to [9] with delay-aware scheduler by about [38.5%] with SU-MIMO   + Case 4: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [1 %, 1%, 15ms, 10ms]     - Capacity performances are increased from [10] with PF scheduler to [11.5] with delay-aware scheduler by about [15%] with SU-MIMO   + Case 5: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [1 %, 5%, 15ms, 10ms]     - Capacity performances are increased from [10.3] with PF scheduler to [11.7] with delay-aware scheduler by about [13.6%] with SU-MIMO |
| Huawei, HiSilicon | We suggest to change “general observation” to “source specific observation”. Please see our full reply in section 2.4. |
| LGE | We prefer to avoid the source-specific naming of a certain enhancement technique. We should think about renaming the enhancement techniques in a more general and easily understood manner. |
| QC | It would be good to have short description on the background for this section and some references for further details. |
| Ericsson | Is “delay aware scheduling” and “Frame Level Integrated Transmission Scheduler the same? It is collected under “general observations” |
| Nokia, NSB | The presented general conclusions require some further clarification. For delay-aware scheduler the gains are primarily visible for SU-MIMO, not for MU-MIMO. This should better be highlighted.  Regarding FLIT, this part should be removed, as proper evaluation of this approach requires an accurate definition of a flow-based traffic model, which RAN1 discussed but decided not to do within this SI. Hence, the numerical conclusions drawn for FLIT are misleading, as they are, de-facto, for another traffic model, not the one agreed by RAN1 for performance evaluation. |

* + 1. Cooperative MIMO/Precoding

**General Observations**

* It is identified that Cooperative MIMO/Precoding can increase XR capacity performance compared to Zero-forcing.

**Detailed Observations:**

* **For FR1, Indoor Hospot DL,** 
  + For VR/AR, 30Mbps, 60FPS, 10ms PDB,
    - 1 source (ZTE) reported the capacity performances are increased from [8.5] without preemption to [11.8] with Rel-15 preemption by about [38.82%] with MU-MIMO.
    - 1 source (ZTE) reported the capacity performances are increased from [8.5] without preemption to [16.6] with enhanced preemption by about [95.29%] with MU-MIMO.
    - 1 source (ZTE) reported the capacity performances are increased from [11.8] with Rel-15 preemption to [16.6] with enhanced preemption by about [40.68%] with MU-MIMO.
* **For FR1, Dense urban, DL,** 
  + For VR/AR, 30Mbps, 60FPS, 10ms PDB,
    - 1 source (FUTUREWEI) reported the capacity performances are increased from [8.7] with Zero-forcing to [16.4] with BiT precoding by about [89%], with DDDUU TDD format, with MU-MIMO.
    - 1 source (FUTUREWEI) reported the capacity performances are increased from [7.6] with Zero-forcing to [9.4] with BiT precoding by about [24%], with DDDUU TDD format, with SU-MIMO.
    - 1 source (FUTUREWEI) reported the capacity performances are increased from [12.3] with Zero-forcing to [20.3] with BiT precoding by about [65%], with DDDSU TDD format, with MU-MIMO.
    - 1 source (FUTUREWEI) reported the capacity performances are increased from [9.7] with Zero-forcing to [11.7] with BiT precoding by about [21%], with DDDSU TDD format, with SU-MIMO.
  + For VR/AR, 45Mbps, 60FPS, 10ms PDB,
    - 1 source (FUTUREWEI) reported the capacity performances are increased from [7.6] with Zero-forcing to [14.3] with BiT precoding by about [88%], with DDDSU TDD format, with MU-MIMO.
    - 1 source (FUTUREWEI) reported the capacity performances are increased from [6] with Zero-forcing to [7] with BiT precoding by about [17%], with DDDSU TDD format, with SU-MIMO.
* **For FR1, Urban Macro, DL,** 
  + For VR/AR, 30Mbps, 60FPS, 10ms PDB,
    - 1 source (FUTUREWEI) reported the capacity performances are increased from [6.1] with Zero-forcing to [9.5] with BiT precoding by about [56%], with DDDUU TDD format, with MU-MIMO.
    - 1 source (FUTUREWEI) reported the capacity performances are increased from [5.4] with Zero-forcing to [6.5] with BiT precoding by about [20%], with DDDUU TDD format, with SU-MIMO.
    - 1 source (FUTUREWEI) reported the capacity performances are increased from [7.7] with Zero-forcing to [11.6] with BiT precoding by about [51%], with DDDSU TDD format, with MU-MIMO.
    - 1 source (FUTUREWEI) reported the capacity performances are increased from [7] with Zero-forcing to [8.9] with BiT precoding by about [27%], with DDDSU TDD format, with SU-MIMO.
  + For VR/AR, 45Mbps, 60FPS, 10ms PDB,
    - 1 source (FUTUREWEI) reported the capacity performances are increased from [4.9] with Zero-forcing to [7.7] with BiT precoding by about [60%], with DDDSU TDD format, with MU-MIMO.
    - 1 source (FUTUREWEI) reported the capacity performances are increased from [4.4] with Zero-forcing to [5.4] with BiT precoding by about [23%], with DDDSU TDD format, with SU-MIMO.
      1. Summary of discussions

1. **Please provide your comment on the above observation.**

|  |  |
| --- | --- |
| Company | Comment |
| FUTUREWEI | Add FUTUREWEI cooperative MIMO/Precoding BiT (via bi-directional training) results. |
| ZTE, Sanechips | It’s appreciated that our results are captured. But unfortunately the enhancement is not MU-MIMO, it's instead enhanced preemption mechanism, which is an example for handling inter-UE multiplexing taking XR service into account. We would prefer to categorize our results in a dedicated section with the title ‘adaptive inter-UE multiplexing techniques’. The general observation would be   * It is identified that adaptive inter-UE multiplexing technique e.g. enhanced preemption mechanism can increase XR capacity performance.   Detailed observations shall be reworded as following,   * + - 1 source (ZTE) reported the capacity performances are increased from [8.5] without preemption to [16.6] with enhanced preemption by about [95.29%] using MU-MIMO.     - 1 source (ZTE) reported the capacity performances are increased from [11.8] with Rel-15 preemption to [16.6] with enhanced preemption by about [40.68%] using MU-MIMO. |
| Huawei, HiSilicon | We suggest to change “general observation” to “source specific observation”. Please see our full reply in section 2.4. |
| LGE | For the enhancement techniques that are evaluated by one or a small number of companies, we think source-specific observations could be captured, if agreed, rather than general observations. For the source-specific observations, we recommend the following wordings in the TR.  “It is identified by source 1 that …”, or “Source 1 observed that …” |
| QC | It would be good to have short description on the background for this section and some references for further details. |
| Ericsson | Agree with Huawei – for now, these are source-specific observations. |
| Nokia, NSB | This section presents the discussion completely out of the XR SI scope and should be discussed in feMIMO track, where more details and specifics of the proposed ideas can be properly evaluated. It is inconsistent thus incorrect to draw any conclusions on MIMO enhancements in the XR-related TR, when there is a dedicated ongoing track in RAN1 focused on MIMO. In addition, the presented numerical results are not fully intuitive, as they suggest that MU-MIMO scheme is better than SU-MIMO scheme only by 10-20%, while most other companies indicate that the difference should be around 100%. Such an inconsistency in MU-MIMO vs. SU-MIMO would lead to misleading conclusions from the TR at large.  The scenario of interest for preemption is (i) not really connected to MIMO/Precoding and (ii) not aligned with XR agreements on the traffic models and evaluation methodology. A proper way to simulate coexistence of XR traffic with other types of traffic has never been agreed or even discussed. The implicit assumptions present of additional parameters (i.e., the fraction of UEs with URLLC traffic, the fraction of UEs with XR traffic, etc.) that would heavily affect the results, while the evaluation is made just for one set of possible configurations. These parameters have to be first discussed and agreed before drawing any conclusions. It is incorrect to draw any TR-level conclusions from individual study that is beyond the scope of XR SI. |

* + 1. Network Coding

**General Observations**

* It is identified that network coding can increase XR system capacity, compared to PDCP duplication.

**Detailed Observations:**

* **For FR2, Dense urban, DL**
  + For VR/AR, 30Mbps, 10ms PDB,
    - 1 source (Qualcomm) reported
      * + the capacity performances are [8.5] with 2CC (30&39GHz) CA, no blocking, [4] with PDCP duplication, 2CC (30&39GHz) CA, no blocking, and [8.5] with network coding (50% redundancy), 2CC (30&39GHz) CA, no blocking
        + the capacity performances are [14.5] with 4CC (30,30.4,39&39.4GHz) CA, no blocking, and [15] with network coding (20% redundancy), 4CC (30,30.4,39&39.4GHz) CA, no blocking
        + the capacity performances are [0] with 2CC (30&39GHz) CA, periodic blocking(4/10ms) on 30GHz CC, [3] with PDCP duplication, 2CC (30&39GHz) CA, periodic blocking(4/10ms) on 30GHz CC, and [5] with network coding (100% redundancy), 2CC (30&39GHz) CA, periodic blocking(4/10ms) on 30GHz CC
        + the capacity performances are [0] with 4CC (30,30.4,39&39.4GHz) CA, periodic blocking (4/10ms) on 39&39.4GHz CCs, and [10] with network coding (120% redundancy), 4CC (30,30.4,39&39.4GHz) CA, periodic blocking (4/10ms) on 39&39.4GHz CCs
  + For VR/AR, 45Mbps, 10ms PDB,
    - 1 source (Qualcomm) reported
      * + the capacity performances are [4.5] with 2CC (30&39GHz) CA, no blocking, [2.5] with PDCP duplication, 2CC (30&39GHz) CA, no blocking, and [5] with network coding (50% redundancy), 2CC (30&39GHz) CA, no blocking
        + the capacity performances are [10] with 4CC (30,30.4,39&39.4GHz) CA, no blocking, and [10] with network coding (20% redundancy), 4CC (30,30.4,39&39.4GHz) CA, no blocking
        + the capacity performances are [0] with 2CC (30&39GHz) CA, periodic blocking(4/10ms) on 30GHz CC, [2] with PDCP duplication, 2CC (30&39GHz) CA, periodic blocking(4/10ms) on 30GHz CC, and [3] with network coding (100% redundancy), 2CC (30&39GHz) CA, periodic blocking(4/10ms) on 30GHz CC
        + the capacity performances are [0] with 4CC (30,30.4,39&39.4GHz) CA, periodic blocking (4/10ms) on 39&39.4GHz CCs, and [6] with network coding (120% redundancy), 4CC (30,30.4,39&39.4GHz) CA, periodic blocking (4/10ms) on 39&39.4GHz CCs
      1. Summary of discussions

1. **Please provide your comment on the above observation.**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei, HiSilicon | We suggest to change “general observation” to “source specific observation”. Please see our full reply in section 2.4. |
| LGE | Same comment as above.  For the enhancement techniques that are evaluated by one or a small number of companies, we think source-specific observations could be captured, if agreed, rather than general observations. For the source-specific observations, we recommend the following wordings in the TR.  “It is identified by source 1 that …”, or “Source 1 observed that …” |
| QC | It would be good to have short description on the background for this section and some references for further details. |
| Ericsson | Agree with HW and LGE |
| Nokia, NSB | *“the capacity performances are [0] with 2CC (30&39GHz) CA, periodic blocking(4/10ms) on 30GHz CC, [3] with PDCP duplication, 2CC (30&39GHz) CA, periodic blocking(4/10ms) on 30GHz CC, and [5] with network coding (100% redundancy), 2CC (30&39GHz) CA, periodic blocking(4/10ms) on 30GHz CC”*  What does “blocking” refer to here? If this is “blocking of one of the links”, as per R1-2110218, then this is not in line with the agreed evaluation setups. |

* + 1. gNB Scheduling Awareness UE Playout Buffer

**General Observations**

* It is identified that gNB scheduling awareness of UE playout buffer increases XR system capacity.

**Detailed Observations:**

* **For FR1, Indoor Hotspot DL,** 
  + For VR/AR 30Mbps, 60FPS, 10ms PDB,
    - 1 source (CATT) reported the capacity performances are increased from [12] to [16] with gNB scheduling awareness of 2 frames UE playout buffer by about [33.33%]
    - 1 source (CATT) reported the capacity performances are increased from [12] to [20] with gNB scheduling awareness of 3 frames UE playout buffer by about [66.67%]
    - 1 source (CATT) reported the capacity performances are increased from [12] to [20] with gNB scheduling awareness of 4 frames UE playout buffer by about [66.67%]
      1. Summary of discussions

1. **Please provide your comment on the above observation.**

|  |  |
| --- | --- |
| Company | Comment |
| Huawei, HiSilicon | We suggest to change “general observation” to “source specific observation”. Please see our full reply in section 2.4. |
| QC | It would be good to have short description on the background for this section and some references for further details. |
| Ericsson | Agree with HW |
| Nokia, NSB | From R1-2109200 *“The playout buffer is to store a few XR video frames at the application layer before it plays out on the screen. The size of the playout buffer depends on the network delay jitter. If the size of the playout buffer is fed back to the gNB scheduler, gNB could have APDB. APDB can give gNB more time to schedule UE within the delay budget requirements of the XR service and more likely to successfully transmit packets.”*  Two questions here:  1) Can you, please, clarify the meaning of APDB? Is it a correct understanding that APDB is more a less an increase of the PDB requirement for particular traffic/packets by a certain value? If yes, then this is de-facto not a technical enhancement, but more a observation related to relaxing the requirements.  2) If the playout buffer is applied at the UE side to store “a few XR video frames” (arriving, on average, every 16.6ms for 60fps), this implies that there would be a massive delay between the feedback the UE provides (i.e., pose/control update) and the video that the user interacts with. This would be a severe issue in a majority of use cases within AR, VR, and CG scope that have bidirectional traffic. |

* 1. Other Comments

1. **Please feel free to make other comments.**

|  |  |
| --- | --- |
| Company | Comment |
| ZTE, Sanechips | (1) Our capacity results in C2.2.1 should be >40, instead of equal to 40.  The suggested modification is as below:   |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **Source** | **Data rate** | **PDB (ms)** | **SU-MIMO** | | | **MU-MIMO** | | | **Notes** | | **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** | **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |  | | ZTE  [R1-2108889] | 0.2Mbps | 10 | - | - | - | >40 | 40 | 100% | Note 2 |   ( |
| CATT | Our proposal of dynamic scheduling enhancement for XR (XR-PMW) in our contribution R1-2109200 shown that the capacity increase around 60% comparing with C-DRX configuration as follows,   |  |  |  |  | | --- | --- | --- | --- | | Configuration | Considered UE set | Mean Power Saving Gain (PSG) compared to Always-on | #satisfied UEs per cell / #UEs per cell | | C-DRX(16,8,4) | All UEs | 12.57% | 6.5 / 12 | | Satisfied UEs | 12.75% | | XR-PMW  (8,6) | All UEs | 3.87% | 10.8 / 12 | | Satisfied UEs | 4.13% | | XR-PMW  (16,12) | All UEs | 3.85% | 10.4 / 12 | | Satisfied UEs | 4.14% | |
| Huawei, HiSilicon | **Comment#1:** For Section 2.2 and 2.3, we suggest to change all “general observations” to “source specific observations”.  In Section 2.2, take the following cases as examples, only 1 company simulated the related case.   * Section 2.2.6 Impact of Dual-eye Buffer Staggering * Section 2.2.8 Impact of Bandwidth * Section 2.2.9 Impact of Carrier Aggregation * Section 2.2.10 Impact of FDM/SDM and mini-slot   In Section 2.3, RAN1 has no discussion on what are the details of these enhancements, and only 1 or 2 companies simulated a specific enhancement. So it’s not ok to call these observations as “general observations”.  In summary, for both Section 2.2 and 2.3, we suggest to change all “general observations” to “source specific observations”. If RAN1 is interested to promote a “source specific observation” to be upgraded as a “general observation”, it should be separately discussed, i.e., case-by-case.  For example:  **~~General~~ Source specific Observations**   * Source [X1] observes that Dual-eye buffer staggering can increase XR capacity performance compared to dual-eye buffer simultaneously.   **~~General~~ Source specific Observations**   * ~~It is identified~~ Source [Y1, Y2, Y3] observes that Delay Aware/Frame Level Integrated Transmission Scheduler can increase XR capacity performance compared to PF scheduler.   ==  **Comment#2**: We suggest to add a subsection “**2.3.6 Prioritizing important stream**” to capture the following:  **Section 2.3.6 Prioritizing important stream**  **Source specific Observations**  Source [18, 22] (Huawei, vivo) observes that prioritizing the transmission of the more important stream increases XR system capacity.  **Detailed Observations:**   * **For FR1, Dense Urban, DL, GOP-Based I/P Frame multi-stream Traffic Model**   + For VR/AR, 30Mbps, 60FPS, [PER\_I, PER\_P, PDB\_I, PDB\_P]=[1%,1%,10ms,10ms],     - 2 source (Huawei, vivo) reported the capacity performances are increased from [5.2~6.0] to [5.35~7.4] with prioritizing the transmission of the more important stream by about [2.9~23.3%] with MU-MIMO.   + For VR/AR, 30Mbps, 60FPS, [PER\_I, PER\_P, PDB\_I, PDB\_P]=[1%,5%,10ms,10ms],     - 1 source (vivo) reported the capacity performances are increased from [5.2] to [5.35] with prioritizing the transmission of the more important stream by about [2.9%] with MU-MIMO.   + For VR/AR, 30Mbps, 60FPS, [PER\_I, PER\_P, PDB\_I, PDB\_P]=[0.5%,5%,10ms,10ms],     - 1 source (vivo) reported the capacity performances are increased from [4.74] to [4.97] with prioritizing the transmission of the more important stream by about [4.9%] with MU-MIMO.   + For VR/AR, 45Mbps, 60FPS, [PER\_I, PER\_P, PDB\_I, PDB\_P]=[1%,1%,10ms,10ms],     - 1 source (Huawei) reported the capacity performances are increased from [1.4] to [2.6] with prioritizing the transmission of the more important stream by about [85.7%] with MU-MIMO. * **For FR1, Dense Urban, UL, pose/control-stream + scene/video/data/voice-stream**   + For AR 2 streams, UL pose/control-stream, 0.2Mbps, 10ms PDB, 250 FPS + UL scene/video/ data/voice-stream, 10Mbps, 30ms PDB,     - 1 source (Huawei) reported the capacity performances are increased from [1.5] to [5.6] with prioritizing the transmission of the more important stream by about [273.3%] with MU-MIMO. |
| Nokia, NSB | Capturing observations related to capacity enhancement is, mostly, pre-mature at this stage. The enhancements track (8.14.4 and later 8.14.3) has never been discussed in this SI. Hence, it is not always clear which technical solution is behind a scheme with a given title.  With respect to the limited time left, it is suggested that RAN1 focuses primarily more on discussing the baseline evaluation methodology and baseline results (the mandatory scope of this SI, as per the SID) before deciding if there is enough time to discuss possible enhancement schemes and their performance gains for this TR. From the TR quality perspective, it is not appropriate to draw any conclusions in the TR before the nature of the particular enhancement scheme is explained in a convincing manner. |

Reference

RAN1 #106-e

1. R1-2108273 Performance Evaluation Results for XR ZTE, Sanechips
2. R1-2106631 Performance evaluation results for XR vivo
3. R1-2106951 Evaluation results of XR performance CATT
4. R1-2107088 XR initial evaluations FUTUREWEI
5. R1-2108213 Evaluation results for XR evaluation OPPO
6. R1-2108251 Evaluation Results for XR Capacity and Power Qualcomm Incorporated
7. R1-2107429 Initial XR Evaluation Results CMCC
8. R1-2108202 Initial Performance and Evaluation Results for XR and CG MediaTek Inc.
9. R1-2107536 Performance Evaluation Results for XR InterDigital, Inc.
10. R1-2108239 Initial results for XR Intel Corporation
11. R1-2107657 Performance results in indoor hotspot and dense urban deployments of CG and VR/AR applications Nokia, Nokia Shanghai Bell
12. R1-2107666 Initial evaluation results for XR and Cloud Gaming Huawei, HiSilicon
13. R1-2107694 XR Initial Performance Results AT&T
14. R1-2107770 Performance evaluation on XR Apple
15. R1-2107907 Initial performance evaluation result for XR Xiaomi
16. R1-2108007 XR performance evaluation results Ericsson
17. R1-2108100 Initial evaluation results for XR China Unicom

RAN1 #106b-e

1. R1-2108736 Performance evaluation results for XR and Cloud Gaming Huawei, HiSilicon
2. R1-2108799 XR evaluation results FUTUREWEI
3. R1-2108869 Initial evaluation results for XR CEWiT
4. R1-2108889 Performance Evaluation Results for XR ZTE, Sanechips
5. R1-2109008 Performance evaluation results on XR vivo
6. R1-2109100 Evaluation results for XR evaluation OPPO
7. R1-2109200 Evaluation results of XR performance CATT
8. R1-2109307 Performance evaluation results for XR CMCC
9. R1-2109393 Performance evaluation result for XR Xiaomi
10. R1-2109555 Performance Evaluation Results MediaTek Inc.
11. R1-2110401 Performance evaluation results for XR and CG Intel Corporation
12. R1-2110386 Performance results in indoor hotspot and dense urban deployments of CG and VR/AR applications Nokia, Nokia Shanghai Bell
13. R1-2109922 XR Performance Evaluation Results AT&T
14. R1-2109924 Performance Evaluation Results for XR InterDigital, Inc.
15. R1-2110403 XR performance evaluation results Ericsson
16. R1-2110402 Evaluation Results for XR Qualcomm Incorporated
17. R1-2110246 Initial performance evaluation results of XR ITRI

Annex A: Simulation assumptions

Table A.1-1: General parameters for FR1

|  |  |
| --- | --- |
| **Parameter** | **Value** |
| Deployment | Indoor hotspot refers to TR 38.913  Dense urban with single layer of Marco layer refers to TR 38.913  Urban Macro refers to TR 38.913 |
| Channel model | For Indoor hotspot:   * InH refers to TR 38.901   For Dense urban:   * Uma refers to TR 38.901   For Urban Macro:   * Uma refers to TR 38.901 |
| Layout | For Indoor hotspot:   * 120m x 50m, ISD = 20m, TRP numbers: 12   For Dense urban:   * 21 cells with wraparound, ISD = 200m   For Urban Macro:   * 21 cells with wraparound, ISD = 500m |
| Carrier frequency | 4GHz |
| Subcarrier spacing | 30kHz |
| System bandwidth | Baseline: 100 MHz  Optional: 20/40 MHz, 2\*100 MHz with CA  Companies should report the CA setting if CA is adopted. |
| TDD configuration | Option 1: DDDSU (S: 10D:2F:2U)  Option 2: DDDUU (The end of third ‘D’: [2]-symbol gap) |
| BS Tx power | For Indoor hotspot:   * 24 dBm per 20 MHz   For Dense urban:   * 44 dBm per 20 MHz   For Urban Macro:   * 49 dBm per 20 MHz   For system BW larger than above, Tx power scales up accordingly. |
| UE max Tx power | 23 dBm |
| BS antenna parameters | For InH scenario:   * 32 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (4,4,2,1,1;4,4) * (dH, dV) = (0.5λ, 0.5λ)   For Dense Urban/Urban Macro scenario:   * Option 1: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8) * Option 2: 32 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,2,2,1,1,8,2) * (dH, dV) = (0.5λ, 0.5λ) * Company to report the BS antenna parameters for XR/CG evaluation.   Other BS antenna parameters can also be optionally evaluated. |
| UE antenna parameters | Baseline: 2T/4R, (M, N, P, Mg, Ng; Mp, Np) = (1,2,2,1,1;1,2), (dH, dV) = (0.5, N/A)λ  Optional: 4T/4R, 1T/2R, 2T2R |
| BS height | For Indoor hotspot:   * 3m   For Dense urban:   * 25m   For Urban Macro:   * 25m |
| UE height | For InH scenario:   * 1.5m   For Dense Urban/Urban Macro scenario:   * Outdoor UEs: 1.5 m * Indoor UTs: 3(nfl – 1) + 1.5; nfl ~ uniform(1,Nfl) where Nfl ~ uniform(4,8) |
| BS antenna pattern | For Indoor hotspot:   * Ceiling-mount antenna radiation pattern, 5 dBi   For Dense urban:   * 3-sector antenna radiation pattern, 8 dBi   For Urban Macro:   * 3-sector antenna radiation pattern, 8 dBi |
| UE antenna pattern | Omni-directional, 0 dBi |
| Noise figure | BS: 5 dB, UE: 9dB |
| Downtilt | For Indoor hotspot:   * 90° (pointing to the ground)   For Dense urban:   * 12 degree * Other downtilt value can also be optionally evaluated   For Urban Macro:   * 6 degree |
| UE distribution | For InH scenario:   * 100% indoor   For Dense Urban/Urban Macro scenario:   * 80% indoor, 20% outdoor |
| UE speed | 3 km/h |
| BS receiver | MMSE-IRC |
| UE receiver | MMSE-IRC |
| Channel estimation | Realistic  Ideal (optional) |
| MCS | Up to 256QAM |
| Power control parameter | Companies should report |
| Transmission scheme | Companies should report |
| Scheduler | SU/MU-MIMO PF scheduler (company to report SU or MU),  other scheduler (e.g., delay aware scheduler) is up to companies report |
| CSI acquisition | Realistic  Both CSI feedback and SRS are considered  Companies should report  •          CSI feedback delay, CSI report periodicity, whether using CSI quantization, CSI error model or not,  •          Assumptions on SRS: periodicity, processing gain, processing delay, etc  and etc. |
| PHY processing delay | Baseline: UE PDSCH processing Capability #1  Optional: UE PDSCH processing Capability #2    Companies should report gNB processing delay, e.g. DL NACK to retransmission delay, UL previous transmission to current transmission delay and etc. |
| PDCCH overhead | Companies should report |
| DMRS overhead | Companies should report |
| Target BLER | Companies should report |
| Max HARQ transmission | Companies should report |

Table A.2-1: General parameters for FR2

|  |  |
| --- | --- |
| **Parameter** | **Value** |
| Deployment | Indoor hotspot refers to TR 38.913  Dense urban with single layer of Marco layer refers to TR 38.913 |
| Channel model | For Indoor hotspot:   * InH refers to TR 38.901   For Dense urban:   * Uma refers to TR 38.901 |
| Layout | For Indoor hotspot:   * 120m x 50m, ISD: 20m, TRP numbers: 12   For Dense urban:   * 21cells with wraparound, ISD: 200m |
| Carrier frequency | 30GHz |
| Subcarrier spacing | 120KHz |
| System bandwidth | Option 1: 100 MHz  Option 2: 400 MHz  Companies should report the CA setting if CA is adopted. |
| TDD configuration | Option 1: DDDSU (S: 10D:2F:2U)  Option 2: DDDUU (The end of third ‘D’: [2]-symbol gap) |
| BS Tx power | For Indoor hotspot:   * 23 dBm per 80 MHz. EIRP should not exceed 58 dBm   For Dense urban:   * 40 dBm per 80 MHz. EIRP should not exceed 73 dBm   For system BW larger than above, Tx power scales up accordingly. |
| UE max Tx power | 23 dBm, maximum EIRP 43 dBm, |
| BS antenna parameters | For InH scenario:   * 2 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (16, 8, 2,1,1;1,1) * (dH, dV) = (0.5λ, 0.5λ)   For Dense urban scenario:   * 2 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (4,8,2,2,2;1,1) * (dH, dV) = (0.5λ, 0.5λ) |
| UE antenna parameters | Option 1 (Follow Rel-17 evaluation methodology for FeMIMO in R1-2007151)   * (M, N, P) = (1, 4, 2), 3 panels (left, right, top) * (Mp, Np) is up to company.   Option 2 (from TR 38.802 – developed in Rel-14)   * 4Tx/4Rx: (M, N, P, Mg, Ng; Mp, Np) = (2,4,2,1,2;1,2), (dH,dV) = (0.5, 0.5)λ, the polarization angles are 0° and 90°   Company to report the UE antenna parameters for XR/CG evaluation.  Other UE antenna parameters can also be optionally evaluated. |
| BS height | For Indoor hotspot:   * 3m   For Dense urban:   * 25m |
| UE height | For InH scenario:   * 1.5m   For Dense Urban/Urban Macro scenario:   * Outdoor UEs: 1.5 m * Indoor UTs: 3(nfl – 1) + 1.5; nfl ~ uniform(1,Nfl) where Nfl ~ uniform(4,8) |
| BS antenna pattern | For Indoor hotspot:   * Ceiling-mount antenna radiation pattern, 5 dBi   For Dense urban:   * 3-sector antenna radiation pattern, 8 dBi |
| UE antenna pattern | UE antenna radiation pattern model 1, 5dBi |
| BS noise figure | 7 dB |
| UE noise figure | 13 dB |
| Downtilt | For Indoor hotspot:   * 90° (pointing to the ground)   For Dense urban:   * 12 degree   Other downtilt can be optionally evaluated |
| UE distribution | For indoor scenario:   * 100% indoor   For outdoor scenario:   * 100% outdoor   Other UE distribution can be evaluated optionally |
| UE speed | 3 km/h |
| BS receiver | MMSE-IRC |
| UE receiver | MMSE-IRC |
| Channel estimation | Realistic  Ideal (optional) |
| MCS | Up to 256QAM |
| Power control parameter | Companies should report |
| Transmission scheme | Companies should report |
| Scheduler | SU/MU-MIMO PF scheduler (company to report SU or MU),  other scheduler (e.g., delay aware scheduler) is up to companies report |
| CSI acquisition | Realistic  Both CSI feedback and SRS are considered  Companies should report  •          CSI feedback delay, CSI report periodicity, whether using CSI quantization, CSI error model or not,  •          Assumptions on SRS: periodicity, processing gain, processing delay, etc  and etc. |
| PHY processing delay | Baseline: UE PDSCH processing Capability #1  Optional: UE PDSCH processing Capability #2    Companies should report gNB processing delay, e.g. DL NACK to retransmission delay, UL previous transmission to current transmission delay and etc. |
| PDCCH overhead | Companies should report |
| DMRS overhead | Companies should report |
| Target BLER | Companies should report |
| Max HARQ transmission | Companies should report |

Annex B: Traffic model

Table B.1-1: Traffic model for DL

|  |  |  |
| --- | --- | --- |
| **Traffic model** | **CG** | **VR/AR** |
| Data rate | baseline: 8Mbps, 30Mbps | baseline: 30Mbps, 45Mbps  optional: 60Mbps |
| PDB | baseline: 15ms | baseline: 10ms |
| Frame per second | baseline: 60fps  optional: 120 fps | |
| Packet size | Truncated Gaussian distribution for packet size  baseline: [STD, Max, Min]: [10.5, 150, 50] % of Mean packet size  optional: [STD, Max, Min] = [4, 112, 88] % of Mean for single eye buffer, [3, 109, 91] % of Mean for dual eye buffer | |
| Jitter | J is drawn from a truncated Gaussian distribution  baseline: Mean: 0 ms; STD: 2 ms; Range: [-4, 4] ms  optional: Mean: 0 ms; STD: 2 ms; Range: [-5, 5] ms | |

Table B.2-1: Traffic model for UL

|  |  |  |
| --- | --- | --- |
| **Traffic model** | **pose/control** | **scene/video/data/audio aggregating streams** |
| Data rate | baseline: 0.2Mbps | baseline: 10 Mbps  optional: 20 Mbps |
| Frame per second | baseline: 250fps | baseline: 60fps |
| PDB | baseline: 10ms | baseline: 30ms  optional: 10ms, 15ms, 60ms |
| Packet size | baseline: Fixed 100 bytes | Truncated Gaussian distribution with the parameter values same as for DL |
| Jitter | baseline: no jitter | optional: same model as for DL |

Annex C: Capacity Evaluation Results

* 1. FR1 DL
     1. DU Scenario
        1. VR/AR
           1. Single stream traffic model

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Data rate** | **PDB (ms)** | | **SU-MIMO** | | | | **MU-MIMO** | | | **Notes** |
| **Capacity** | | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** | **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |  |
| Huawei, HiSilicon  [R1-2108736] | 30Mbps | 10 | | 5.1 | | 5 | 91.43% | 11.5 | 11 | 92.99% | Note 1 |
| 10 | |  | |  |  | 9.9 | 9 | 94.36% | Note 1, 2 |
| 10 | |  | |  |  | 16.8 | 16 | 91.96% | Note 1, 3 |
| 7 | |  | |  |  | 6.3 | 6 | 91.67% | Note 1 |
| 13 | |  | |  |  | 14.6 | 14 | 91.72% | Note 1 |
| 13 | |  | |  |  | 19.3 | 19 | 90.54% | Note 1,3 |
| 10 | |  | |  |  | 11.6 | 11 | 93.42% | Note 1,4 |
| 10 | | 6.4 | | 6 | 91.67% | 14 | 14 | 90.08% | Note 1,5 |
| 45Mbps | 10 | | 2.1 | | 2 | 91.29% | 5.3 | 5 | 91.90% | Note 1 |
| 10 | | 2.7 | | 2 | 95.00% | 6.6 | 6 | 92.59% | Note 1,5 |
| Note 1: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8)  Note 2: X = 99.5  Note 3: X = 95  Note 4: Without jitter  Note 5: With Frame Level Integrated Transmission (FLIT) | | | | | | | | | | |
| FUTUREWEI  [R1-2108799] | 30Mbps | 10 | | 7.6 | | 7 | 94% | 8.7 | 8 | 94% | Note 1,2 |
| 10 | | 9.4 | | 9 | 94% | 16.4 | 16 | 92% | Note 1,2,3 |
| 10 | | 9.7 | | 9 | 94% | 12.3 | 12 | 93% | Note 1 |
| 10 | | 11.7 | | 11 | 95% | 20.3 | 20 | 94% | Note 1,3 |
| 45Mbps | 10 | | 6 | | 6 | 90% | 7.6 | 7 | 91% | Note 1 |
| 10 | | 7 | | 7 | 90% | 14.3 | 14 | 91% | Note 1,3 |
| Note 1: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8)  Note 2: TDD format: DDDUU  Note 3: Cooperative MIMO/precoding | | | | | | | | | | |
| CEWiT [R1-2108869] | 30Mbps | 10 | | 4.05 | | 4 | 90.48% |  |  |  | Note 1 |
| Note 1: BS antenna parameters: 32 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,2,2,1,1:8,2) | | | | | | | | | | |
| ZTE, Sanechips [R1-2108889] | 30Mbps | 10 | |  | |  |  | 12.5 | 12 | 90% | Note 1,2 |
| 10 | |  | |  |  | 13.6 | 13 | 92% | Note 1,2,3 |
| 45Mbps | 10 | |  | |  |  | 7.8 | 7 | 97% | Note 1,2 |
| 10 | |  | |  |  | 7.9 | 7 | 97% | Note 1,2,3 |
| Note 1: 64QAM  Note 2: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8)  Note 3: the traffic model for [3, 109, 91]% relationship | | | | | | | | | | |
| vivo  [R1-2109008] | 30Mbps | 10 | | 9.49 | | 9 | 94.18% | 13.59 | 13 | 92.43% | Note 1 |
| 10 | | 12.67 | | 12 | 95.12% | 14.4 | 14 | 91.84% | Note 1,2 |
| 10 | |  | |  |  | 20.78 | 20 | 92.54% | Note 1,3 |
| 45Mbps | 10 | |  | |  |  | 6.91 | 6 | 95.63% | Note 1 |
| 10 | |  | |  |  | 11.42 | 11 | 91.77% | Note 1,2 |
| Note 1: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8)  Note 2: Delay aware scheduler  Note 3: 120FPS | | | | | | | | | | |
| OPPO  [R1-2109100] | 30Mbps | 10 | | 8.4 | | 8 |  |  |  |  | Note 1,2 |
| 10 | | 9.2 | | 9 |  |  |  |  | Note 1,3 |
| 10 | | 7.4 | | 7 |  |  |  |  | Note 1,4 |
| 10 | | 9 | | 9 |  |  |  |  | Note 1,2,5 |
| 10 | | 10.5 | | 10 |  |  |  |  | Note 1,3,5 |
| 10 | | 7.1 | | 7 |  |  |  |  | Note 1,4,5 |
| 15 | | 10.2 | | 10 |  |  |  |  | Note 1,2 |
| 15 | | 10.3 | | 10 |  |  |  |  | Note 1,3 |
| 15 | | 10.3 | | 10 |  |  |  |  | Note 1,4 |
| 15 | | 10.5 | | 10 |  |  |  |  | Note 1,2,5 |
| 15 | | 11 | | 11 |  |  |  |  | Note 1,3,5 |
| 15 | | 10.1 | | 10 |  |  |  |  | Note 1,4,5 |
| 45Mbps | 10 | | 5.2 | | 5 |  |  |  |  | Note 1,2 |
| 10 | | 5.4 | | 5 |  |  |  |  | Note 1,3 |
| 10 | | 4.4 | | 4 |  |  |  |  | Note 1,4 |
| 10 | | 5.4 | | 5 |  |  |  |  | Note 1,2,5 |
| 10 | | 6.6 | | 6 |  |  |  |  | Note 1,3,5 |
| 10 | | 4.4 | | 4 |  |  |  |  | Note 1,4,5 |
| 15 | | 6.3 | | 6 |  |  |  |  | Note 1,2 |
| 15 | | 6.3 | | 6 |  |  |  |  | Note 1,3 |
| 15 | | 6.4 | | 6 |  |  |  |  | Note 1,4 |
| 15 | | 6.7 | | 6 |  |  |  |  | Note 1,2,5 |
| 15 | | 7.1 | | 7 |  |  |  |  | Note 1,3,5 |
| 15 | | 6.3 | | 6 |  |  |  |  | Note 1,4,5 |
| Note 1: BS antenna parameters: 32 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,2,2,1,1:8,2)  Note 2: The interval of packet arrival among UEs are random  Note 3: The interval of packet arrival among UEs are equal  Note 4: The interval of packet arrival among UEs are zero, i.e. packet arrival among UEs are synchronized  Note 5: Without jitter | | | | | | | | | | |
| CATT  [R1-2109200] | 30Mbps | | 10 | |  |  |  | 8 | 8 | 91% | Note 1 |
| Note 1: 64QAM | | | | | | | | | | |
| CMCC  [R1-2109307] | 30Mbps | 10 | | 1 | | 1 | 95.24% | 7 | 7 | 94.56% | Note 1,2 |
| Note 1: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8)  Note 2: Delay aware scheduler | | | | | | | | | | |
| Xiaomi  [R1-2109393] | 30Mbps | 10 | | 7 | | 7 | 90% |  |  |  | Note 1 |
| 45Mbps | 10 | | 5 | | 5 | 92% |  |  |  | Note 1 |
| Note 1: BS antenna parameters: 32 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,2,2,1,1:8,2) | | | | | | | | | | |
| MTK  [R1-2109555] | 30Mbps | 10 | | 10.6 | | 10 | 94.30% |  |  |  | Note 1 |
| 45Mbps | 10 | | 6 | | 6 | 91.75% |  |  |  | Note 1 |
| 10 | | 0 | | 0 | N/A |  |  |  | Note 1,2 |
| 10 | | 4.2 | | 4 | 91.93% |  |  |  | Note 1,3 |
| 10 | | 10.3 | | 10 | 91.53% |  |  |  | Note 1,4 |
| 10 | | 12.3 | | 12 | 92.15% |  |  |  | Note 1,5 |
| Note 1: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8)  Note 2: DDDDD DDDUU (2.6GHz)  Note 3: DSUDD SUUDD (4.9GHz)  Note 4: CA baseline: DDDDD DDDUU (2.6GHz) + DSUDD SUUDD (4.9GHz)  Note 5: CA with enhancements: DDDDD DDDUU (2.6GHz) + DSUDD SUUDD (4.9GHz) | | | | | | | | | | |
| Intel  [R1-2110401] | 30Mbps | 10 | | 5.45 | | 5 | 94.19% | 7 | 7 | 90% | Note 1 |
| 10 | |  | |  |  | 7.5 | 7 | 95.71% | Note 1,2 |
| Note 1: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8)  Note 2: No jitter | | | | | | | | | | |
| Nokia  [R1-2110386] | 30Mbps | 10 | | | 6.54 | 6 | 97% |  |  |  | Note 1 |
| 45Mbps | 10 | | | 4.1 | 4 | 92% |  |  |  | Note 1 |
| Note 1: BS antenna parameters: 32 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,2,2,1,1:8,2) | | | | | | | | | | |
| Interdigital[R1-2109924] | 30Mbps | 10 | | |  |  |  | 3.9 | 3 | 99% | Note 1 |
| 45Mbps | 10 | | |  |  |  | 2.4 | 2 | 95% | Note 1 |
| Note 1: BS antenna parameters: 32 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,2,2,1,1:8,2) | | | | | | | | | | |
| Ericsson [R1-2110403] | 30Mbps | 10 | | 9.3 | |  |  | 11.1 |  |  | Note 1 |
| 45Mbps | 10 | | 5.3 | |  |  | 6.4 |  |  | Note 1 |
| Note 1: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8) | | | | | | | | | | |
| QC  [R1-2110402] | 30Mbps | 10 | | 8.2 | | 8 | 93% | 13.4 | 13 | 92% | Note 1 |
| 45Mbps | 10 | | 5.2 | | 5 | 93% | 8.4 | 8 | 92% | Note 1 |
| Note 1: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8) | | | | | | | | | | |

* + - * 1. Multi-stream traffic model

**I/P Frame Traffic Model GOP-Based**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Data rate** | **Alpha** | **[I\_PDB, P\_PDB] (ms)** | **SU-MIMO** | | | | **MU-MIMO** | | | | | | **Notes** |
| **Capacity** | | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** | **Capacity** | | **C1=floor (Capacity)** | | **% of satisfied UEs when #UEs/cell =C1** | |  |
| Huawei, HiSilicon  [R1-2108736] | 30Mbps | 1 | [10,10] |  | |  |  | 10 | | 10 | | 90.08% | | Note 1,2 |
| 1.5 | [10,10] |  | |  |  | 8.5 | | 8 | | 93.95% | | Note 1,2 |
| 2 | [10,10] |  | |  |  | 6.7 | | 6 | | 93.12% | | Note 1,2 |
| [15, 9] |  | |  |  | 8.8 | | 8 | | 94.35% | | Note 1,2 |
| [10,10] |  | |  |  | 6.7 | | 6 | | 93.12% | | Note 1,3 |
| [15,10] |  | |  |  | 9.1 | | 9 | | 90.87% | | Note 1,2 |
| [15,10] |  | |  |  | 9.6 | | 9 | | 92.06% | | Note 1,3 |
| [10,10] |  | |  |  | 6 | | 6 | | 90.08% | | Note 1,4 |
| [17, 9] |  | |  |  | 9.5 | | 9 | | 91.45% | | Note 1,2 |
| [17, 10] |  | |  |  | 10.5 | | 10 | | 91.59% | | Note 1,2 |
| [17, 10] |  | |  |  | 11.8 | | 11 | | 93.51% | | Note 1,3 |
| [10,10] |  | |  |  | 7.4 | | 7 | | 91.38% | | Note 1,4,5 |
| [10,10] |  | |  |  | 8.6 | | 8 | | 95.44% | | Note 1,4,6, |
| 3 | [10,10] |  | |  |  | 4 | | 4 | | 90.12% | | Note 1,2 |
| 45Mbps | 1.5 | [10,10] |  | |  |  | 1.4 | | 1 | | 97.14% | | Note 1,4 |
|  | |  |  | 2.6 | | 2 | | 92.83% | | Note 1,4,5 |
|  | |  |  | 3.2 | | 3 | | 90.79% | | Note 1,4,6 |
| Note 1: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8)  Note 2: [PER\_I, PER\_P] = [1%, 1%]  Note 3: [PER\_I, PER\_P] = [1%, 5%]  Note 4: [PER\_I, PER\_P] = [0.5%, 5%]  Note 5: Based on PF, prioritize the transmission of I frame  Note 6: [PER\_I, PER\_P] = FLIT and prioritize the transmission of I frame | | | | | | | | | | | | | |
| ZTE, Sanechips [R1-2108889] | 30Mbps | 2 | [10,10] |  | |  |  | 10.8 | | 10 | | 94% | | Note 1,2,3 |
|  | |  |  | 12.2 | | 12 | | 92% | | Note 1,2,4 |
|  | |  |  | 10.9 | | 10 | | 94% | | Note 1,2,5 |
|  | |  |  | 10.9 | | 10 | | 94% | | Note 1,2,6 |
| Note 1: 64QAM  Note 2: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8)  Note 3: [PER\_I, PER\_P] = [1%, 1%]  Note 4: [PER\_I, PER\_P] = [10%, 1%]  Note 5: [PER\_I, PER\_P] = [1%, 10%]  Note 6: [PER\_I, PER\_P] = [1%, 5%] | | | | | | | | | | | | | |
| vivo  [R1-2109008] | 30Mbps | 1.5 | [10,10] | |  |  |  | 6.74 | | 6 | | 93.12% | | Note 1,2 |
|  |  |  | 6.74 | | 6 | | 93.12% | | Note 1,3 |
|  |  |  | 6.39 | | 6 | | 91.67% | | Note 1,4 |
| [15,10] | |  |  |  | 12.58 | | 12 | | 92.20% | | Note 1,2 |
|  |  |  | 12.8 | | 12 | | 92.86% | | Note 1,3 |
|  |  |  | 12.25 | | 12 | | 91.14% | | Note 1,4 |
| [15,9] | |  |  |  | 12.39 | | 12 | | 91.53% | | Note 1,2 |
|  |  |  | 12.53 | | 12 | | 92.06% | | Note 1,3 |
|  |  |  | 12.2 | | 12 | | 90.87% | | Note 1,4 |
| 2 | [10,10] | |  |  |  | 5.2 | | 5 | | 91.14% | | Note 1,2 |
|  |  |  | 5.2 | | 5 | | 91.14% | | Note 1,3 |
|  |  |  | 4.74 | | 4 | | 94.84% | | Note 1,4 |
|  |  |  | 5.35 | | 5 | | 91.47% | | Note 1,2,5 |
|  |  |  | 5.35 | | 5 | | 91.47% | | Note 1,3,5 |
|  |  |  | 4.97 | | 4 | | 90.87% | | Note 1,4,5 |
| [15,10] | |  |  |  | 10.06 | | 10 | | 90.32% | | Note 1,2 |
|  |  |  | 10.06 | | 10 | | 90.32% | | Note 1,3 |
|  |  |  | 9.12 | | 9 | | 90.40% | | Note 1,4 |
| [15,9] | |  |  |  | 9.19 | | 9 | | 92.70% | | Note 1,2 |
|  |  |  | 9.97 | | 9 | | 92.83% | | Note 1,3 |
|  |  |  | 8.99 | | 8 | | 93.55% | | Note 1,4 |
| 3 | [10,10] | |  |  |  | 2.21 | | 2 | | 92.86% | | Note 1,2 |
|  |  |  | 2.21 | | 2 | | 92.86% | | Note 1,3 |
|  |  |  | 2.09 | | 2 | | 91.27% | | Note 1,4 |
| [15,10] | |  |  |  | 5.73 | | 5 | | 93.58% | | Note 1,2 |
|  |  |  | 5.73 | | 5 | | 93.75% | | Note 1,3 |
|  |  |  | 4.91 | | 4 | | 94.44% | | Note 1,4 |
| [15,9] | |  |  |  | 5.69 | | 5 | | 93.17% | | Note 1,2 |
|  |  |  | 5.69 | | 5 | | 93.17% | | Note 1,3 |
|  |  |  | 4.84 | | 4 | | 93.58% | | Note 1,4 |
| Note 1: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8)  Note 2: [PER\_I, PER\_P] = [1%, 1%]  Note 3: [PER\_I, PER\_P] = [1%, 5%]  Note 4: [PER\_I, PER\_P] = [0.5%, 5%]  Note 5: Based on PF, prioritize the transmission of I frame | | | | | | | | | | | | | |
| MTK  [R1-2109555] | 30Mbps | 2 | [10,10] | 6 | | 6 | 93.34% | |  | |  | |  | Note 1,2 |
| [10,10] | 6 | | 6 | 93.81% | |  | |  | |  | Note 1,3 |
| [10,10] | 2 | | 2 | 91.91% | |  | |  | |  | Note 1,4 |
| [17, 9] | 9 | | 9 | 89.60% | |  | |  | |  | Note 1,2 |
| [15,10] | 10 | | 10 | 90.39% | |  | |  | |  | Note 1,2 |
| [15,10] | 10 | | 10 | 94.00% | |  | |  | |  | Note 1,3 |
| [10,10] | 8 | | 8 | 94.05% | |  | |  | |  | Note 1,2,5 |
| [10,10] | 8 | | 8 | 94.41% | |  | |  | |  | Note 1,3,5 |
| [10,10] | 2 | | 2 | 89.53% | |  | |  | |  | Note 1,4,5 |
| [17, 9] | 11 | | 11 | 88.30% | |  | |  | |  | Note 1,2,5 |
| [15,10] | 11 | | 11 | 90.65% | |  | |  | |  | Note 1,2,5 |
| [15,10] | 11 | | 11 | 92.27% | |  | |  | |  | Note 1,3,5 |
| 45Mbps | 1.5 | [10,10] | 2 | | 2 | 89.05% | |  | |  | |  | Note 1,2 |
| [10,10] | 3 | | 3 | 89.53% | |  | |  | |  | Note 1,2,5 |
| [10,10] | 3 | | 3 | 90.16% | |  | |  | |  | Note 1,3,5 |
| [17, 9] | 4 | | 4 | 89.77% | |  | |  | |  | Note 1,2,5 |
| [15,10] | 4 | | 4 | 88.58% | |  | |  | |  | Note 1,2 |
| [15,10] | 5 | | 5 | 91.24% | |  | |  | |  | Note 1,3 |
| [15,10] | 5 | | 5 | 89.72% | |  | |  | |  | Note 1,2,5, |
| [15,10] | 6 | | 6 | 89.21% | |  | |  | |  | Note 1,3,5 |
| 3 | [10,10] | <2 | | <2 | N/A | |  | |  | |  | Note 1,2 |
| [10,10] | 2 | | 2 | 87.62% | |  | |  | |  | Note 1,2,5 |
| [10,10] | 2 | | 2 | 89.53% | |  | |  | |  | Note 1,3,5 |
| [17, 9] | 4 | | 4 | 89.77% | |  | |  | |  | Note 1,2,5 |
| [15,10] | 4 | | 4 | 95.00% | |  | |  | |  | Note 1,3 |
| [15,10] | 4 | | 4 | 96.91% | |  | |  | |  | Note 1,2 |
| [15,10] | 6 | | 6 | 88.26% | |  | |  | |  | Note 1,3,5 |
| [15,10] | 6 | | 6 | 89.85% | |  | |  | |  | Note 1,2,5 |
| Note 1: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8)  Note 2: [PER\_I, PER\_P] = [1%, 1%]  Note 3: [PER\_I, PER\_P] = [1%, 5%]  Note 4: [PER\_I, PER\_P] = [0.5%, 5%]  Note 5: Delay aware scheduler | | | | | | | | | | | | | |

**I/P Frame Traffic Model Slice-Based**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Data rate** | **Alpha** | **[I\_PDB, P\_PDB] (ms)** | **SU-MIMO** | | | | **MU-MIMO** | | | **Notes** |
| **Capacity** | | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** | **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |  |
| Huawei, HiSilicon [R1-2108736] | 30Mbps | 2 | [10,10] |  | |  |  | 14.9 | 14 | 91.67% | Note 1,2 |
| [10,10] |  | |  |  | 15.7 | 15 | 91.17% | Note 1,4 |
| [10,10] |  | |  |  | 17.3 | 17 | 90.87% | Note 1,3 |
| Note 1: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8)  Note 2: [PER\_I, PER\_P] = [1%, 1%]  Note 3: [PER\_I, PER\_P] = [1%, 5%]  Note 4: [PER\_I, PER\_P] = [0.5%, 5%] | | | | | | | | | | |
| ZTE, Sanechips [R1-2108889] | 30Mbps | 2 | [10,10] |  | |  |  | 12.7 | 12 | 93% | Note 1,2,3 |
|  | |  |  | 14.6 | 14 | 91% | Note 1,2,6 |
| Note 1: 64QAM  Note 2: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8)  Note 3: [PER\_I, PER\_P] = [1%, 1%]  Note 6: [PER\_I, PER\_P] = [1%, 5%] | | | | | | | | | | |
| vivo  [R1-2109008] | 30Mbps | 1.5 | [10,10] | |  |  |  | 13.78 | 13 | 92.38% | Note 1,2 |
|  |  |  | 16.74 | 16 | 91.52% | Note 1,3 |
|  |  |  | 16.74 | 16 | 91.52% | Note 1,4 |
| [15,10] | |  |  |  | 13.93 | 13 | 92.87% | Note 1,2 |
|  |  |  | 16.79 | 16 | 91.72% | Note 1,3 |
|  |  |  | 16.77 | 16 | 91.62% | Note 1,4 |
| [15,9] | |  |  |  | 13.27 | 13 | 90.86% | Note 1,2 |
|  |  |  | 16.37 | 16 | 90.92% | Note 1,3 |
|  |  |  | 16.33 | 16 | 90.82% | Note 1,4 |
| 2 | [10,10] | |  |  |  | 13.69 | 13 | 92.25% | Note 1,2 |
|  |  |  | 16.84 | 16 | 91.77% | Note 1,3 |
|  |  |  | 16.59 | 16 | 91.27% | Note 1,4 |
|  |  |  | 13.54 | 13 | 91.72% | Note 1,2,5 |
|  |  |  | 16.23 | 16 | 90.77% | Note 1,3,5 |
|  |  |  | 16.17 | 16 | 90.57% | Note 1,4,5 |
| [15,10] | |  |  |  | 13.73 | 13 | 92.44% | Note 1,2 |
|  |  |  | 16.95 | 16 | 91.96% | Note 1,3 |
|  |  |  | 16.8 | 16 | 91.67% | Note 1,4 |
| [15,9] | |  |  |  | 13.36 | 13 | 91.21% | Note 1,2 |
|  |  |  | 16.74 | 16 | 91.46% | Note 1,3 |
|  |  |  | 16.66 | 16 | 91.36% | Note 1,4 |
| 3 | [10,10] | |  |  |  | 13.77 | 13 | 92.46% | Note 1,2 |
|  |  |  | 16.89 | 16 | 91.67% | Note 1,3 |
|  |  |  | 16.89 | 16 | 91.67% | Note 1,4 |
| [15,10] | |  |  |  | 13.84 | 13 | 92.63% | Note 1,2 |
|  |  |  | 16.98 | 16 | 92.06% | Note 1,3 |
|  |  |  | 16.89 | 16 | 91.85% | Note 1,4 |
| [15,9] | |  |  |  | 13.46 | 13 | 91.43% | Note 1,2 |
|  |  |  | 16.75 | 16 | 91.54% | Note 1,3 |
|  |  |  | 16.72 | 16 | 91.48% | Note 1,4 |
| Note 1: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8)  Note 2: [PER\_I, PER\_P] = [1%, 1%]  Note 3: [PER\_I, PER\_P] = [1%, 5%]  Note 4: [PER\_I, PER\_P] = [0.5%, 5%]  Note 5: Based on PF, prioritize the transmission of I frame | | | | | | | | | | |

* + - 1. CG

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Data rate** | **PDB (ms)** | **SU-MIMO** | | | | | | | | | | | | | | **MU-MIMO** | | | | | | | | | **Notes** |
| **Capacity** | | | | | **C1=floor (Capacity)** | | | | **% of satisfied UEs when #UEs/cell =C1** | | | | | **Capacity** | **C1=floor (Capacity)** | | | | **% of satisfied UEs when #UEs/cell =C1** | | | |  |
| Huawei, HiSilicon  [R1-2108736] | 30Mbps | 15 | 7.6 | | | | | 7 | | | | 92.52% | | | | | 16.1 | 16 | | | | 90.77% | | | | Note 1 |
| Note 1: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8) | | | | | | | | | | | | | | | | | | | | | | | | | |
| CEWiT  [R1-2108869] | 30Mbps | 15 | 5.57 | | | | | 5 | | | | 93.65% | | | | |  |  | | | |  | | | | Note 1 |
| Note 1: BS antenna parameters: 32 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,2,2,1,1:8,2) | | | | | | | | | | | | | | | | | | | | | | | | | |
| ZTE, Sanechips [R1-2108889] | 30Mbps | 15 |  | | | | |  | | | |  | | | | | 14.7 | 14 | | | | 93% | | | | Note 1,2 |
| 15 |  | | | | |  | | | |  | | | | | 14.8 | 14 | | | | 93% | | | | Note 1,2,3 |
| Note 1: 64QAM  Note 2: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8)  Note 3: the traffic model for [3, 109, 91]% relationship | | | | | | | | | | | | | | | | | | | | | | | | | |
| vivo  [R1-2109008] | 30Mbps | 15 | | 11.68 | | | | | 11 | | | | 94.81% | | | | 19.65 | 19 | | | | 92.56% | | | | Note 1 |
| 15 | | 13.58 | | | | | 13 | | | | 94.90% | | | | 19.75 | 19 | | | | 92.86% | | | | Note 1,2 |
| Note 1: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8)  Note 2: Delay aware scheduler | | | | | | | | | | | | | | | | | | | | | | | | | |
| CATT  [R1-2109200] | 30Mbps | 15 | |  | | | | |  | | | |  | | | | 10 | 10 | | | | 92% | | | | Note 1 |
| Note 1: 64QAM | | | | | | | | | | | | | | | | | | | | | | | | | |
| CMCC  [R1-2109307] | 30Mbps | 15 | 1 | | | | | 1 | | | | 100.00% | | | | | 7 | 7 | | | | 97.96% | | | | Note 1,2 |
| Note 1: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8)  Note 2: Delay aware scheduler | | | | | | | | | | | | | | | | | | | | | | | | | |
| Xiaomi  [R1-2109393] | 30Mbps | 15 | 8 | | | | 8 | | | | | 92% | | | |  | |  | | | |  | | | | Note 1 |
| Note 1: BS antenna parameters: 32 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,2,2,1,1:8,2) | | | | | | | | | | | | | | | | | | | | | | | | | |
| MTK  [R1-2109555] | 8Mbps | 15 | >20 | | >20 | | | | | | N/A | | | |  | | | | | |  | | | |  | Note 1 |
| 30Mbps | 15 | 13 | | 13 | | | | | | 90.41% | | | |  | | | | | |  | | | |  | Note 1 |
| Note 1: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8) | | | | | | | | | | | | | | | | | | | | | | | | | |
| Intel  [R1-2110401] | 30Mbps | 15 | 6.17 | | | | 6 | | | | | 91.01% | | | | 7.47 | | 7 | | | | 94.35% | | | | Note 1 |
| 15 |  | | | |  | | | | |  | | | | 8.20 | | 8 | | | | 90.14% | | | | Note 1,2 |
| Note 1: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8)  Note 2: No jitter | | | | | | | | | | | | | | | | | | | | | | | | | |
| Nokia  [R1-2110386] | 30Mbps | 15 | 8.5 | | | | | 8 | | | | 97% | | | |  | |  | | | |  | | | | Note 1 |
| Note 1: BS antenna parameters: 32 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,2,2,1,1:8,2) | | | | | | | | | | | | | | | | | | | | | | | | | |
| Interdigital [R1-2109924] | 30Mbps | 15 |  | | | | |  | | | |  | | | | 5 | | 5 | | | | 90% | | | | Note 1 |
| Note 1: BS antenna parameters: 32 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,2,2,1,1:8,2) | | | | | | | | | | | | | | | | | | | | | | | | | |
| Ericsson [R1-2110403] | 8Mbps | 15 | >36 | |  | | | | |  | | | | >36 | | | | | |  | | | |  | | Note 1 |
| 30Mbps | 15 | 11 | |  | | | | |  | | | | 15.1 | | | | | |  | | | |  | | Note 1 |
| Note 1: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8) | | | | | | | | | | | | | | | | | | | | | | | | | |
| QC  [R1-2110402] | 8Mbps | 15 | 24.4 | | | 24 | | | | | 93% | | | 56.6 | | | | | 56 | | | | 92% | | | Note 1 |
| 30Mbps | 15 | 10 | | | 10 | | | | | 91% | | | 16.5 | | | | | 16 | | | | 93% | | | Note 1 |
| Note 1: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8) | | | | | | | | | | | | | | | | | | | | | | | | | |

* + 1. InH Scenario
       1. VR/AR
          1. Single stream traffic model

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Data rate** | **PDB (ms)** | **SU-MIMO** | | | **MU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** | **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |  |
| ZTE, Sanechips [R1-2108889] | 30Mbps | 10 |  |  |  | 11.4 | 11 | 92% | Note 1 |
| 10 |  |  |  | 11.8 | 11 | 94% | Note 1,2 |
| 10 |  |  |  | 16.6 | 16 | 91% | Note 1,3 |
| 10 |  |  |  | 11.8 | 11 | 94% | Note 1,4 |
| 10 |  |  |  | 8.5 | 8 | 95% | Note 1,5 |
| 45Mbps | 10 |  |  |  | 7.2 | 7 | 92% |  |
| 10 |  |  |  | 7.3 | 7 | 93% | Note 1,2 |
| Note 1: 64QAM  Note 2: the traffic model for [3, 109, 91]% relationship  Note 3: Ehanced Preemption  Note 4: Rel-15 Preemption  Note 5: No Preemption | | | | | | | | |
| vivo  [R1-2109008] | 30Mbps | 10 | 8.27 | 8 | 92.71% | 10.8 | 10 | 92.50% |  |
| 10 | 10.77 | 10 | 95.20% | 12.4 | 12 | 93.06% | Note 1 |
| 10 |  |  |  | 16.53 | 16 | 92.71% | Note 2 |
| 45Mbps | 10 |  |  |  | 5.91 | 5 | 96.67% |  |
| 10 |  |  |  | 9.22 | 9 | 91.36% | Note 2 |
| Note 1: Delay aware scheduler  Note 2: 120FPS | | | | | | | | |
| CATT  [R1-2109200] | 30Mbps | 10 |  |  |  | 12 | 12 | 96% | Note 1 |
| 7 |  |  |  | 8 | 8 | 96% | Note 1 |
| 10 |  |  |  | 16 | 16 | 95% | Note 1,2 |
| 10 |  |  |  | 20 | 20 | 92% | Note 1,3 |
| 10 |  |  |  | 20 | 20 | 91% | Note 1,4 |
| 10 |  |  |  | 12 | 12 | 90% | Note 1,5 |
| 45Mbps | 10 |  |  |  | 12 | 12 | 94% | Note 1 |
| 60Mbps | 10 |  |  |  | 4 | 4 | 100% | Note 1 |
| Note 1: 64QAM  Note 2: gNB scheduling awareness of 2 frames UE playout buffer  Note 3: gNB scheduling awareness of 3 frames UE playout buffer  Note 4: gNB scheduling awareness of 4 frames UE playout buffer  Note 5: XR-dedicated PDCCH monitoring window | | | | | | | | |
| CMCC  [R1-2109307] | 30Mbps | 10 | 1 | 1 | 100.00% | 5 | 5 | 91.67% | Note 1 |
| Note 1: Delay aware scheduler | | | | | | | | |
| MTK  [R1-2109555] | 30Mbps | 10 | 8 | 8 | 88.13% |  |  |  |  |
| 45Mbps | 10 | 4.6 | 4 | 96.30% |  |  |  |  |
|  | | | | | | | | |
| Nokia  [R1-2110386] | 30Mbps | 10 | 5.2 | 5 | 94% |  |  |  |  |
| 45Mbps | 10 | 3.27 | 3 | 97% |  |  |  |  |
|  | | | | | | | | |
| Interdigital [R1-2109924] | 30Mbps | 10 |  |  |  | 5.8 | 5 | 96.8% |  |
| 45Mbps | 10 |  |  |  | 3 | 3 | 98% |  |
|  | | | | | | | | |
| Ericsson [R1-2110403] | 30Mbps | 10 | 8.5 |  |  | 9.2 |  |  |  |
| 45Mbps | 10 | 4.8 |  |  | 5.4 |  |  |  |
|  | | | | | | | | |
| ITRI  [R1-2110246] | 30Mbps | 10 | 4.85 | 4 | 100.00% |  |  |  |  |
|  | | | | | | | | |
| QC  [R1-2110402] | 30Mbps | 10 | 7 | 7 | 91% | 10.3 | 10 | 93% |  |
| 45Mbps | 10 | 4.3 | 4 | 97% | 6.4 | 6 | 93% |  |
|  | | | | | | | | |

* + - * 1. Multi-stream traffic model
      1. CG

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Data rate** | | **PDB (ms)** | | **SU-MIMO** | | | | | **MU-MIMO** | | | | | **Notes** |
| **Capacity** | **C1=floor (Capacity)** | | **% of satisfied UEs when #UEs/cell =C1** | | **Capacity** | | **C1=floor (Capacity)** | | **% of satisfied UEs when #UEs/cell =C1** |  |
| ZTE, Sanechips [R1-2108889] | 30Mbps | | 15 | |  |  | |  | | 12.9 | | 12 | | 90% | Note 1 |
| 15 | |  |  | |  | | 13.3 | | 13 | | 92% | Note 1,2 |
| Note 1: 64QAM  Note 2: the traffic model for [3, 109, 91]% relationship | | | | | | | | | | | | | | |
| vivo  [R1-2109008] | 30Mbps | | 15 | | 10.14 | 10 | | 91.67% | | 16.2 | | 16 | | 91.15% |  |
| 15 | | 11.43 | 11 | | 96.06% | | 16.67 | | 16 | | 92.01% | Note 1 |
| Note 1: Delay aware scheduler | | | | | | | | | | | | | | |
| CATT  [R1-2109200] | 30Mbps | | 15 | |  |  | |  | | 15 | | 15 | | 90% | Note 1 |
| Note 1: 64QAM | | | | | | | | | | | | | | |
| CMCC  [R1-2109307] | 30Mbps | 15 | | 1 | | | 1 | | 100.00% | | 7 | | 7 | 97.62% | Note 1 |
| Note 1: Delay aware scheduler | | | | | | | | | | | | | | |
| MTK  [R1-2109555] | 8Mbps | 15 | | >20 | | | >20 | | N/A | |  | |  |  |  |
| 30Mbps | 15 | | 9 | | | 9 | | 89.55% | |  | |  |  |  |
|  | | | | | | | | | | | | | | |
| Nokia  [R1-2110386] | 30Mbps | 15 | | 5.96 | | | 5 | | 99% | |  | |  |  |  |
|  | | | | | | | | | | | | | | |
| Interdigital[R1-2109924] | 30Mbps | 15 | |  | | |  | |  | | 7.2 | | 7 | 97.57% |  |
|  | | | | | | | | | | | | | | |
| Ericsson [R1-2110403] | 8Mbps | 15 | | >38.7 | | |  | |  | | >38.7 | |  |  |  |
| 30Mbps | 15 | | 10.5 | | |  | |  | | 12.3 | |  |  |  |
|  | | | | | | | | | | | | | | |
| ITRI  [R1-2110246] | 30Mbps | 15 | | 9.4 | | | 9 | | 91.67% | |  | |  |  |  |
|  | | | | | | | | | | | | | | |
| QC  [R1-2110402] | 8Mbps | 15 | | 22.3 | | | 22 | | 94% | | 44.1 | | 44 | 90% |  |
| 30Mbps | 15 | | 8.4 | | | 8 | | 97.5 | | 12.8 | | 12 | 95% |  |
|  | | | | | | | | | | | | | | |

* + 1. Uma Scenario
       1. VR/AR
          1. Single stream traffic model

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Data rate** | **PDB (ms)** | | | **SU-MIMO** | | | | **MU-MIMO** | | | **Notes** |
| **Capacity** | | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** | **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |  |
| Huawei, HiSilicon  [R1-2108736] | 30Mbps | 10 | | | 4.5 | | 4 | 92.38% | 9.3 | 9 | 91.22% | Note 1 |
| 45Mbps | 10 | | | 1.8 | | 1 | 94.29% | 4 | 4 | 90.00% | Note 1 |
| Note 1: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8) | | | | | | | | | | | |
| FUTUREWEI  [R1-2108799] | 30Mbps | 10 | | | 5.4 | | 5 | 93% | 6.1 | 6 | 91% | Note 1,2 |
| 10 | | | 6.5 | | 6 | 95% | 9.5 | 9 | 91% | Note 1,2,3 |
| 10 | | | 7 | | 7 | 90% | 7.7 | 7 | 97% | Note 1 |
| 10 | | | 8.9 | | 8 | 94% | 11.6 | 11 | 94% | Note 1,3 |
| 45Mbps | 10 | | | 4.4 | | 4 | 94% | 4.9 | 4 | 96% | Note 1 |
| 10 | | | 5.4 | | 5 | 93% | 7.7 | 7 | 92% | Note 1,3 |
| Note 1: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8)  Note 2: TDD format: DDDUU  Note 3: Cooperative MIMO/precoding | | | | | | | | | | | |
| CEWiT [R1-2108869] | 30Mbps | 10 | | | 2.98 | | 2 | 97.62% |  |  |  | Note 1 |
| Note 1: BS antenna parameters: 32 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,2,2,1,1:8,2) | | | | | | | | | | | |
| ZTE, Sanechips [R1-2108889] | 30Mbps | 10 | | |  | |  |  | 10 | 10 | 90% | Note 1,2 |
| 45Mbps | 10 | | |  | |  |  | 6 | 6 | 90% | Note 1,2 |
| Note 1: 64QAM  Note 2: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8) | | | | | | | | | | | |
| vivo  [R1-2109008] | 30Mbps | | 10 | | | 7.24 | 7 | 92.48% | 8.82 | 8 | 93.75% | Note 1 |
| 10 | | | 8.56 | 8 | 92.64% | 9.55 | 9 | 92.30% | Note 1,2 |
| 10 | | |  |  |  | 14.59 | 14 | 92.06% | Note 1,3 |
| 45Mbps | | 10 | | |  |  |  | 4.68 | 4 | 94.05% | Note 1 |
| 10 | | |  |  |  | 8.12 | 8 | 90.87% | Note 1,2 |
| Note 1: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8)  Note 2: Delay aware scheduler  Note 3: 120FPS | | | | | | | | | | | |
| MTK  [R1-2109555] | 30Mbps | | 10 | | | 8 | 8 | 89.05% |  |  |  | Note 1 |
| 45Mbps | | 10 | | | 4.2 | 4 | 92.86% |  |  |  | Note 1 |
| Note 1: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8) | | | | | | | | | | | |
| Ericsson [R1-2110403] | 30Mbps | | 10 | | | 7.2 |  |  | 8.7 |  |  | Note 1 |
| 45Mbps | | 10 | | | 3.7 |  |  | 4.6 |  |  | Note 1 |
| Note 1: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8) | | | | | | | | | | | |
| QC  [R1-2110402] | 30Mbps | | | 10 | | 4.4 | 4 | 94% | 5.2 | 5 | 91% | Note 1 |
| 45Mbps | | | 10 | | 2.4 | 2 | 93% | 2.9 | 2 | 93% | Note 1 |
| Note 1: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8) | | | | | | | | | | | |

* + - * 1. Multi-stream traffic model
      1. CG

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Data rate** | **PDB (ms)** | | | **SU-MIMO** | | | | | | | | | | | **MU-MIMO** | | | | | | | | **Notes** |
| **Capacity** | | | | **C1=floor (Capacity)** | | | | **% of satisfied UEs when #UEs/cell =C1** | | | **Capacity** | | | **C1=floor (Capacity)** | | | **% of satisfied UEs when #UEs/cell =C1** | |  |
| Huawei, HiSilicon  [R1-2108736] | 30Mbps | 15 | | | 6.5 | | | | 6 | | | | 92.86% | | | 12.4 | | | 12 | | | 92.46% | | Note 1 |
| Note 1: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8) | | | | | | | | | | | | | | | | | | | | | | | |
| CEWiT  [R1-2108869] | 30Mbps | 15 | | | 4.08 | | | | 4 | | | | 90.48% | | | |  | |  | | |  | | Note 1 |
| Note 1: BS antenna parameters: 32 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,2,2,1,1:8,2) | | | | | | | | | | | | | | | | | | | | | | | |
| ZTE, Sanechips [R1-2108889] | 30Mbps | 15 | | |  | | | |  | | | |  | | | 11.6 | | | 11 | | | 93% | | Note 1,2 |
| Note 1: 64QAM  Note 2: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8) | | | | | | | | | | | | | | | | | | | | | | | |
| vivo  [R1-2109008] | 30Mbps | | 15 | | | 10.33 | | | | 10 | | | | 91.90% | | | | 14.33 | | | 14 | | 91.33% | Note 1 |
| 15 | | | 11.94 | | | | 11 | | | | 93.78% | | | | 14.45 | | | 14 | | 91.73% | Note 1,2 |
| Note 1: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8)  Note 2: Delay aware scheduler | | | | | | | | | | | | | | | | | | | | | | | |
| MTK  [R1-2109555] | 8Mbps | 15 | | >20 | | | | >20 | | | | N/A | | |  | | | |  | | |  | | Note 1 |
| 30Mbps | 15 | | 9.5 | | | | 9 | | | | 92.35% | | |  | | | |  | | |  | | Note 1 |
| Note 1: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8) | | | | | | | | | | | | | | | | | | | | | | | |
| Ericsson [R1-2110403] | 8Mbps | 15 | | 32.9 | | |  | | | |  | | | | >36 | | | |  | | |  | | Note 1 |
| 30Mbps | 15 | | 9.2 | | |  | | | |  | | | | 12.1 | | | |  | | |  | | Note 1 |
| Note 1: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8) | | | | | | | | | | | | | | | | | | | | | | | |
| QC  [R1-2110402] | 8Mbps | 15 | | 17.5 | | | | 16 | | | 94% | | | | 23.8 | | | | | 23 | | 93% | | Note 1 |
| 30Mbps | 15 | | 5.4 | | | | 5 | | | 92% | | | | 8 | | | | | 8 | | 90% | | Note 1 |
| Note 1: BS antenna parameters: 64 TxRU, (M, N, P, Mg, Ng; Mp, Np) = (8,8,2,1,1;4,8) | | | | | | | | | | | | | | | | | | | | | | | |

* 1. FR1 UL
     1. DU Scenario
        1. VR/CG (Pose/control-stream)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Data rate** | **PDB (ms)** | **SU-MIMO** | | | **MU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** | **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |  |
| vivo  [R1-2109008] | 0.2Mbps | 10 | 20 | 20 | 99.99% |  |  |  |  |
| QC  [R1-2110402] | 0.2Mbps | 10 | 224.9 | 224 | 92% | >240 | 240 | 99% |  |
| Nokia  [R1-2110386] | 0.2Mbps | 10 | 45.77 | 45 | 98% |  |  |  | Note 2 |
| MTK  [R1-2109555] | 0.2Mbps | 10 | >30 | >30 | 100% |  |  |  |  |
| Interdigital  [R1-2109924] | 0.2Mbps | 10 |  |  |  | 8 | 8 | 96.50% | Note 2 |
| Huawei  [R1-2108736] | 0.2Mbps | 10 |  |  |  | >15 |  | 100% (15) |  |
| FUTUREWEI  [R1-2108799] | 0.2Mbps | 10 | 160.8 | 160 | 90% |  |  |  | Note 1 |
| Ericsson  [R1-2110403] | 0.2Mbps | 10 | 39.9 |  |  |  |  |  | Note 1 |
| Note 1: DDDUU  Note 2: 32TxRU,(8,2,2,1,1:8,2) | | | | | | | | | |

* + - 1. AR (1 stream: Scene/video/data/voice-stream)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Data rate** | **PDB (ms)** | **SU-MIMO** | | | **MU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** | **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |  |
| ZTE  [R1-2108889] | 10Mbps | 30 |  |  |  | 10.9 | 10 | 94% |  |
| vivo  [R1-2109008] | 10Mbps | 30 | 9.49 | 9 | 92.95% |  |  |  |  |
| QC  [R1-2110402] | 10Mbps | 30 | 4.5 | 4 | 93.3% | 7.3 | 7 | 90% |  |
| Nokia  [R1-2110386] | 10Mbps | 10 | 4.77 | 4 | 91% |  |  |  | Note 2  Note 9 |
| MTK  [R1-2109555] | 10Mbps | 30 | 9.39 | 9 | 90% |  |  |  |  |
| Interdigital [R1-2109924] | 10Mbps | 30 |  |  |  | 2.3 | 2 | 96% | Note 2  Note 9 |
| Huawei  [R1-2108736] | 10Mbps | 30 |  |  |  | 8.1 | 8 | 91.67% | Note 3 |
| 10 |  |  |  | <1 |  |  | Note 4 |
| 15 |  |  |  | 5.4 | 5 | 92.19% | Note 5 |
| 60 |  |  |  | 8.3 | 8 | 93.81% | Note 6 |
| 30 |  |  |  | 8.3 | 8 | 93.10% | Note 7 |
| 30 |  |  |  | 8.4 | 8 | 94.05% | Note 8 |
| Ericsson  [R1-2110403] | 10Mbps | 30 | 5.8 |  |  |  |  |  | Note 1 |
| Intel  [R1-2110401] | 10Mbps | 30 | 7.80 | 7 | 98.23% | 10.49 | 10 | 95.24% |  |
| Note 1: DDDUU  Note 2: 32TxRU,(8,2,2,1,1:8,2)  Note 3: (99,30)  Note 4: (99,10)  Note 5: (99,15)  Note 6: (99,60)  Note 7: (95,30)  Note 8: (90,30)  Note 9: with jitter | | | | | | | | | |

* + - 1. AR (2 streams: Pose/control-stream + scene/video/data/voice-stream)

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Pose/control stream** | | **Scene/video/data/voice stream** | | **SU-MIMO** | | | **MU-MIMO** | | | **Notes** |
| **Data rate**  **(Mbps)** | **PDB**  **(ms)** | **Data rate**  **(Mbps)** | **PDB**  **(ms)** | **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** | **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |  |
| vivo  [R1-2109008] | 0.2 | 10 | 10 | 30 | 7.43 | 7 | 92.29% |  |  |  |  |
| QC  [R1-2110402] | 0.2 | 10 | 10 | 30 | 4.1 | 4 | 90.4% | 5.8 | 5 | 92.4% |  |
| Interdigital [R1-2109924] | 0.2 | 10 | 10 | 30 |  |  |  | 0 | 0 | 0% | Note 3 |
| Huawei [R1-2108736] | 0.2 | 10 | 10 | 30 |  |  |  | 1.5 | 1 | 92.38% |  |
| 0.2 | 10 | 10 | 30 |  |  |  | 5.6 | 5 | 94.48% | Note 2 |
| Ericsson [R1-2110403] | 0.2 | 10 | 10 | 30 | 2.6 |  |  |  |  |  | Note 1 |
| Intel  [R1-2110401] | 0.2 | 10 | 10 | 30 | 3.35 | 3 | 91.90% | 4.57 | 4 | 90.75% |  |
| Note 1: DDDUU  Note 2: Aware traffic  Note 3: with jitter | | | | | | | | | | | |

* + 1. InH Scenario
       1. VR/CG (Pose/control-stream)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Data rate** | **PDB (ms)** | **SU-MIMO** | | | **MU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** | **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |  |
| ZTE  [R1-2108889] | 0.2Mbps | 10 | - | - | - | 40 | 40 | 100% | Note 2 |
| vivo  [R1-2109008] | 0.2Mbps | 10 | 20 | 20 | 100.00% | - | - | - |  |
| QC  [R1-2110402] | 0.2Mbps | 10 | 198 | 192 | 99% | >240 | 240 | 99% |  |
| Nokia  [R1-2110386R1-2110386] | 0.2Mbps | 10 | 54.59 | 54 | 97% | - | - | - |  |
| MTK  [R1-2109555] | 0.2Mbps | 10 | >30 | >30 | 100% | - | - | - |  |
| Interdigital  [R1-2109924] | 0.2Mbps | 10 | - | - | - | 20 | 20 | 100% | Note 3 |
| Ericsson  [R1-2110403] | 0.2Mbps | 10 | >40 | - | - | - | - | - | Note 1 |
| CATT  [R1-2109200] | 0.2Mbps | 10 | >12 | >12 | - | - | - | - | Note 1  Note 2 |
| Note 1: DDDUU  Note 2: 64QAM  Note 3: with jitter | | | | | | | | | |

* + - 1. AR (1 stream: Scene/video/data/voice-stream)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Data rate** | **PDB (ms)** | **SU-MIMO** | | | **MU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** | **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |  |
| vivo  [R1-2109008] | 10Mbps | 30 | 13.95 | 13 | 93.59% | - | - | - |  |
| QC  [R1-2110402] | 10Mbps | 30 | 4.4 | 4 | 97.3% | 7.1 | 7 | 95% |  |
| Nokia  [R1-2110386] | 10Mbps | 10 | 4.66 | 4 | 99% | - | - | - | Note 3 |
| MTK  [R1-2109555] | 10Mbps | 30 | 5.09 | 5 | 90% | - | - | - |  |
| Interdigital [R1-2109924] | 10Mbps | 30 | - | - | - | 11.5 | 11 | 94.50% | Note 3 |
| Ericsson  [R1-2110403] | 10Mbps | 30 | 6.1 | - | - | - | - | - | Note 2 |
| CATT  [R1-2109200] | 10Mbps | 30 | 6 | 6 | 100% | - | - | - | Note 1  Note 2 |
| Note 1: 64QAM  Note 2: DDDUU  Note 3: with jitter | | | | | | | | | |

* + - 1. AR (2 streams: Pose/control-stream + scene/video/data/voice-stream)

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Pose/control stream** | | **Scene/video/data/voice stream** | | **SU-MIMO** | | | **MU-MIMO** | | | **Notes** |
| **Data rate**  **(Mbps)** | **PDB**  **(ms)** | **Data rate**  **(Mbps)** | **PDB**  **(ms)** | **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** | **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |  |
| vivo  [R1-2109008] | 0.2 | 10 | 10 | 30 | 12.71 | 12 | 93.29% | - | - | - |  |
| QC  [R1-2110402] | 0.2 | 10 | 10 | 30 | 4.1 | 4 | 91.9% | 7.4 | 7 | 95.4% |  |
| Nokia  [R1-2110386] | 0.2 | 10 | 10 | 10 | 4.05 | 4 | 94% | - | - | - | Note 2 |
| Interdigital [R1-2109924] | 0.2 | 10 | 10 | 30 | - | - | - | 7.2 | 7 | 94% | Note 2 |
| Ericsson  [R1-2110403] | 0.2 | 10 | 10 | 30 | 5.8 | - | - | - | - | - | Note 1 |
| Note 1: DDDUU  Note 2: with jitter | | | | | | | | | | | |

* + 1. Uma Scenario
       1. VR/CG (Pose/control-stream)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Data rate** | **PDB (ms)** | **SU-MIMO** | | | **MU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** | **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |  |
| vivo  [R1-2109008] | 0.2Mbps | 10 | 20 | 20 | 97.70% |  |  |  |  |
| QC  [R1-2110402] | 0.2Mbps | 10 | 143 | 136 | 94% | >240 | 240 | 93% |  |
| MTK  [R1-2109555] | 0.2Mbps | 10 | >30 | >30 | 100% |  |  |  | Note 2 |
| Huawei  [R1-2108736] | 0.2Mbps | 10 |  |  |  | >15 |  | 95.56% (15) | Note 2 |
| FUTUREWEI  [R1-2108799] | 0.2Mbps | 10 | 142.4 | 142 | 95% |  |  |  | Note 1 |
| Ericsson  [R1-2110403] | 0.2Mbps | 10 | 17.4 |  |  |  |  |  | Note 1 |
| Note 1: DDDUU  Note 2: downtilt: 12 | | | | | | | | | |

* + - 1. AR (1 stream: Scene/video/data/voice-stream)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Data rate** | **PDB (ms)** | **SU-MIMO** | | | **MU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** | **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |  |
| vivo  [R1-2109008] | 10Mbps | 30 | <1 | 0 | 74.60% |  |  |  |  |
| QC  [R1-2110402] | 10Mbps | 30 | 0 | 0 | N.A. | 0 | 0 | 0% |  |
| MTK  [R1-2109555] | 10Mbps | 30 | 1.34 | 1 | 90% |  |  |  | Note 2 |
| Huawei  [R1-2108736] | 10Mbps | 30 |  |  |  | <1 |  |  | Note 2 |
| Ericsson  [R1-2110403] | 10Mbps | 30 | <1 |  |  |  |  |  | Note 1 |
| Note 1: DDDUU  Note 2: downtilt: 12 | | | | | | | | | |

* + - 1. AR (2 streams: Pose/control-stream + scene/video/data/voice-stream)

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Pose/control stream** | | **Scene/video/data/voice stream** | | **SU-MIMO** | | | **MU-MIMO** | | | **Notes** |
| **Data rate**  **(Mbps)** | **PDB**  **(ms)** | **Data rate**  **(Mbps)** | **PDB**  **(ms)** | **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** | **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |  |
| QC  [R1-2110402] | 0.2 | 10 | 10 | 30 | 0 | 0 | N.A. | 0 | 0 | N.A. |  |
| Ericsson  [R1-2110403] | 0.2 | 10 | 10 | 30 | <1 |  |  |  |  |  | Note 1 |
| Note 1: DDDUU | | | | | | | | | | | |

* 1. FR2 DL
     1. DU Scenario
        1. VR/AR
           1. Single stream traffic model

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Data rate** | **PDB (ms)** | **SU-MIMO** | | | | | | | | **MU-MIMO** | | | **Notes** |
| **Capacity** | | | | **C1=floor (Capacity)** | | **% of satisfied UEs when #UEs/cell =C1** | | **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |  |
| vivo  [R1-2109008] | 30Mbps | 10 | 13.44 | | | | 13 | | 95.24% | |  |  |  | Note 1 |
| 10 | 14.16 | | | | 14 | | 91.27% | |  |  |  | Note 1,2 |
| 10 | 16.28 | | | | 16 | | 93.55% | |  |  |  | Note 1,3 |
| 45Mbps | 10 | 8.2 | | | | 8 | | 93.25% | |  |  |  | Note 1 |
| 10 | 10.32 | | | | 10 | | 93.97% | |  |  |  | Note 1,2 |
| 10 | 43.89 | | | | 43 | | 91.92% | |  |  |  | Note 1,4 |
| Note 1: UE antenna configuraiton: (M, N, P) = (1, 4, 2), 3 panels (left, right, top)  Note 2: Delay aware scheduler  Note 3: 120FPS  Note 4: 400MHz bandwidth | | | | | | | | | | | | | |
| MTK  [R1-2109555] | 30Mbps | 10 | | 10 | | | 10 | 88.58% | |  | |  |  | Note 1 |
| 45Mbps | 10 | | 4.7 | | | 4 | 92.62% | |  | |  |  | Note 1 |
| Note 1: UE antenna configuraiton: 4Tx/4Rx: (M, N, P, Mg, Ng; Mp, Np) = (2,4,2,1,2;1,2) | | | | | | | | | | | | | |
| Nokia  [R1-2110386] | 30Mbps | 10 | | | | 6.35 | 6 | 96% | |  | |  |  | Note 1 |
| 45Mbps | 10 | | | | 3.94 | 3 | 98% | |  | |  |  | Note 1 |
| Note 1: UE antenna configuraiton: (M, N, P) = (1, 4, 2), 3 panels (left, right, top) | | | | | | | | | | | | | |
| Ericsson [R1-2110403] | 30Mbps | 10 | | | | 4.2 |  |  | |  | |  |  | Note 1,2 |
| 45Mbps | 10 | | | | 2 |  |  | |  | |  |  | Note 1,2 |
| Note 1: UE antenna configuraiton: (M, N, P) = (1, 4, 2), 3 panels (left, right, top)  Note 2: DDDUU | | | | | | | | | | | | | |
| QC  [R1-2110402] | 30Mbps | 10 | | | 5.5 | | 5 | 97% | |  | |  |  | Note 1,16 |
| 10 | | | 4 | | 4 |  | |  | |  |  | Note 1,17 |
| 10 | | | 2 | | 2 | 90% | |  | |  |  | Note 1,2,16 |
| 10 | | | 23.5 | | 23 | 91% | |  | |  |  | Note 1,3,16 |
| 10 | | | 17.5 | | 17 |  | |  | |  |  | Note 1,3,17 |
| 10 | | | 15 | | 15 | 90% | |  | |  |  | Note 1,2,3,16 |
| 10 | | | 8.5 | | 8 | 91% | |  | |  |  | Note 1,4,5,15 |
| 10 | | | 4 | | 4 | 90% | |  | |  |  | Note 1,4,6,15 |
| 10 | | | 8.5 | | 8 | 91% | |  | |  |  | Note 1,4,7,15 |
| 10 | | | 0 | | 0 | n/a | |  | |  |  | Note 1,4,8,15, |
| 10 | | | 3 | | 3 | 90% | |  | |  |  | Note 1,4,9,15 |
| 10 | | | 5 | | 5 | 90% | |  | |  |  | Note 1,4,10,15 |
| 10 | | | 14.5 | | 14 | 92% | |  | |  |  | Note 1,4,11,15 |
| 10 | | | 15 | | 15 | 90% | |  | |  |  | Note 1,4,12,15, |
| 10 | | | 0 | | 0 | n/a | |  | |  |  | Note 1,4,13,15 |
| 10 | | | 10 | | 10 | 90% | |  | |  |  | Note 1,4,14,15 |
| 45Mbps | 10 | | | 2 | | 2 | 90% | |  | |  |  | Note 1,16 |
| 10 | | | 1.8 | | 1 |  | |  | |  |  | Note 1,17 |
| 10 | | | 19 | | 19 | 90% | |  | |  |  | Note 1,3,16 |
| 10 | | | 15 | | 15 |  | |  | |  |  | Note 1,3,17 |
| 10 | | | 4.5 | | 4 | 91% | |  | |  |  | Note 1,4,5,15 |
| 10 | | | 2.5 | | 2 | 94% | |  | |  |  | Note 1,4,6,15 |
| 10 | | | 5 | | 5 | 90% | |  | |  |  | Note 1,4,7,15 |
| 10 | | | 0 | | 0 | n/a | |  | |  |  | Note 1,4,8,15, |
| 10 | | | 2 | | 2 | 89% | |  | |  |  | Note 1,4,9,15 |
| 10 | | | 3 | | 3 | 89% | |  | |  |  | Note 1,4,10,15 |
| 10 | | | 10 | | 10 | 92% | |  | |  |  | Note 1,4,11,15 |
| 10 | | | 10 | | 10 | 92% | |  | |  |  | Note 1,4,12,15, |
| 10 | | | 0 | | 0 | n/a | |  | |  |  | Note 1,4,13,15 |
| 10 | | | 6 | | 6 | 90% | |  | |  |  | Note 1,4,14,15 |
| Note 1: UE antenna configuraiton: (M, N, P) = (1, 4, 2), 3 panels (left, right, top)  Note 2: DDDUU  Note 3: 400MHz Bandwidth  Note 4: BS antenna parameters: 2TxRU, (M, N, P, Mg, Ng; Mp, Np) = (16,8,2,1,1:1,1)  Note 5: baseline, 2CC(30&39GHz) CA, no blocking  Note 6: PDCP duplication, 2CC(30&39GHz) CA, no blocking  Note 7: Network coding(50% redundancy), 2CC(30&39GHz) CA, no blocking  Note 8: Baseline, 2CC(30&39GHz) CA, periodic blocking(4/10ms) on 30GHz CC  Note 9: PDCP duplication, 2CC(30&39GHz) CA, periodic blocking(4/10ms) on 30GHz CC  Note 10: Network coding(100% redundancy), 2CC(30&39GHz) CA, periodic blocking(4/10ms) on 30GHz CC  Note11: Baseline, 4CC(30,30.4,39&39.4GHz) CA, no blocking  Note12: Network coding(20% redundancy), 4CC(30,30.4,39&39.4GHz) CA, no blocking  Note13: Baseline, 4CC(30,30.4,39&39.4GHz) CA, periodic blocking (4/10ms) on 39&39.4GHz CCs  Note14: Network coding(120% redundancy), 4CC(30,30.4,39&39.4GHz) CA, periodic blocking (4/10ms) on 39&39.4GHz CCs  Note15: Traffic arrival offset among different UEs are random  Note16: Traffic arrival offset among different UEs are evenly spaced  Note17: Traffic arrival offset among different UEs are zero | | | | | | | | | | | | | |

* + - * 1. Multi-stream traffic model

**VR+Audio/Data**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **VR**  **Data rate** | **VR PDB (ms)** | **Audio/Data**  **Data rate** | **Audio/Data PDB (ms)** | **SU-MIMO** | | | **MU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** | **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |  |
| QC  [R1-2110402] | 30Mbps | 10 | 0.756Mbps | 10 | 5 | 5 | 90% |  |  |  | Note 1 |
| 5.5 | 5 | 93% |  |  |  | Note 1,2 |
| Note 1: UE antenna configuraiton: (M, N, P) = (1, 4, 2), 3 panels (left, right, top)  Note 2: Delay aware scheduler | | | | | | | | | | |

* + - 1. CG

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Data rate** | **PDB (ms)** | **SU-MIMO** | | | | | | | | **MU-MIMO** | | | | | **Notes** |
| **Capacity** | | **C1=floor (Capacity)** | | | | **% of satisfied UEs when #UEs/cell =C1** | | **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** | | |  |
| vivo  [R1-2109008] | 30Mbps | 15 | 16.16 | | 16 | | | | 92.36% | |  |  |  | | | Note 1 |
| 15 | 16.82 | | 16 | | | | 96.73% | |  |  |  | | | Note 1,2 |
| Note 1: UE antenna configuraiton: (M, N, P) = (1, 4, 2), 3 panels (left, right, top)  Note 2: Delay aware scheduler | | | | | | | | | | | | | | | |
| MTK  [R1-2109555] | 8Mbps | 15 | | >20 | | >20 | N/A | | | |  |  | | |  | Note 1 |
| 30Mbps | 15 | | 11 | | 11 | 90.60% | | | |  |  | | |  | Note 1 |
| Note 1: UE antenna configuraiton: 4Tx/4Rx: (M, N, P, Mg, Ng; Mp, Np) = (2,4,2,1,2;1,2) | | | | | | | | | | | | | | | |
| Nokia  [R1-2110386] | 30Mbps | 15 | | 8.25 | | 8 | | | 93% | |  |  | |  | | Note 1 |
| Note 1: UE antenna configuraiton: (M, N, P) = (1, 4, 2), 3 panels (left, right, top) | | | | | | | | | | | | | | | |
| Ericsson [32] | 30Mbps | 15 | | 5.1 | |  | | |  | |  |  | |  | | Note 1 |
| Note 1: UE antenna configuraiton: (M, N, P) = (1, 4, 2), 3 panels (left, right, top) | | | | | | | | | | | | | | | |
| QC  [R1-2110402] | 8Mbps | 15 | | 24 | | 24 | | 90% | |  | |  | |  | | Note 1 |
| 15 | | >30 | | >30 | | 90% | |  | |  | |  | | Note 1,2 |
| 30Mbps | 15 | | 6 | | 6 | | 90% | |  | |  | |  | | Note 1 |
| 15 | | 25 | | 25 | | 90% | |  | |  | |  | | Note 1,2 |
| Note 1: UE antenna configuraiton: (M, N, P) = (1, 4, 2), 3 panels (left, right, top)  Note 2: 400MHz bandwidth | | | | | | | | | | | | | | | |

* + 1. InH Scenario
       1. VR/AR
          1. Single stream traffic model

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Data rate** | **PDB (ms)** | | **SU-MIMO** | | | **MU-MIMO** | | | | | **Notes** |
| **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** | **Capacity** | | **C1=floor (Capacity)** | | **% of satisfied UEs when #UEs/cell =C1** |  |
| ZTE, Sanechips [R1-2108889] | 30Mbps | 10 | | 7.8 | 7 | 91% |  | |  | |  | Note 1,2 |
| Note 1: 64QAM  Note 2: UE antenna configuraiton: 4Tx/4Rx: (M, N, P, Mg, Ng; Mp, Np) = (2,4,2,1,2;1,2) | | | | | | | | | | | |
| vivo  [R1-2109008] | 30Mbps | | 10 | 8.72 | 8 | 92.01% |  |  | |  | | Note 1 |
| 10 | 8.83 | 8 | 92.36% |  |  | |  | | Note 1,2 |
| 10 | 10.23 | 10 | 91.94% |  |  | |  | | Note 1,3 |
| 45Mbps | | 10 | 4.67 | 4 | 94.44% |  |  | |  | | Note 1 |
| 10 | 6.03 | 6 | 90.28% |  |  | |  | | Note 1,2 |
| Note 1: UE antenna configuraiton: (M, N, P) = (1, 4, 2), 3 panels (left, right, top)  Note 2: Delay aware scheduler  Note 3: 120FPS | | | | | | | | | | | |
| MTK  [R1-2109555] | 30Mbps | | 10 | 10 | 10 | 89.00% |  |  | |  | | Note 1 |
| 45Mbps | | 10 | 4.7 | 4 | 96.26% |  |  | |  | | Note 1 |
| Note 1: UE antenna configuraiton: 4Tx/4Rx: (M, N, P, Mg, Ng; Mp, Np) = (2,4,2,1,2;1,2) | | | | | | | | | | | |
| Nokia  [R1-2110386] | 30Mbps | | 10 | 10.17 | 10 | 98% |  |  | |  | | Note 1 |
| 45Mbps | | 10 | 6.09 | 6 | 98% |  |  | |  | | Note 1 |
| Note 1: UE antenna configuraiton: (M, N, P) = (1, 4, 2), 3 panels (left, right, top) | | | | | | | | | | | |
| QC  [R1-2110402] | 30Mbps | | 10 | 5.5 | 5 | 98% |  |  | |  | | Note 1,5 |
| 10 | 4.5 | 4 |  |  |  | |  | | Note 1,4 |
| 10 | 3 | 3 | 90% |  |  | |  | | Note 1,2,5 |
| 10 | 26 | 26 | 90% |  |  | |  | | Note 1,3,5 |
| 10 | 18 | 18 |  |  |  | |  | | Note 1,3,4 |
| 10 | 15.5 | 15 | 94% |  |  | |  | | Note 1,2,3,5 |
| 45Mbps | | 10 | 3 | 3 | 90% |  |  | |  | | Note 1,5 |
| 10 | 2.5 | 2 |  |  |  | |  | | Note 1,4 |
| 10 | 20.5 | 20 | 92% |  |  | |  | | Note 1,3,5 |
| 10 | 16 | 16 |  |  |  | |  | | Note 1,3,4 |
| Note 1: UE antenna configuraiton: (M, N, P) = (1, 4, 2), 3 panels (left, right, top)  Note 2: DDDUU  Note 3: 400MHz Bandwidth  Note4: Traffic arrival offset among different UEs are zero  Note5: Traffic arrival offset among different UEs are evenly spaced | | | | | | | | | | | |

* + - * 1. Multi-stream traffic model

**I/P Frame Traffic Model GOP-Based**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Data rate** | **Alpha** | **[I\_PDB, P\_PDB] (ms)** | **SU-MIMO** | | | | **MU-MIMO** | | | **Notes** |
| **Capacity** | | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** | **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |  |
| vivo  [R1-2109008] | 30Mbps | 1.5 | [10,10] | | 5.37 | 5 | 91.20% |  |  |  | Note 1,2 |
| 5.43 | 5 | 91.55% |  |  |  | Note 1,3 |
| 4.98 | 4 | 93.75% |  |  |  | Note 1,4 |
| [15,10] | | 7.07 | 7 | 90.34% |  |  |  | Note 1,2 |
| 7.43 | 7 | 91.61% |  |  |  | Note 1,3 |
| 6.8 | 6 | 93.06% |  |  |  | Note 1,4 |
| [15,9] | | 6.91 | 6 | 93.98% |  |  |  | Note 1,2 |
| 7.11 | 7 | 90.56% |  |  |  | Note 1,3 |
| 6.93 | 6 | 94.44% |  |  |  | Note 1,4 |
| 2 | [10,10] | | 3.53 | 3 | 92.01% |  |  |  | Note 1,2 |
| 3.87 | 3 | 92.71% |  |  |  | Note 1,3 |
| 2.73 | 2 | 93.06% |  |  |  | Note 1,4 |
| [15,10] | | 5.23 | 5 | 91.15% |  |  |  | Note 1,2 |
| 5.52 | 5 | 92.71% |  |  |  | Note 1,3 |
| 4.91 | 4 | 94.94% |  |  |  | Note 1,4 |
| [15,9] | | 4.99 | 4 | 94.68% |  |  |  | Note 1,2 |
| 5.33 | 5 | 91.67% |  |  |  | Note 1,3 |
| 4.78 | 4 | 94.14% |  |  |  | Note 1,4 |
| 3 | [10,10] | | 2.29 | 2 | 93.06% |  |  |  | Note 1,2 |
| 2.29 | 2 | 93.06% |  |  |  | Note 1,3 |
| 2.03 | 2 | 90.28% |  |  |  | Note 1,4 |
| [15,10] | | 3.29 | 3 | 91.32% |  |  |  | Note 1,2 |
| 3.29 | 3 | 91.32% |  |  |  | Note 1,3 |
| 2.68 | 2 | 93.06% |  |  |  | Note 1,4 |
| [15,9] | | 3.29 | 3 | 90.97% |  |  |  | Note 1,2 |
| 3.29 | 3 | 90.97% |  |  |  | Note 1,3 |
| 2.68 | 2 | 93.06% |  |  |  | Note 1,4 |
| Note 1: UE antenna configuraiton: (M, N, P) = (1, 4, 2), 3 panels (left, right, top)  Note 2: [PER\_I, PER\_P] = [1%, 1%]  Note 3: [PER\_I, PER\_P] = [1%, 5%]  Note 4: [PER\_I, PER\_P] = [0.5%, 5%] | | | | | | | | | | |

**I/P Frame Traffic Model Slice-Based**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Data rate** | **Alpha** | **[I\_PDB, P\_PDB] (ms)** | **SU-MIMO** | | | **MU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** | **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |  |
| vivo  [R1-2109008] | 30Mbps | 1.5 | [10,10] | 8.23 | 8 | 92.53% |  |  |  | Note 1,2 |
| 10.61 | 10 | 92.08% |  |  |  | Note 1,3 |
| 10.46 | 10 | 91.67% |  |  |  | Note 1,4 |
| [15,10] | 8.24 | 8 | 92.71% |  |  |  | Note 1,2 |
| 10.77 | 10 | 92.50% |  |  |  | Note 1,3 |
| 10.55 | 10 | 91.94% |  |  |  | Note 1,4 |
| [15,9] | 8.14 | 8 | 91.67% |  |  |  | Note 1,2 |
| 10.51 | 10 | 91.48% |  |  |  | Note 1,3 |
| 10.43 | 10 | 91.39% |  |  |  | Note 1,4 |
| 2 | [10,10] | 8.24 | 8 | 92.71% |  |  |  | Note 1,2 |
| 10.73 | 10 | 92.50% |  |  |  | Note 1,3 |
| 10.46 | 10 | 91.67% |  |  |  | Note 1,4 |
| [15,10] | 8.24 | 8 | 92.71% |  |  |  | Note 1,2 |
| 10.72 | 10 | 92.50% |  |  |  | Note 1,3 |
| 10.66 | 10 | 92.22% |  |  |  | Note 1,4 |
| [15,9] | 8.18 | 8 | 92.01% |  |  |  | Note 1,2 |
| 10.38 | 10 | 91.39% |  |  |  | Note 1,3 |
| 10.45 | 10 | 91.53% |  |  |  | Note 1,4 |
| 3 | [10,10] | 8.23 | 8 | 92.53% |  |  |  | Note 1,2 |
| 10.61 | 10 | 92.08% |  |  |  | Note 1,3 |
| 10.38 | 10 | 91.39% |  |  |  | Note 1,4 |
| [15,10] | 8.28 | 8 | 93.06% |  |  |  | Note 1,2 |
| 10.63 | 10 | 92.22% |  |  |  | Note 1,3 |
| 10.55 | 10 | 91.94% |  |  |  | Note 1,4 |
| [15,9] | 8.22 | 8 | 92.36% |  |  |  | Note 1,2 |
| 10.46 | 10 | 91.49% |  |  |  | Note 1,3 |
| 10.48 | 10 | 91.67% |  |  |  | Note 1,4 |
| Note 1: UE antenna configuraiton: (M, N, P) = (1, 4, 2), 3 panels (left, right, top)  Note 2: [PER\_I, PER\_P] = [1%, 1%]  Note 3: [PER\_I, PER\_P] = [1%, 5%]  Note 4: [PER\_I, PER\_P] = [0.5%, 5%] | | | | | | | | | |

**VR+Audio/Data**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **VR**  **Data rate** | **VR PDB (ms)** | **Audio/Data**  **Data rate** | **Audio/Data PDB (ms)** | **SU-MIMO** | | | **MU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** | **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |  |
| QC  [R1-2110402] | 30Mbps | 10 | 0.756Mbps | 10 | 4.5 | 4 | 95% |  |  |  | Note 1 |
| 5.4 | 5 | 93% |  |  |  | Note 1,2 |
| 2.5 | 2 | 94% |  |  |  | Note 1,3 |
| Note 1: UE antenna configuraiton: (M, N, P) = (1, 4, 2), 3 panels (left, right, top)  Note 2: Delay aware scheduler  Note 3: DDDUU | | | | | | | | | | |

* + - 1. CG

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | | | **Data rate** | | | **PDB (ms)** | | **SU-MIMO** | | | | | | | **MU-MIMO** | | | | | | **Notes** | |
| **Capacity** | | | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** | | | **Capacity** | | **C1=floor (Capacity)** | | **% of satisfied UEs when #UEs/cell =C1** | |  | |
| ZTE, Sanechips [R1-2108889] | | | 30Mbps | | | 10 | | 7.8 | | | 7 | 91% | | |  | |  | |  | | Note 2 | |
| Note 1: 64QAM  Note 2: UE antenna configuraiton: 4Tx/4Rx: (M, N, P, Mg, Ng; Mp, Np) = (2,4,2,1,2;1,2) | | | | | | | | | | | | | | | | | | | |
| vivo  [R1-2109008] | | | 30Mbps | | | 15 | | 9.91 | | | 9 | 95.37% | | |  | |  | |  | | Note 1 | |
| 15 | | 10.23 | | | 10 | 91.11% | | |  | |  | |  | | Note 1,2 | |
| Note 1: UE antenna configuraiton: (M, N, P) = (1, 4, 2), 3 panels (left, right, top)  Note 2: Delay aware scheduler | | | | | | | | | | | | | | | | | | | |
| MTK  [R1-2109555] | | | 8Mbps | | | 15 | >20 | | >20 | | | | N/A |  | |  | |  | | Note 1 | | |
| 30Mbps | | | 15 | 11 | | 11 | | | | 90.46% |  | |  | |  | | Note 1 | | |
| Note 1: UE antenna configuraiton: 4Tx/4Rx: (M, N, P, Mg, Ng; Mp, Np) = (2,4,2,1,2;1,2) | | | | | | | | | | | | | | | | | | | |
| Nokia  [R1-2110386] | | 30Mbps | | | 15 | | | 11.45 | | | 11 | 99% | | |  | |  | |  | | | Note 1 |
| Note 1: UE antenna configuraiton: (M, N, P) = (1, 4, 2), 3 panels (left, right, top) | | | | | | | | | | | | | | | | | | | | |
| QC  [R1-2110402] | 8Mbps | | | 15 | | | 27.5 | | | 27 | | 92% | | |  | |  | |  | | | Note 1 |
| 15 | | | >30 | | | >30 | | 90% | | |  | |  | |  | | | Note 1,2 |
| 30Mbps | | | 15 | | | 6 | | | 6 | | 90% | | |  | |  | |  | | | Note 1 |
| 15 | | | 28 | | | 28 | | 94% | | |  | |  | |  | | | Note 1,2 |
| Note 1: UE antenna configuraiton: (M, N, P) = (1, 4, 2), 3 panels (left, right, top)  Note 2: 400MHz bandwidth | | | | | | | | | | | | | | | | | | | | | |

* 1. FR2 UL
     1. DU Scenario
        1. VR/CG (Pose/control-stream)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Data rate** | **PDB (ms)** | **SU-MIMO** | | | **MU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** | **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |  |
| Vivo  [R1-2109008] | 0.2Mbps | 10 | 20 | 20 | 96.51% | - | - | - |  |
| QC  [R1-2110402] | 0.2Mbps | 10 | 7.5 | 7 | 90% | - | - | - | Note 7  Note 6 |
| 8.5 | 8 | 90% | - | - | - | Note 7  Note 6  Note 2 |
| 15 | 15 | 90% | - | - | - | Note 6  Note 5 |
| 18.5 | 18 | 91% | - | - | - | Note 4  Note 6 |
| 26.5 | >30 | 90% | - | - | - | Note 4  Note 5 |
| 18.5 | 18 | 93% | - | - | - | Note 1 |
| MTK [R1-2109555] | 0.2Mbps | 10 | >30 | >30 | 99% | - | - | - | Note 3 |
| Note 1: DDDUU  Note 2: Banwidth: 400MHz  Note 3: 4T4R (2,4,2,1,2:1,2)  Note 4: mini slot  Note 5: FDM/SDM  Note 6: Full antenna  Note 7: Regular slot | | | | | | | | | |

* + - 1. AR (1 stream: Scene/video/data/voice-stream)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Data rate** | **PDB (ms)** | **SU-MIMO** | | | **MU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** | **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |  |
| vivo  [R1-2109008] | 10Mbps | 30 | 8.3 | 8 | 92.66% | - | - | - |  |
| QC  [R1-2110402] | 20Mbps | 60 | 5 | 5 | 90% | - | - | - | Note 1 |
| 20Mbps | 15 | 3.5 | 3 | >90% | - | - | - | Note 1 |
| 10Mbps | 30 | 9 | 9 | 90% | - | - | - | Note 1 |
| 20Mbps | 30 | 5 | 5 | 90% | - | - | - | Note 1 |
| MTK  [R1-2109555] | 10Mbps | 30 | 1.29 | 1 | 90% | - | - | - | Note 2 |
| Note 1: DDDUU  Note 2: 4T4R,(2,4,2,1,2:1,2) | | | | | | | | | |

* + - 1. AR (2 streams: Pose/control-stream + scene/video/data/voice-stream)

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Pose/control stream** | | **Scene/video/data/voice stream** | | **SU-MIMO** | | | **MU-MIMO** | | | **Notes** |
| **Data rate**  **(Mbps)** | **PDB**  **(ms)** | **Data rate**  **(Mbps)** | **PDB**  **(ms)** | **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** | **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |  |
| QC  [R1-2110402] | 0.2 | 10 | 10 | 30 | 4.5 | 4 | 94% |  |  |  | Note 1 |
| 0.2 | 10 | 10 | 30 | 4.5 | 4 | 94% |  |  |  | Note 1,3 |
| 0.2 | 10 | 10 | 30 | 1.5 | 1 | 94% |  |  |  |  |
| 0.2 | 10 | 10 | 30 | 7 | 7 | 90% |  |  |  | Note 1  Note 2 |
| 0.2 | 10 | 20 | 30 | 2 | 2 | 90.00% |  |  |  | Note 1 |
| 0.2 | 10 | 20 | 30 | 2 | 2 | 90.00% |  |  |  | Note 1,3 |
| Note 1: DDDUU  Note 2: Bandwidth: 400MHz  Note 3: With jitter | | | | | | | | | | | |

* + 1. InH Scenario
       1. VR/CG (Pose/control-stream)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Data rate** | **PDB (ms)** | **SU-MIMO** | | | **MU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** | **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |  |
| vivo  [R1-2109008] | 0.2Mbps | 10 | 20 | 20 | 97.69% | - | - | - |  |
| QC  [R1-2110402] | 0.2Mbps | 10 | 7 | 7 | 90% | - | - | - | Note 6  Note 7 |
| 7 | 7 | 90% | - | - | - | Note 2 |
| 11.5 | 11 | 94% | - | - | - | Note 5  Note 7 |
| 20 | 20 | 90% | - | - | - | Note 4  Note 6 |
| 26 | 26 | 90% | - | - | - | Note 4  Note 5 |
| 19 | 19 | 90% | - | - | - | Note 1 |
| MTK [R1-2109555] | 0.2Mbps | 10 | 12.09 | 12 | 90.28% | - | - | - | Note 3 |
| Note 1: DDDUU  Note 2: Banwidth: 400MHz  Note 3: 4T4R,(2,4,2,1,2:1,2)  Note 4: mini slot  Note 5: FDM/SDM  Note 6: Full antenna  Note 7: Regular slot | | | | | | | | | |

* + - 1. AR (1 stream: Scene/video/data/voice-stream)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Data rate** | **PDB (ms)** | **SU-MIMO** | | | **MU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** | **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |  |
| vivo  [R1-2109008] | 10Mbps | 30 | 8.59 | 8 | 95.14% | - | - | - |  |
| QC  [R1-2110402] | 20Mbps | 60 | 6 | 6 | 90% | - | - | - | Note 1 |
| 20Mbps | 15 | 5 | 5 | 92% | - | - | - | Note 1 |
| 10Mbps | 30 | 10 | 10 | 90% | - | - | - | Note 1 |
| 20Mbps | 30 | 6 | 6 | 90% | - | - | - | Note 1 |
| MTK  [R1-2109555] | 10Mbps | 30 | 1 | 1 | 90% | - | - | - | Note 2 |
| Note 1: DDDUU  Note 2: 4T4R (2,4,2,1,2:1,2) | | | | | | | | | |

* + - 1. AR (2 streams: Pose/control-stream + scene/video/data/voice-stream)

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Pose/control stream** | | **Scene/video/data/voice stream** | | **SU-MIMO** | | | **MU-MIMO** | | | **Notes** |
| **Data rate**  **(Mbps)** | **PDB**  **(ms)** | **Data rate**  **(Mbps)** | **PDB**  **(ms)** | **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** | **Capacity** | **C1=floor (Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |  |
| QC  [R1-2110402] | 0.2 | 10 | 10 | 30 | 5.5 | 5 | 90% |  |  |  | Note 1 |
| 0.2 | 10 | 10 | 30 | 5 | 5 |  |  |  |  | Note 1,4 |
| 0.2 | 10 | 10 | 30 | 2.5 | 2 | 93% |  |  |  |  |
| 0.2 | 10 | 10 | 30 | 7.5 | 7 | 94% |  |  |  | Note 1  Note 2 |
| 0.2 | 10 | 20 | 30 | 3.5 | 3 | 93% |  |  |  | Note 1 |
| 0.2 | 10 | 20 | 30 | 3.5 | 3 | 93% |  |  |  | Note 1,4 |
| 0.2 | 10 | 10 | 30 | 6.5 | 6 | 95% |  |  |  | Note 1  Note 3 |
| Note 1: DDDUU  Note 2: Bandwidth: 400MHz  Note 3: DA scheduler  Note 4: With jitter | | | | | | | | | | | |

Annex D: Mobility Evaluation Results

TBD