3GPP TSG RAN WG1 #106-e R1-210XXXX

e-Meeting, August 16th – 27th, 2021

Source: vivo

Title: Summary of [106-e-NR-XR-03] email discussion on XR evaluation results

Agenda Item: 8.14.3

Document for: Discussion and Decision

1. Introduction

The document provides a summary of XR evaluation results based on the submitted simulation data in excel appendix of contributions [1-17] for the [106-e-NR-XR-03] Email discussion/approval on initial performance evaluation results.

Following check points are planned for the discussion. Note that the deadline for the discussion for the email thread is 8/27.

[106-e-NR-XR-03] Email discussion/approval on initial performance evaluation results – Xiaohang (vivo)

* 1st check point: August 19
* 2nd check point: August 24
* Final check: August 27

**For the discussion in RAN1 #106-e, following is planned.**

* During RAN1#106-e, a moderator (Xiaohang, vivo) will present an excel file that collects companies’ results submitted for RAN1#106-e.  Discussions to cross-check companies’ results for clarification purpose will be conducted in email thread.
* Based on the excel file, RAN1#106-e will start to discuss observations/conclusions to be captured in the TR.  Xiaohang will also present a summary of results as well as initial observations from the results.
* Companies who have not submitted results following the excel format are recommended to submit an excel file during RAN1#106-e.
* Companies can submit updated results for the same cases or results for new cases in future meetings and can ask to replace/update their results in the excel file with the new/updated results. In other words, the excel file is a living document that are to be updated in future meetings as necessary.

1. Discussion on initial observations (2nd round)

Based on the 1st round discussion, some general comments are provided as follows.

* For the updated results submitted by companies (Futurewei, ZTE, OPPO, IDC, Intel) and mentioned in the comments, the corresponding tables are updated.
  + Also fix some typos in the summary tables
* Clarification on the evaluation results
  + Some companies are using 256QAM MCS table while others are using 64QAM MCS table. The Max code rates of 256QAM and 64QAM are similar. Therefore, it seems not a key factor for capacity and it may not cause much difference between the results with 64QAM and 256QAM MCS. Hence, for a given scenario and traffic, both results with 64QAM and 256QAM MCS are included. Additional notes to indicate the MCS table to differentiate them will be added.
  + There are some cases showing SU-MIMO outperforms MU-MIMO. Comparing the results of these cases, it appears that the average performance of MU-MIMO is lower than SU-MIMO. However, if we compare the results of SU-MIMO and MU-MIMO from a single company, it is obviously that MU-MIMO capacity performance is much better than SU-MIMO. Therefore, it is recommended that companies can provide both SU-MIMO and MU-MIMO capacity evaluation results.
* Clarification on the observations
  + Regarding the observation for enhancement schemes, currently there are limited results for enhancement schemes so that it may not be sufficient to draw valid observation based on the current results. It is recommended that companies can provide more evaluation results for the enhancement scheme.
  + It is a good way to draw more informative observation by excluding some extreme results. However, due to limited results, excluding these results may lead to misleading observations. So, after there are more results submitted, we can try to make more accurate observation.
  + Currently, all the un-highlighted results including with or without the notes are considered in the observations.
  + According to HW’s comment, the observations will be revised.
  + Regarding the bottleneck of capacity performance, there will be no discussion at current stage. Need to have more results for both DL and UL evaluation results to stabilize the baseline performance.
  1. Capacity
     1. Baseline performance

This section is a summary of observations for the baseline evaluation performance.

* + - 1. FR1 InH DL

9 sources (Nokia, Ericsson, Interdigital, Qualcomm, vivo, CATT, MediaTek, ZTE, CMCC) reported the evaluation results of capacity performance with InH, 100MHz bandwidth, DDDSU TDD format, as shown in Table 1 to Table 4.

Observation for **CG, 8Mbps, 15ms PDB, 60 FPS** is TBD.

Following is observed for **CG, 30Mbps, 15ms PDB, 60 FPS**

* According to 4 sources (Nokia, MediaTek, Qualcomm, vivo), with SU-MIMO, the capacity performances are in the range of {5.96~10.14}, and the mean value of capacity performance is approximately [].
* According to 5 sources (Interdigital, CATT, ZTE, Qualcomm, vivo), with MU-MIMO, the capacity performances are in the range of {6~16.2}, and the mean value of capacity performance is approximately [].

Following is observed for **VR/AR, 30Mbps, 10ms PDB, 60 FPS**

* According to 4 sources (Nokia, Qualcomm, vivo, MediaTek), with SU-MIMO, the capacity performances are in the range of {5.2~8.27}, and the mean value of capacity performance is approximately [].
* According to 4 sources (CATT, Qualcomm, vivo, ZTE), with MU-MIMO, the capacity performances are in the range of {10.3~12}, and the mean value of capacity performance is approximately [].

Following is observed for **VR/AR, 45Mbps, 10ms PDB, 60 FPS**

* According to 3 sources (MediaTek, Nokia, Qualcomm), with SU-MIMO, the capacity performances are in the range of {3.27~4.6}, and the mean value of capacity performance is approximately [].
* According to 4 sources (CATT, Qualcomm, vivo, ZTE), with MU-MIMO, the capacity performances are in the range of {5.91~12}, and the mean value of capacity performance is approximately [].
  + - 1. FR1 DU DL

10 sources (OPPO, Nokia, Qualcomm, vivo, CATT, MediaTek, ZTE, Huawei, Ericsson, Xiaomi) reported the evaluation results of capacity performance with Dense Urban, 100MHz bandwidth, DDDSU TDD format, as shown in Table 5 to Table 8.

Observation for **CG, 8Mbps, 15ms PDB, 60 FPS** is TBD.

Following is observed for **CG, 30Mbps, 15ms PDB, 60 FPS**

* According to 8 sources (OPPO, Nokia, Ericsson, Qualcomm, vivo, CATT, MediaTek, Huawei), with SU-MIMO, the capacity performances are in the range of {5.1~13}. The mean value of capacity performance is approximately [].
* According to 5 sources (Qualcomm, vivo, ZTE, Huawei, Intel), with MU-MIMO, the capacity performances are in the range of {7.4~19.65}. The mean value of capacity performance is approximately [].

Following is observed for **VR/AR, 30Mbps, 10ms PDB, 60 FPS**

* According to 8 sources (OPPO, Nokia, CATT, Ericsson, MediaTek, Huawei, Qualcomm, vivo), with SU-MIMO, the capacity performances are in the range of {4.2~10.6}, and the mean value of capacity performance is approximately [].
* According to 6 sources (ZTE, Huawei, Qualcomm, vivo, Futurewei, Intel), with MU-MIMO, the capacity performances are in the range of {7~13.59}, and the mean value of capacity performance is approximately [].

Following is observed for **VR/AR, 45Mbps, 10ms PDB, 60 FPS**

* According to 4 sources (Xiaomi, Nokia, MediaTek, Qualcomm), with SU-MIMO, the capacity performances are in the range of {4.1~7}, and the mean value of capacity performance is approximately [].
* According to 3 sources (ZTE, Qualcomm, vivo), with MU-MIMO, the capacity performances are in the range of {6.91~8.4}, and the mean value of capacity performance is approximately [].
  + - 1. FR1 UMa DL

8 sources (MediaTek, China Unicom, Huawei, Qualcomm, vivo, ZTE, Huawei, FUTUREWEI ) reported the evaluation results of capacity performance with UMa, 100MHz bandwidth, DDDSU TDD format, as shown in Table 9 to Table 12.

Observation for **CG, 8Mbps, 15ms PDB, 60 FPS** is TBD.

Following is observed for **CG, 30Mbps, 15ms PDB, 60 FPS**

* According to 5 sources (MediaTek, China Unicom, Huawei, Qualcomm, vivo), with SU-MIMO, the capacity performances are in the range of {5.4~10.33}, and the mean value of capacity performance is approximately [].
* According to 4 sources (ZTE, Huawei, Qualcomm, vivo), with MU-MIMO, the capacity performances are in the range of {8~14.33}, and the mean value of capacity performance is approximately [].

Following is observed for **VR/AR, 30Mbps, 10ms PDB, 60 FPS**

* According to 6 sources (China Unicom, MediaTek, ZTE, Huawei, Qualcomm, vivo), with SU-MIMO, the capacity performances are in the range of {4.4~8}, and the mean value of capacity performance is approximately [].
* According to 5 sources (ZTE, Huawei, Qualcomm, vivo, FUTUREWEI), with MU-MIMO, the capacity performances are in the range of {5.2~10}, and the mean value of capacity performance is approximately [].

Following is observed for **VR/AR, 45Mbps, 10ms PDB, 60 FPS**

* According to 3 sources (China Unicom, MediaTek, Qualcomm), with SU-MIMO, the capacity performances are in the range of {2.4~4.6}, and the mean value of capacity performance is approximately [].
* According to 2 sources (Qualcomm, vivo), the capacity performances are in the range of {2.9, 4.68}, and the mean value of capacity performance is approximately [].
  + - 1. FR1 InH UL

6 sources (Nokia, CATT, MediaTek, vivo, Interdigital, Qualcomm ) reported the evaluation results of capacity performance with InH, 100MHz bandwidth, DDDSU TDD format, as shown in Table 13 to Table 15.

Following is observed for **UL pose/control-stream, 0.2Mbps, 10ms PDB, 250 FPS**

* According to 5 sources (Nokia, CATT, MediaTek, vivo, Qualcomm), with SU-MIMO, the capacity performances are in the range of {>10~198}.
* According to 2 sources (Interdigital, Qualcomm), with MU-MIMO, the capacity performances are in the range of {20, >240}.

Following is observed for **UL scene/video/data/voice-stream, 10Mbps, 30ms PDB, 60FPS**

* According to 3 sources (CATT, MediaTek, vivo), with SU-MIMO, the capacity performances are in the range of {5.09~13.95}, and the mean value of capacity performance is approximately [].
* According to 2 sources (Interdigital, Qualcomm), with MU-MIMO, the capacity performances are in the range of {7.1, 11.5}, and the mean value of capacity performance is approximately [].

Following is observed for **UL two-stream pose/control-stream, 0.2Mbps, 10ms PDB, 250FPS + scene/video/ data/voice-stream, 10Mbps, 30ms PDB, 60FPS**

* According to 2 sources (MediaTek, vivo), with SU-MIMO, the capacity performances are in the range of {5.56, 12.71}, and the mean value of capacity performance is approximately [].
* According to 2 sources (Interdigital, Qualcomm), with MU-MIMO, the capacity performances are in the range of {3.4, 7.2}, and the mean value of capacity performance is approximately [].
  + - 1. FR1 DU UL

9 sources (Nokia, Ericsson, MTK, vivo, Interdigital, Huawei, QC, ZTE, Intel) reported the evaluation results of capacity performance with DU, 100MHz bandwidth, DDDSU TDD format, as shown in Table 16 to Table 18.

Following is observed for **UL pose/control-stream, 0.2Mbps, 10ms PDB, 250 FPS**

* According to 5 sources (Nokia, Ericsson, MediaTek, vivo, Qualcomm), with SU-MIMO, the capacity performances are in the range of {>10~224.9}
* According to 2 sources (Huawei, Qualcomm), with MU-MIMO, the capacity performances are in the range of {>15, >240}

Following is observed for **UL scene/video/data/voice-stream, 10Mbps, 30ms PDB, 60FPS**

* According to 3 sources (Ericsson, MediaTek, vivo), with SU-MIMO, the capacity performances are in the range of {5~9.49}, and the mean value of capacity performance is approximately [].
* According to 4 sources (ZTE, Huawei, Qualcomm, Intel), with MU-MIMO, the capacity performances are in the range of {7.3~14.7}, and the mean value of capacity performance is approximately [].

Following is observed for **UL two-stream pose/control-stream, 0.2Mbps, 10ms PDB, 250FPS + scene/video/ data/voice-stream, 10Mbps, 30ms PDB, 60FPS**

* According to 3 sources (Ericsson, MediaTek, vivo), with SU-MIMO, the capacity performances are in the range of {5~10.78}, and the mean value of capacity performance is approximately [].
* According to 1 source (Qualcomm), with MU-MIMO, the capacity performances are in the range of {3.1}, and the mean value of capacity performance is approximately [].
  + - 1. FR1 UMa UL

5 sources (Ericsson, MediaTek, vivo, Huawei, Qualcomm) reported the evaluation results of capacity performance with Uma, 100MHz bandwidth, DDDSU TDD format, as shown in Table 19 to Table 21.

Following is observed for **UL pose/control-stream, 0.2Mbps, 10ms PDB, 250 FPS**

* According to 4 sources (Ericsson, MediaTek, vivo, Qualcomm), with SU-MIMO, the capacity performances are in the range of {15~143}.
* According to 2 sources (Huawei, Qualcomm), with MU-MIMO, the capacity performances are in the range of {>15, >240}.

Following is observed for **UL scene/video/data/voice-stream, 10Mbps, 30ms PDB, 60FPS**

* According to 3 sources (Ericsson, MediaTek, vivo), with SU-MIMO, the capacity performances are in the range of {0~1.34}, and the mean value of capacity performance is smaller than [].
* According to 2 sources (Qualcomm, Huawei), with MU-MIMO, the capacity performances are in the range of {0, <1}, and the mean value of capacity performance is smaller than [].
  + - 1. FR2 InH DL

6 sources (Nokia, Qualcomm, vivo, MediaTek, ZTE, Ericsson) reported the evaluation results of capacity performance with InH, 100/400MHz bandwidth, DDDSU TDD format, as shown in Table 22 to Table 25.

Following is observed for **CG, 8Mbps, 15ms PDB, 60 FPS**

* According to 2 sources (MediaTek, Qualcomm), with SU-MIMO, 100MHz bandwidth, the capacity performances are in the range of {>20, 27.5}.
* According to 1 source (Qualcomm), with SU-MIMO, 400MHz bandwidth, the capacity performances are in the range of {>30}.

Following is observed for **CG, 30Mbps, 15ms PDB, 60 FPS**

* According to 5 sources (Nokia, MediaTek, ZTE, Qualcomm, vivo), with SU-MIMO, 100MHz bandwidth, the capacity performances are in the range of {6~11}, and the mean value of capacity performance is approximately [].
* According to 1 source (Qualcomm), with SU-MIMO, 400MHz bandwidth, the capacity performances are in the range of {28}.

Following is observed for **VR/AR, 30Mbps, 10ms PDB, 60 FPS**

* According to 6 sources (Nokia, Ericsson, MediaTek, ZTE, Qualcomm, vivo), with SU-MIMO, 100MHz bandwidth, the capacity performances are in the range of {3.3~ >10}.
* According to 1 source (Qualcomm), with SU-MIMO, 400MHz bandwidth, the capacity performances are in the range of {26}.

Following is observed for **VR/AR, 45Mbps, 10ms PDB, 60 FPS**

* According to 4 sources (Nokia, MediaTek, Qualcomm, vivo), with SU-MIMO, 100MHz bandwidth, the capacity performances are in the range of {3~6.13}, and the mean value of capacity performance is approximately [].
* According to 1 source (Qualcomm), with SU-MIMO, 400MHz bandwidth, the capacity performances are in the range of {20.5}.
  + - 1. FR2 DU DL

5 sources (Nokia, Qualcomm, vivo, MediaTek, Ericsson) reported the evaluation results of capacity performance with Dense Urban, 100/400MHz bandwidth, DDDSU TDD format, as shown in Table 26 to Table 29.

Following is observed for **CG, 8Mbps, 15ms PDB, 60 FPS**

* According to 2 sources (MediaTek, Qualcomm), with SU-MIMO, 100MHz bandwidth, the capacity performances are in the range of {>20, 24}.
* According to 1 source (Qualcomm), with SU-MIMO, 400MHz bandwidth, the capacity performances are in the range of {>30}.

Following is observed for **CG, 30Mbps, 15ms PDB, 60 FPS**

* According to 5 sources (Nokia, Ericsson, MediaTek, Qualcomm, vivo), with SU-MIMO, 100MHz bandwidth, the capacity performances are in the range of {6~16.16}, and the mean value of capacity performance is approximately [].
* According to 1 source (Qualcomm), with SU-MIMO, 400MHz bandwidth, the capacity performances are in the range of {25}.

Following is observed for **VR/AR, 30Mbps, 10ms PDB, 60 FPS**

* According to 5 sources (Nokia, Ericsson, MediaTek, Qualcomm, vivo), with SU-MIMO, 100MHz bandwidth, the capacity performances are in the range of {5.3~13.44}, and the mean value of capacity performance is approximately [].
* According to 1 source (Qualcomm), with SU-MIMO, 400MHz bandwidth, the capacity performances are in the range of {23.5}.

Following is observed for **VR/AR, 45Mbps, 10ms PDB, 60 FPS**

* According to 4 sources (Nokia, MediaTek, Qualcomm, vivo), with SU-MIMO, 100MHz bandwidth, the capacity performances are in the range of {2~8.2}, and the mean value of capacity performance is approximately [].
* According to 2 sources (vivo, Qualcomm), with SU-MIMO, 400MHz bandwidth, the capacity performances are in the range of {>16, 19}.
  + - 1. FR2 InH UL

3 sources (MediaTek, Qualcomm, vivo) reported the evaluation results of capacity performance with FR2, InH, UL, as shown in Table 30 to Table 33.

(TBD on observation)

* + - 1. FR2 DU UL

3 sources (MediaTek, Qualcomm, vivo) reported the evaluation results of capacity performance with FR2, DU, UL, as shown in Table 34 to Table 37.

(TBD on observation)

* + 1. Impact on capacity

This section summarizes the key observations for capacity, including the impact of different assumptions/configurations, the potential gain of enhancement scheme, etc.

(Since there are limited results for different cases, following initial observations are provided as examples.)

* + - 1. Impact of data rate

Following is observed for **FR1 InH DL**

* 9 sources (Nokia, Ericsson, Interdigital, Qualcomm, vivo, CATT, MediaTek, ZTE, CMCC) reported the evaluation results of capacity performance with InH, 100MHz bandwidth, DDDSU TDD format, as shown in Table 1 to Table 4.
* **For VR/AR, 10ms PDB, 60 FPS**
  + According to 4 sources (Nokia, Qualcomm, vivo, MediaTek), with SU-MIMO, **with data rate from 30Mbps to 45Mbps**, the capacity performances are decreased from {5.2~8.27} to {3.27~4.6}.
  + According to 6 sources (CMCC, Interdigital, CATT, Qualcomm, vivo, ZTE, CATT), with MU-MIMO, **with data rate from 30Mbps to 45Mbps**, the capacity performances are decreased from {10.3~12} to {5.91~12}.

(More observations will be added after there are more results…)

* + - 1. Impact of PDB

TBD

* + - 1. Impact of jitter

TBD

* + - 1. Impact of frame rates

TBD

* + - 1. Impact of scheduling algorithm

TBD

* + - 1. Impact of frequency bandwidth in FR2

TBD

* + - 1. Impact of TDD configuration

TBD

* + - 1. Impact of xxx
    1. Summary of discussion

1. **Please share your comment on the observations for baseline capacity evaluation.**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| MTK | We are fine for the observations. Thanks for the great efforts of collects such a huge amount of results. |
| Ericsson | Thank you for summarizing the results. One thing that is somewhat unclear to us how the collection and summary in this section is performed. The excel file contains all the results, with all the parameters listed. Anyone can then understand what results comparable, and what results are not.  In the summary in sec 2.1, some information is lost. There is for sure a range, but the assumptions for the listed results are different: just to mention a few, the number of BS antennas is different, as are the assumptions on the distribution of the number of UEs in a cell. Why have we made the choice to separate SU-MIMO and MU-MIMO, and not other parameters?  Regarding the impact of various parameters, it is not clear to us how this will help us find bottlenecks in the system. We also note that for several of these heading, the associated simulations are optional. How are these headings selected? (And some are even assuming that we go beyond the simulation assumptions, e.g., regarding jitter.) |
| Nokia, NSB | The current list of conclusions seems sufficient at this stage. We may want to revise some observations and/or the list of headings, when more data becomes available during the following meetings.  Following the comment, raised by Ericsson in the email discussion, there may be a benefit of adding an additional subsubsection on 2.1.2.8 “Impact of Even vs. Uneven distribution of UEs”, where the effect can be discussed in more details.  From the presented observations, it is possible to conclude that NR Rel.16 is, in general, capable of supporting at least moderate number of satisfied UEs per cell simultaneously. This may be one of the general outcomes from our study. |
| Huawei, HiSilicon | **Comment#1**: suggest to include capacity results of multi-stream model (I/P-frame) in Section 5.  We agree to focus on baseline performance discussions in this meeting. Meanwhile, we notice that in Section 5, some results of capacity/power enhancements are already included, e.g., delay-aware (DA) scheduling, eCDRX, XR-dedicated PDCCH monitoring window, C-DRX with UE playout buffer, Genie, etc.  So we suggest to also include the capacity results of multi-stream model (I/P-frame) in Section 5, which can be used for further discussions along with other optional cases and enhancements. This also encourages companies to provide more results or update the values in future meetings. For convenience, we add Table x1, x2, x3, x4, x5 in Section 5.1.2 and Section 5.3.1 (with tracking changes, see “Huawei”). If any mistakes on these newly added tables, please FL and related companies update accordingly and my apologies in advance.  **Comment#2**: suggest to add a separate sub-section for multi-stream model, details can be TBD.  So far, quite a few companies already provided results for multi-stream model “Option 1: I-frame + P-frame”. And it is expected more companies will submit results in future meetings for multi-stream model “Option 1: I-frame + P-frame”, as well as multi-stream model “Option 2: video + audio/data”.  So we suggest to add a sub-section for multi-stream model, details can be TBD. This helps RAN1 to have a better understanding on the whole picture.  An example is given below:  ==  2.1.2 Multi-stream performance  This section is a summary of observations for the multi-stream models, e.g., I-frame + P-frame, video + audio/data, etc.  the (TBD on observation) |
| CATT | Thanks for update the observation with the indication of the extreme results. This would be good study point for the discussion. It would be better if a note would be included to show the reason of those extreme results. |
| QC | We think the sections of impact of various parameters on capacity could capture many informative observations (to be) made in this SI. Given that this is study item, we may want to study how those different parameters of XR applications or system configuration could affect XR performance in terms of capacity, power, etc. We already have observed that MIMO scheme is the one of such factors affecting capacity significantly. We see other parameters listed in FL summary also have significant impact.  To capture observations for those section, what we can do is simply compare the existing results from compiled excel sheet. For example,   * To understand the impact of data rate, we can simply compare, e.g., results for (VR,30Mbps) vs (VR,45Mbps) vs (VR,60Mbps). * For capturing the impact of PDB, we can compare (VR, 30Mbps, PDB10ms) and (CG, 30Mbps, PDB15ms). If there are other optionally evaluated PDB values, then, they can be also used to make observations. * … |
| Futurewei | Thank you for the tremendous effort in capturing this. If time allows, we can add more assumptions to the table to facilitate the comparison of results. About the observations, we think it is a bit premature to draw real observation and conclusion at any level. Companies (including us) are in the processing of generating more results based on the latest agreements. It is better to wait until more results become available. |

1. **Please share your comment on the observations for the impact of capacity evaluation, e.g. what needs to be captured for the observations of capacity evaluation, what enhancement schemes need to be considered in the observation for capacity, etc.**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| MTK | For baseline single stream evaluation, we think delay-aware scheduling can be captured as one enhancement scheme. For two-stream (I/P stream) model, we think delay-aware scheduling and PDB/PER adjustment can be captured as enhancement schemes. |
| Nokia, NSB | From our understanding, a discussion on the XR-aware SPS/CG needs to be added to the capacity evaluation.  There is also a suggestion to clearly separate the (potentially more detailed) discussion on the baseline system performance from the (potentially shorter) discussion on the possible enhancements that are not yet supported by the NR.  Here, it may be beneficial to also unify the approach on how the possible enhancements can be captured in the TR. From our understanding, there could be at least three possible alternatives:   * To have a dedicated Section between current Section 7 and current Section 8 in the TR skeleton. (i.e., Section 8. Enhancements, where Section 9 becomes “Conclusions”) * To have a dedicated subsection within Section 7 (i.e., 7.2 Enhancements)   To have dedicated subsubsections within the subsections in Section 7 associated with different KPIs (i.e., 7.1. Capacity KPI -> 7.1.1. Baseline Capacity Evaluation, 7.1.2 Capacity Enhancements, 7.2 UE Power KPI -> 7.2.1 Baseline UE Power Evaluation, 7.2.2 UE Power Enhancements. |
| Huawei, HiSilicon | **Comment#1**: In the first paragraph of Section 2.1.2 and 2.2.2, it is mentioned that “ … the potential gain of enhancement scheme … ” is one of the topics for these two sub-sections. And “Section 2.2.2.1 Impact of enhancement power saving scheme” is already there to capture enhancement power saving schemes. So we suggest to have a similar sub-section to capture capacity enhancement schemes as below:  2.1.2.1 Impact of capacity enhancement schemes  Note: we note that currently there is a sub-section “2.1.2.5 Impact of scheduling algorithm”. However, we are not sure what will be discussed in this sub-section, maybe just SU-MIMO, MU-MIMO? Anyway, we think it’s better to have a separate sub-section for capacity enhancement schemes, which is also aligned with enhancement power saving scheme.  **Comment#2**: we suggest to add “/PER” to the title of section 2.1.2.2. Because both PDB and PER will impact capacity, and are worthwhile to be discussed.  2.1.2.2. Impact of PDB/PER  **Comment#3**: In section 2.1.2.1, we assume there might be some copy-paste error as below.  *According to ~~6 sources (CMCC, Interdigital, CATT, Qualcomm, vivo, ZTE, CATT)~~ 4 sources (CATT, Qualcomm, vivo, ZTE), with MU-MIMO,* ***with data rate from 30Mbps to 45Mbps****, the capacity performances are decreased from {10.3~12} to {5.91~12}.* |
| CATT | We consider the analysis of the system capacity impact from simulation results are most important aspect in this agenda item. We could have a note in generate to list the proposed technique of capacity enhancement by each company, if any, to associate with the simulation results |
| QC | Thanks for the great efforts for collecting data and organizing discussion.  Regarding “**what** enhancements scheme need to be considered”, we think at least following enhancements w/ results can be considered for making observations.   * Delay aware scheduling algorithm * Traffic offset staggering   In order to capture them as RAN1 observations, we think there should be evaluation/analysis results showing potential benefits of schemes. It could be either quantitative or qualitative. RAN1 may need to discuss / understand those and make agreements in order to capture them as observations.  Together with potential enhancements, we think making observations on baseline performance is also very important given that this SI’s main objective is the evaluation of current NR systems for XR support. We believe study in the impact of various parameters on performance will be critical part of study giving lots of insight on the performance of XR applications in NR systems. |
| Futurewei | We are ok to add a sub-section of capacity enhancement schemes as suggested by others. At this stage it may be sufficient to list the possible capacity enhancement techniques considered by companies and corresponding simulation results. More time is needed for companies to evaluate and study the proposed capacity enhancement techniques. The following is one example that may capture our comment:  The schemes considered by companies that may increase system capacity   * XR aware SPS/ CG configurations * Cooperative MIMO precoding * Delay aware scheduling * … |

* 1. Power consumption
     1. Baseline performance

This section is a summary of observations for the power evaluation performance with baseline power saving scheme.

As discussed before, when a power saving scheme (PSS) applies, % of satisfied UEs may vary depending on the selected PSS parameters. It is recommended that the PSS parameters are chosen to lead to a minimum satisfaction loss compared to no power saving. Therefore, in this section, the evaluation results with [<50] % of satisfied UEs loss for power saving schemes compared to no power saving are considered for the observations.

* + - 1. FR1 InH DL

4 sources (Interdigital, Nokia, vivo, CATT) reported the evaluation results of power consumption compared to AlwaysOn (baseline) scheme, with InH, 100MHz bandwidth, DDDSU TDD format, as shown in Table 38 to Table 40.

Comparing to UE always on, following is observed for **CG, 30Mbps, 15ms PDB:**

* According to 1 source (Interdigital), for R15/16CDRX power saving scheme, the power saving gain is in the range of {5.28%} for low load with no % of satisfied UE loss.
* According to 1 source (Nokia), for R15/16CDRX power saving scheme, the power saving gain is in the range of {15.23%} for high load with {2.67%} of satisfied UE loss.

Comparing to UE always on, following is observed for **VR/AR, 30Mbps, 10ms PDB:**

* According to 1 source (vivo), for R15/16CDRX power saving scheme, the power saving gain is in the range of {3.67%, 5.72%} for low load with no % of satisfied UE loss.
* According to 2 sources (vivo, CATT), for R15/16CDRX power saving scheme, the power saving gain is in the range of {2.39%~4.88%} for high load with {0.69%~4.86%} of satisfied UE loss.

Comparing to UE always on, following is observed for **VR/AR, 45Mbps, 10ms PDB:**

* According to 1 source (vivo), for R15/16CDRX power saving scheme, the power saving gain is in the range of {3.46%, 5.32%} for low load with no % of satisfied UE loss.
* According to 1 source (vivo), for R15/16CDRX power saving scheme, the power saving gain is in the range of {2.83%, 4.68%} for high load with {2.23%, 3.89%} of satisfied UE loss.
  + - 1. FR1 DU DL

5 sources (Interdigital, Huawei, Ericsson, vivo, Interdigital) reported the evaluation results of power consumption compared to AlwaysOn (baseline) scheme, with DU, 100MHz bandwidth, DDDSU TDD format, as shown in Table 41 to Table 43.

Comparing to UE always on, following is observed for **VR/AR, 30Mbps, 10ms PDB:**

* According to 1 source (Interdigital), for R15/16CDRX power saving scheme, the power saving gain is in the range of {6.64%} for low load with no % of satisfied UE loss.
* According to 2 sources (Huawei, Ericsson), for R15/16CDRX power saving scheme, the power saving gain is in the range of {2.67%~8%} for high load with {3%~14%} of satisfied UE loss.

Comparing to UE always on, following is observed for **VR/AR, 45Mbps, 10ms PDB:**

* According to 1 source (vivo), for R15/16CDRX power saving scheme, the power saving gain is in the range of {3.53%, 5.56%} for low load with no % of satisfied UE loss.
* According to 3 sources (vivo, Huawei, Ericsson), for R15/16CDRX power saving scheme, the power saving gain is in the range of {2.89%~5.00%} for high load with {1.45%~8%} of satisfied UE loss.
  + - 1. FR1 Uma DL

1 source (vivo) reported the evaluation results of power consumption compared to AlwaysOn (baseline) scheme, with Uma, 100MHz bandwidth, DDDSU TDD format, as shown in Table 44 and Table 45.

(TBD on observations)

* + - 1. FR1 InH UL

1 source (vivo) reported the evaluation results of power saving performance with InH, 100MHz bandwidth, DDDSU TDD format, as shown in Table 46 to Table 48.

(TBD on observations)

* + - 1. FR1 DU UL

1 source (vivo) reported the evaluation results of power saving performance with DU, 100MHz bandwidth, DDDSU TDD format, as shown in Table 49 to Table 51.

(TBD on observations)

* + - 1. FR1 Uma UL

1 source (vivo) reported the evaluation results of power saving performance with Uma, 100MHz bandwidth, DDDSU TDD format, as shown in Table 52.

(TBD on observations)

* + - 1. FR1 InH DL+UL

4 sources (vivo, Qualcomm, MediaTek, ZTE) reported the evaluation results of power consumption compared to AlwaysOn (baseline) scheme, with InH, 100MHz bandwidth, DDDSU TDD format, as shown in Table 53 to Table 59.

Following is observed for **DL video-stream (30Mbps, 10ms PDB) + UL pose/control-stream (0.2Mbps, 10ms PDB)**, one source (vivo) provides the following results:

* According to 1 source (vivo), for R15/16CDRX power saving scheme, the power saving gain is in the range of {3.64%, 3.71%} for low load with no % of satisfied UE loss.
* According to 1 source (vivo), for R15/16CDRX power saving scheme, the power saving gain is in the range of {2.33%, 3.45%} for high load with {0.69%, 1.25%} of satisfied UE loss.

Following is observed for **DL video-stream (30Mbps, 10ms PDB) + UL video-stream (10Mbps, 30ms PDB)**, one source (vivo) provides the following results

* According to 1 source (vivo), for R15/16CDRX power saving scheme, the power saving gain is in the range of {2.59%, 4.20%} for low load with no % of satisfied UE loss.
* According to 1 source (vivo), for R15/16CDRX power saving scheme, the power saving gain is in the range of {1.69%, 2.62%} for high load with {0.56%, 0.83%} of satisfied UE loss.

Following is observed for **DL video-stream (30Mbps, 10ms PDB) + UL two-stream (pose/control-stream (0.2Mbps, 10ms PDB) + video-stream (10Mbps, 30ms PDB))**, one source (vivo) provides the following results

* According to 1 source (vivo), for R15/16CDRX power saving scheme, the power saving gain is in the range of {1.02%, 1.81%} for low load with no % of satisfied UE loss.
* According to 1 source (vivo), for R15/16CDRX power saving scheme, the power saving gain is in the range of {0.83%, 1.59%} for high load with {0.55%,1.39%} of satisfied UE loss.
  + - 1. FR1 DU DL+UL

4 sources (vivo, Qualcomm, MediaTek, Ericsson) reported the evaluation results of power consumption compared to AlwaysOn (baseline) scheme, with dense urban, 100MHz bandwidth, DDDSU TDD format, as shown in Table 60 to Table 63.

Following is observed for Following is observed for **DL video-stream (30Mbps, 10ms PDB) + UL pose/control-stream (0.2Mbps, 10ms PDB),** two sources (vivo, Qualcomm) provide the following results

* According to 1 source (vivo), for R15/16CDRX power saving scheme, the power saving gain is in the range of {2.44%, 3.56%} for low load with no % of satisfied UE loss.
* According to 1 source (vivo), for R15/16CDRX power saving scheme, the power saving gain is in the range of {2.24%, 3.31%} for high load with {0.85%, 2.32%} of satisfied UE loss.

Following is observed for Following is observed for **DL video-stream (30Mbps, 10ms PDB) + UL video-stream (10Mbps, 30ms PDB),** one sources (vivo) provides the following results

* According to 1 source (vivo), for R15/16CDRX power saving scheme, the power saving gain is in the range of {2.39%, 3.79%} for low load with no % of satisfied UE loss.
* According to 1 source (vivo), for R15/16CDRX power saving scheme, the power saving gain is in the range of {1.62%, 2.58%} for high load with {0.53%, 0.70%} of satisfied UE loss.

Following is observed for Following is observed for **DL video-stream (30Mbps, 10ms PDB) + UL two-stream (pose/control-stream (0.2Mbps, 10ms PDB)+video-stream (10Mbps, 30ms PDB)),** one sources (vivo) provides the following results

* According to 1 source (vivo), for R15/16CDRX power saving scheme, the power saving gain is in the range of {0.91%, 1.63%} for low load with no % of satisfied UE loss.
* According to 1 source (vivo), for R15/16CDRX power saving scheme, the power saving gain is in the range of {0.79%, 1.51%} for high load with {0.45%, 0.90%} of satisfied UE loss.
  + - 1. FR2 InH DL

3 sources (vivo, Nokia, Qualcomm) reported the evaluation results of power saving performance with InH, 100MHz bandwidth, DDDSU TDD format, as shown in Table 64 to Table 66.

(TBD on observation)

* + - 1. FR2 DU DL

1 source (vivo) reported the evaluation results of power saving performance with Dense Urban, 100MHz bandwidth, DDDSU TDD format, as shown in Table 67 and Table 68.

(TBD on observation)

* + - 1. FR2 InH UL

1 source (vivo) reported the evaluation results of power saving performance with FR2, InH, UL, pose/control stream as shown in Table 69 and Table 70.

(TBD on observation)

* + - 1. FR2 DU DL

1 source (vivo) reported the evaluation results of power saving performance with FR2, DU, UL, pose/control stream as shown in Table 71 and Table 72.

(TBD on observation)

* + 1. Impact on power consumption

This section summarizes the key observations for power consumption, including the impact of different assumptions/configurations, the potential gain of enhancement scheme, etc.

* + - 1. Impact of enhancement power saving scheme

TBD

* + - 1. Impact of tradeoff between capacity and power

TBD

* + - 1. Impact of data rate

TBD

* + - 1. Impact of xxx
    1. Summary of discussion

1. **Please share your comment on the observations for baseline power consumption evaluation.**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| MTK | Current power saving results capture 1 or 2 sources results, and most of them are only from vivo. Maybe we can capture results from more companies (Ex. MTK)? Besides, we think one observation can be the consumed power between XR service and conventional eMBB service to show how power consuming XR application is compared to eMBB. Last but not least, current captured results seem to take CDRX as baseline, which does not fit previous RAN1 agreements. |
| Nokia, NSB | Thank you for providing the revised list of draft observations. We believe there may be a small typo in 2.2.1.1. “for high load with {4~~2~~.67%} of satisfied UE loss.” It should be 4.67, not 2.67, as the drop is from 99% (not from 97%) down to 94.33%. |
| Huawei, HiSilicon | **Comment#1**: In section 2.2.1.2 FR1 DU DL, there might be some mistakes, the following red changes are suggested:  ==  Comparing to UE always on, following is observed for **~~VR/AR~~CG, 30Mbps, 1~~0~~5ms PDB:**   * According to 1 source (Interdigital), for R15/16CDRX power saving scheme, the power saving gain is in the range of {6.64%} for low load with no % of satisfied UE loss. * According to 2 sources (Huawei, Ericsson), for R15/16CDRX power saving scheme, the power saving gain is in the range of {2.67%~8%} for high load with {3%~14%} of satisfied UE loss.   Comparing to UE always on, following is observed for **VR/AR, 45Mbps, 10ms PDB:**   * According to 1 source (vivo), for R15/16CDRX power saving scheme, the power saving gain is in the range of {3.53%, 5.56%} for low load with no % of satisfied UE loss.   Comparing to UE always on, following is observed for **VR/AR, 30Mbps, 10ms PDB:**  According to 3 sources (vivo, Huawei, Ericsson), for R15/16CDRX power saving scheme, the power saving gain is in the range of {2.89%~5.00%} for high load with {1.45%~8%} of satisfied UE loss. |
| CATT | The current formula in observation is good. We would continue update the results at the next meetings. It would be good to have note to include the analysis of potential technique of power saving. |
| QC | Current baseline performance was captured only in terms of power saving gain. Since no absolute power numbers are captured, it is not easy/straightforward to compare UE power consumption across e.g.,   * different scenarios (InH vs DU vs UMa)   + example observation: UE power consumption for UMa could be higher than others due to UE higher tx power. * different methodologies (DL only vs DL+UL joint eval)   + example observation: if UL is considered PSG could reduce due to highly active UL traffic. * different system load (low vs high)   + example observation: PSG could be higher in low load case due to …   Since power saving gain (PSG) itself is relative metric, we can compute PSG for different cases (using exactly same formula w.r.t a reference case) above and just label it as “relative power consumption”. Since these are not comparison across “PS schemes”, it may not be good idea to call/label it as PSG. Instead, calling it as a relative power consumption would be better choice. |
| Futurewei | As the number of companies provided results here are very limited, we suggest focussing on properly capturing the results and draw observation/conclusion later till more results become available. |

1. **Please share your comment on the observations for the impact of power consumption evaluation, e.g. what needs to be captured for the observations of power evaluation, what enhancement schemes need to be considered in the observation for power, etc.**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| MTK | Some companies provided results for R16/R17 power saving techniques, ex. BWP switch, cross slot scheduling, PDCCH skipping. We think those results should also be captured. |
| ZTE, Sanechips | Answer to QC’s Question to ZTE in power consumption in Round 1.  In our contribution, the DL and UL power consumption were evaluated independently and calculated jointly to simplify the simulation. So we provided % of satisfied UE in DL, and % of satisfied UE for UL separately. The total % of satisfied UE can be derived according to min{% of satisfied UE in DL, % of satisfied UE in UL}.  The following steps are  used for independent DL and UL power consumption evaluation in our contribution:   * Evaluating DL and UL power consumption independently; * Collecting DL and UL slot states respectively; * Recombining these slot states in a single timeline; * Calculating overall power consumption according to the recombined timeline.   We think the above method can be used to collect the power consumption results for both DL and UL to draw a full picture of UE power consumption. Hence, a new sub-section is suggested as: 5.5.4 DL and UL evaluating separately  Besides, we think the C-DRX enhancement is an important scheme which should be considered for in the observation for power. |
| Nokia, NSB | A further discussion on enhanced CDRX configurations is necessary and would be beneficial. It is suggested to clearly separate the (potentially more detailed) discussion on the baseline system performance from the (potentially shorter) discussion on the possible enhancements. |
| Huawei, HiSilicon | **Comment#1**: Suggest to have a sub-section below, where legacy power saving schemes, e.g., legacy C-DRX can be discussed. We assume different C-DRX parameters may impact capacity and power consumption, and need to be discussed.  2.2.2.1. Impact of legacy power saving schemes |
| CATT | The evaluation results of proposed power saving techniques should be captured separately with note to include the analysis of power saving technique to help making conclusion in the study item. |
| QC | * **Response to ZTE**: Thanks ZTE for providing additional explanation. To our understanding, the method ZTE has used is a kind of a new method to approximate actual DL+UL simultaneous evaluation. If DL and UL traces are combined, then, one can get a trace of slot activities for DL and UL, but there is no interaction between DL and UL especially with CDRX enabled. For example, UL grant could extend inactivity timer, during which additional DL or UL grants could be received. For this reason, we recommend that we capture a note for this method when capturing results. * **Enhancements:**   + We think enhancements could include schemes which do not exist in current spec till R16 (or R17) such as eCDRX, etc. |
| Futurewei | Similar to our comment for Question 2, a simple list of possible enhancement techniques that are considered by companies may be sufficient to be listed here for power savings. Further study is needed for capturing the results. |

1. Discussion on evaluation results (1st round)

In this section, discussions to cross-check companies’ results for clarification purpose will be conducted.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Moderator | Question for clarification:  **@InterDigital**  According to the agreement on system capacity definition, System capacity is defined as the maximum number of users per cell with at least X % of UEs being satisfied, where X=90 (baseline) or 95 (optional).  For the capacity evaluation results, it seems the results in your contribution showing % of satisfied UEs when the number of UEs per cell = C1(Capacity) is lower than 90%? Could you clarify why?  **@Ericsson**  For Capacity evaluation, for cases e.g. FR1, InH, DL VR/AR, 30Mbps with SU-MIMO, it seems your results are much lower than the results from other companies. Could you explain why?  **@CMCC**  For capacity, DU, VR/AR, 30Mbps with MU-MIMO, it seems your results are much lower than the results from other companies. Could you explain why?  **@ China Unicom**  Could you provide the % of satisfied UEs when #UEs/cell =C1 corresponding to the capacity?  **@Qualcomm**  For the evaluation results of QC in FR2 UL InH in Table 30, why the number of satisfied UEs with 400MHz bandwidth is smaller than that with 100MHz bandwidth?  **@Nokia**  Why the average PS gain of R15/16CDRX of Nokia is much higher than other results while keeping limited capacity loss? |
| Futurewei | Thank you for the moderator’s hard work in providing this summary. We would like to note Futurewei added/uploaded results in excel sheet accordingly with the moderator suggestion and would appreciate it to be included in this word doc.  Here we make a couple of general points and suggestions on the methodology adopted   * In general, looking at the capacity results summarized in the tables in Appendix there are cases which present large variations and are highly diverse. As an example, for UL Table 13 the minimum capacity value is >10 while the maximum capacity 198. A similar is observation is made for other scenarios such as Table 16. Some wide variations are also present for the DL capacity results. Variance calculation may provide some insights. It is not clear at this point if simple arithmetic average is the best representative (while removing outliers). This calls for some efforts on aligning and calibrating the results from the group such that averaging (or other form of processing of the results) may make sense. * Number of companies contributed evaluation results are still limited which is reasonable as we are finalizing the evaluation methodology and assumptions and it takes time and efforts to generate proper results. Therefore, it is a bit early to try to draw observation and conclusion based on the current results. * We also noted that sometimes the results for the same scenario and traffic model, some different assumptions are used by the companies as notes of the tables specified. This makes the dataset of the same assumption even smaller. * The Study group would also need to discuss how the to use the averaged results (or other forms of processing of the results agreed by the group). For example, how do we use the averaged capacity to compare to capacity with potential enhancement techniques it is not very clear at this point. |
| Nokia, NSB | Thank you for a nice summary. We would ask to clarify a few things here (related to the question to Nokia):   * How is the “capacity loss” defined and measured in the combined statistics? According to the table template, only the “percentage of satisfied UEs” is reported as a capacity-centric metric for Baseline (i.e., P1) and CDRX (i.e., P2) schemes. So, is the capacity loss computed as P1 – P2, P2/P1 or something else? * Regarding the PS gains, we don’t see them much higher than the values reported by other companies (when comparable CDRX configs are analyzed). An important note here can be that R15/16 CDRX configs have the minimum long duration of 10ms (as per TS 38.331, “DRX-Config information element”, page 431). Hence, it may be better to threat the results submitted by companies for long duration of less than 10ms, including Nokia (8, 4, 4) and (4,2,2) as eCDRX. Here, the only comparable results for (4,2,2) are provided by IDT in Table 38 and further, but it is hard to compare directly, as IDT results may have different deployment assumptions (i.e., it is 12 UEs/cell deployed, which is much higher than the observed capacity limit, isn’t the system overloaded?) |
| InterDigital | Thank you for capturing and summarizing the performance results. Regarding our capacity evaluation results, it appears that there has been a miscalculation when extracting the % of satisfied UEs, with the assumption of at least 90% UEs being satisfied. In light of this, we amended our results in the summary below for both capacity and power consumption (tables in Section 4) and the excel template. |
| China Unicom | Thank you for moderator’s summary.  The % of satisfied UEs when #UEs/cell =C1 corresponding to the capacity are listed in the following table:   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Traffic Model** | **AR/VR-45** | **AR/VR-30** | **CG-30** | **CG-8** | | Capacity | 4.6 | 5.5 | 7.9 | >30 | | C1=floor(Capacity) | 4 | 5 | 7 | >30 | | % of satisfied UEs when #UEs/cell =C1 | 92.7% | 92.4% | 93.8% | 99%(30) | |
|  |  |

1. Discussion on initial observations (1st round)

(Note: Regarding the initial observations, it should be noted that current observations are made mainly based on the simulation cases with sufficient evaluation results submitted by companies. Moreover, as starting point, we focus on the observations for baseline performance. The observation for the enhancement schemes can be discussed later after we have clear picture on the baseline performance.)

* 1. Capacity
     1. FR1 InH DL

8 sources (OPPO, Nokia, Qualcomm, vivo, CATT, MediaTek, ZTE, CMCC) reported the evaluation results of capacity performance with InH, 100MHz bandwidth, DDDSU TDD format, as shown in Table 1 to Table 4.

Following is observed for **CG, 30Mbps, 15ms PDB, 60 FPS**

* With SU-MIMO, the capacity performances are in the range of {5.96~14.5}, and the mean value of capacity performance is approximately [9.6].
* With MU-MIMO, the capacity performances are in the range of {12.8~16.5}, and the mean value of capacity performance is approximately [14.67].

Following is observed for **VR/AR, 30Mbps, 10ms PDB, 60 FPS**

* For 60 FPS, with SU-MIMO, the capacity performances are in the range of {5.2~13.2}, and the mean value of capacity performance is approximately [8.41].
* For 60 FPS, with MU-MIMO, the capacity performances are in the range of {5~10.8}, and the mean value of capacity performance is approximately [9.53].

Following is observed for **VR/AR, 45Mbps, 10ms PDB, 60 FPS**

* For 60 FPS, with SU-MIMO, the capacity performances are in the range of {3.27~4.6}, and the mean value of capacity performance is approximately [4.06].
* For 60 FPS, with MU-MIMO, the capacity performances are in the range of {5.91~12}, and the mean value of capacity performance is approximately [7.88].
  + 1. FR1 DU DL

9 sources (Nokia, Qualcomm, vivo, CATT, MediaTek, ZTE, Huawei, Ericsson, Xiaomi) reported the evaluation results of capacity performance with Dense Urban, 100MHz bandwidth, DDDSU TDD format, as shown in Table 5 to Table 8.

Following is observed for **CG, 30Mbps, 15ms PDB, 60 FPS**

* With SU-MIMO, the capacity performances are in the range of {7.6~13}. With excluding the smallest and the largest values among sources, the mean value of capacity performance is approximately [10.16].
* With MU-MIMO, the capacity performances are in the range of {16.1~19.65}. With excluding the smallest and the largest values among sources, the mean value of capacity performance is approximately [17.42].

Following is observed for **VR/AR, 30Mbps, 10ms PDB, 60 FPS**

* For 60 FPS, with SU-MIMO, the capacity performances are in the range of {5.1~10.6}, and the mean value of capacity performance is approximately [7.99].
* For 60 FPS, with MU-MIMO, the capacity performances are in the range of {11.6~13.59}, and the mean value of capacity performance is approximately [12.77].

Following is observed for **VR/AR, 45Mbps, 10ms PDB, 60 FPS**

* For 60 FPS, with SU-MIMO, the capacity performances are in the range of {4.1~7}, and the mean value of capacity performance is approximately [5.6].
* For 60 FPS, with MU-MIMO, the capacity performances are in the range of {6.91~8.4}, and the mean value of capacity performance is approximately [7.7].
  + 1. FR1 UMa DL

6 sources (Huawei, Qualcomm, vivo, China unicom, MediaTek, ZTE) reported the evaluation results of capacity performance with UMa, 100MHz bandwidth, DDDSU TDD format, as shown in Table 9 to Table 12.

Following is observed for **CG, 30Mbps, 15ms PDB, 60 FPS**

* With SU-MIMO, the capacity performances are in the range of {5.4~10.33}, and the mean value of capacity performance is approximately [7.93].
* With MU-MIMO, the capacity performances are in the range of {8~14.33}, and the mean value of capacity performance is approximately [11.58].

Following is observed for **VR/AR, 30Mbps, 10ms PDB, 60 FPS**

* For 60 FPS, with SU-MIMO, the capacity performances are in the range of {4.4~8}, and the mean value of capacity performance is approximately [5.75].
* For 60 FPS, with MU-MIMO, the capacity performances are in the range of {5.2~10}, and the mean value of capacity performance is approximately [8.33].

Following is observed for **VR/AR, 45Mbps, 10ms PDB, 60 FPS**

* For 60 FPS, with SU-MIMO, the capacity performances are in the range of {2.4~5.5}, and the mean value of capacity performance is approximately [4.03].
* For 60 FPS, with MU-MIMO, the capacity performances are in the range of {2.9, 4.68}, and the mean value of capacity performance is approximately [3.79].
  + 1. FR1 InH UL

6 sources (Nokia, CATT, MTK, vivo, Interdigital, QC ) reported the evaluation results of capacity performance with InH, 100MHz bandwidth, DDDSU TDD format, as shown in Table 13 to Table 15.

Following is observed for **UL pose/control-stream, 0.2Mbps, 10ms PDB, 250 FPS**

* With SU-MIMO, the capacity performances are in the range of {>10~198}.
* With MU-MIMO, the capacity performances are in the range of {>20, 240}.

Following is observed for **UL scene/video/data/voice-stream, 10Mbps, 30ms PDB, 60FPS**

* With SU-MIMO, the capacity performances are in the range of {5.09, 13.95}, and the mean value of capacity performance is approximately [9.52].
* With MU-MIMO, the capacity performances are in the range of {7.1, 11.5}, and the mean value of capacity performance is approximately [9.3].

Following is observed for **UL two-stream pose/control-stream, 0.2Mbps, 10ms PDB, 250FPS + scene/video/ data/voice-stream, 10Mbps, 30ms PDB, 60FPS**

* With SU-MIMO, the capacity performances are in the range of {5.56, 12.71}, and the mean value of capacity performance is approximately [9.14].
  + 1. FR1 DU UL

9 sources (Nokia, Ericsson, MTK, vivo, Interdigital, Huawei, QC, ZTE) reported the evaluation results of capacity performance with DU, 100MHz bandwidth, DDDSU TDD format, as shown in Table 16 to Table 18.

Following is observed for **UL pose/control-stream, 0.2Mbps, 10ms PDB, 250 FPS**

* With SU-MIMO, the capacity performances are in the range of {>10~224.9}
* With MU-MIMO, the capacity performances are in the range of {>15, >240}

Following is observed for **UL scene/video/data/voice-stream, 10Mbps, 30ms PDB, 60FPS**

* With SU-MIMO, the capacity performances are in the range of {5~9.49}, and the mean value of capacity performance is approximately [7.96].
* With MU-MIMO, the capacity performances are in the range of {7.3~10.9}, and the mean value of capacity performance is approximately [8.77].

Following is observed for **UL two-stream pose/control-stream, 0.2Mbps, 10ms PDB, 250FPS + scene/video/ data/voice-stream, 10Mbps, 30ms PDB, 60FPS**

* With SU-MIMO, the capacity performances are in the range of {5~10.78}, and the mean value of capacity performance is approximately [7.74].
  + 1. FR1 UMa UL

5 sources (Ericsson, MTK, vivo, Huawei, QC) reported the evaluation results of capacity performance with Uma, 100MHz bandwidth, DDDSU TDD format, as shown in Table 19 to Table 21.

Following is observed for **UL pose/control-stream, 0.2Mbps, 10ms PDB, 250 FPS**

* With SU-MIMO, the capacity performances are in the range of {15~143}.
* With MU-MIMO, the capacity performances are in the range of {>15, >240}.

Following is observed for **UL scene/video/data/voice-stream, 10Mbps, 30ms PDB, 60FPS**

* With SU-MIMO, the capacity performances are in the range of {0~1.34}, and the mean value of capacity performance is smaller than [1].
* With MU-MIMO, the capacity performances are in the range of {0, <1}, and the mean value of capacity performance is smaller than [1].
  + 1. FR2 InH DL

6 sources (Nokia, Qualcomm, vivo, MediaTek, ZTE, Ericsson) reported the evaluation results of capacity performance with InH, 100/400MHz bandwidth, DDDSU TDD format, as shown in Table 22 to Table 25.

Following is observed for **CG, 8Mbps, 15ms PDB, 60 FPS**

* With SU-MIMO, 100MHz bandwidth, the capacity performances are in the range of {20~27.5}, and the mean value of capacity performance is approximately [23.75].

Following is observed for **CG, 30Mbps, 15ms PDB, 60 FPS**

* With SU-MIMO, 100MHz bandwidth, the capacity performances are in the range of {6~10}, and the mean value of capacity performance is approximately [9.36].

Following is observed for **VR/AR, 30Mbps, 10ms PDB, 60 FPS**

* For 60 FPS, with SU-MIMO, 100MHz bandwidth, the capacity performances are in the range of {5.5~10}, and the mean value of capacity performance is approximately [8.48].

Following is observed for **VR/AR, 45Mbps, 10ms PDB, 60 FPS**

* For 60 FPS, with SU-MIMO, 100MHz bandwidth, the capacity performances are in the range of {3~6.13}, and the mean value of capacity performance is approximately [4.61].
  + 1. FR2 DU DL

5 sources (Nokia, Qualcomm, vivo, MediaTek, Ericsson) reported the evaluation results of capacity performance with Dense Urban, 100/400MHz bandwidth, DDDSU TDD format, as shown in Table 26 to Table 29.

Following is observed for **CG, 8Mbps, 15ms PDB, 60 FPS**

* With SU-MIMO, 100MHz bandwidth, the capacity performances are in the range of {20~24}, and the mean value of capacity performance is approximately [22].

Following is observed for **CG, 30Mbps, 15ms PDB, 60 FPS**

* With SU-MIMO, 100MHz bandwidth, the capacity performances are in the range of {6~16.16}, and the mean value of capacity performance is approximately [9.522].

Following is observed for **VR/AR, 30Mbps, 10ms PDB, 60 FPS**

* For 60 FPS, with SU-MIMO, 100MHz bandwidth, the capacity performances are in the range of {5.3~13.44}, and the mean value of capacity performance is approximately [8.12].

Following is observed for **VR/AR, 45Mbps, 10ms PDB, 60 FPS**

* For 60 FPS, with SU-MIMO, 100MHz bandwidth, the capacity performances are in the range of {2~8.2}, and the mean value of capacity performance is approximately [4.71].
* For 60 FPS, with SU-MIMO, 400MHz bandwidth, the capacity performances are in the range of {16~19}, and the mean value of capacity performance is approximately [17.5].
  + 1. FR2 InH UL

3 sources (MediaTek, Qualcomm, vivo) reported the evaluation results of capacity performance with FR2, InH, UL, as shown in Table 30 to Table 33.

(TBD on observation)

* + 1. FR2 DU UL

3 sources (MediaTek, Qualcomm, vivo) reported the evaluation results of capacity performance with FR2, DU, UL, as shown in Table 34 to Table 37.

(TBD on observation)

* + 1. Summary of discussion

1. **Please share your comment on the observations for capacity evaluation for FR1 DL.**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| MTK | We think the observations are quite good. An observation (table) to capture the capacity bottleneck (DL or UL) for each deployment/application would be good. |
| Futurewei | One general comment, it is not clear why for the FR1 DU DL scenario has been treated differently than the rest of the scenarios. In particular, for this case outliers have been excluded while reset of scenarios include all statistics. |
| Nokia, NSB | **FR1 InH DL:**  The statistical data for **FR1 InH DL** (also relevant for other cases, e.g., FR1 DU, FR1 Uma, FR2 InH) contains the results with the “max MCS up to 64QAM” together with “up to 256QAM” option. Do we want to consider both type of results (“up to 256QAM” and “up to 64QAM”) together in the same range?  [**Question to OPPO, CATT, ZTE, China Unicom**] What are the reasons/advantages for choosing the option of max MCS up to 64 QAM, instead of agreed “Up to 256QAM”?  [**Question to CMCC]** for the case: **FR1 InH DL,** **VR/AR, 30Mbps, 10ms PDB, 60 FPS**. Particularly the results from **CMCC** on MU-MIMO says they have 100% of satisfied UEs out of 5 UEs. Does it mean that for the case with 6 UEs the percent of satisfied UEs is less than 90%?  **FR1 Uma DL:**  We have a comment for the case: **VR/AR, 45Mbps, 10ms PDB, 60 FPS**  We notice that the mean value for MU-MIMO is even **a bit less** than the one for SU-MIMO. Such trend is different from all the previous cases, where MU-MIMO was always **notably higher** than SU-MIMO. We might not have enough data to make the conclusion for that case. There are just two companies submitted the results.  [**Question to moderator**] Do we want to keep this observation with the trend in its current form?  [Question to **Qualcomm and vivo**] In that regard, could you, please, provide some more details on the MU-MIMO scheme you have used in your simulations? In particular, it would be interesting to know if the scheduler has a discrete set of beams to choose from or if more advanced techniques have been used. In case a grid of beams has been defined it would be helpful to know the configuration used in the simulations. |
| CATT | The summary and observation are quite comprehensive. Most companies are in the similar range. However, we observe the excessive good capacity results. It would be nice to outline the results with excessive good or bad capacity with note of analyzing the outcome of those excessive results. |
| Apple | For FR1 inH DL,  For VR/AR, 30Mbps, 10ms PDB, 60 FPS, the MU-MIMO performance seems to be worse than the SU-MIMO performance? |
| ZTE, Sanechips | Thanks for the great effort in capacity results summary.  Firstly, we have noticed that there are some problems with our evaluation results.   1. The preemption results, that is line 14, 15, 16 with Note 5, 6, 7, respectively in Table 2, should be the capacity results with SU-MIMO. 2. For Note 4 in Table 2, The relationship of standard deviation/maximum/minimum packet size is [3,109,91]%.   Note 4: the relationship of standard deviation/maximum/minimum packet size w.r.t ~~[10.5, 150, 50]%~~ [3, 109, 91]% of mean packet size  The same problem is also in Table 1-4, 6-8.  Secondly, two more suggestions about the method of summarized capacity results.   1. The capacity results should be all included in results ranging with excluding some extreme results. And the capacity results in the results ranging should be all utilized to calculate the average capacity.   From our perspective, we suggest to have some modification on the observation:  For example, for InH scenario,  Following is observed for **VR/AR, 30Mbps, 10ms PDB, 60 FPS**   * For 60 FPS, with MU-MIMO, the capacity performances are in the range of ~~{5~10.8}~~ {5.8~11.4}, and the mean value of capacity performance is approximately ~~[9.53]~~ [9.37].   For another example, for DU scenario,  Following is observed for **CG, 30Mbps, 15ms PDB, 60 FPS**   * With MU-MIMO, the capacity performances are in the range of ~~{16.1~19.65}~~. {14.7~19.65}. ~~With excluding the smallest and the largest values among sources~~, the mean value of capacity performance is approximately ~~[17.42]~~ [16.73].  1. It should be clarified that whether the capacity results with Notes are considered in the ranging. |
| InterDigital | We agree with the FL’s observations. |
| China Unicom | We agree with moderator’s summary. |
| Huawei, HiSilicon | Thank you for the great efforts on providing such nice summary. We have some comments below:  **Comment#1:**  We suggest the following changes in red on all the observations (the following one is just taken as an example):  *Following is observed for* ***VR/AR, 45Mbps, 10ms PDB, 60 FPS***   * *~~For 60 FPS,~~ According to 3 sources (MediaTek, China Unicom, Qualcomm), with SU-MIMO, the capacity performances are in the range of {2.4~5.5}, and the mean value of capacity performance is approximately [4.03].* * *~~For 60 FPS,~~ According to 2 sources (Qualcomm, vivo), with MU-MIMO, the capacity performances are in the range of {2.9, 4.68}, and the mean value of capacity performance is approximately [3.79].*   The main reasons are:   * Reason#1: As already commented by some companies, in the above example, the mean value of capacity of SU-MIMO (i.e., 4.03) is larger than that of MU-MIMO (i.e., 3.79), which is not as expected.   + We observe that, for a given company (e.g., QC in this example), we can still observe that the capacity of SU-MIMO is smaller than that of MU-MIMO, which is as expected.   + So we assume the reason for the above unexpected result is that the sources for SU-MIMO and MU-MIMO are different when we calculate the mean value.   + Therefore, to avoid such confusion, we suggest to add “According to X sources (A, B, C, …)” to the beginning of each sub-bullet.   + Note: we observe other cases also have this SU-MIMO > MU-MIMO issue, e.g., “FR1 InH UL scene/video/data/voice-stream, 10Mbps, 30ms PDB, 60FPS”. * Reason#2: Take Section 3.1.3 as an example   + At the beginning of this section, currently it says “*6 sources (Huawei, Qualcomm, vivo, China unicom, MediaTek, ZTE) reported the evaluation results …”.* And then it gives the results for 30 Mbps, 45 Mbps, SU-MIMO, MU-MIMO, etc.   + This may give a wrong impression that all the 6 sources simulated all the cases below, which is not the case actually. For example, at least Huawei does not simulate 45 Mbps in this meeting.   + So again, adding “According to X sources (A, B, C, …)” to the beginning of each sub-bullet can avoid such confusion. * Reason#3:   + In some cases, a lot of companies (e.g., >10) simulated a specific case.   + While in some other cases, maybe only one or two companies simulated a specific case.   + So adding “According to X sources (A, B, C, …)” to the beginning of each sub-bullet can help companies quickly know the level of interest of this case, and know how many values are involved to calculate the mean capacity value. * “For 60 FPS” can be removed to avoid duplications with the main bullet   **Comment#2:**  Take Section 3.1.7 as an example, “FR2 DL, InH/DU, CG, 8Mbps”. In Table 22, some company report capacity value >20. So the following value range and mean value might be inaccurate. We gave some suggested changes in red. This issue may also exist in other cases.  *Following is observed for* ***CG, 8Mbps, 15ms PDB, 60 FPS***   * *With SU-MIMO, 100MHz bandwidth, the capacity performances are in the range of {~~20~27.5~~ >20}, and the mean value of capacity performance is approximately [> 23.75].*   **Comment#3:**  As FL explained in the beginning of section 3, for this meeting, RAN1 will not discuss enhancement schemes for both capacity and power saving, right?  For the baseline performance, will RAN1 have further discussion like which is the bottleneck in this meeting? |
| vivo | We think the presentation of observations based on the baseline performance evaluation results is a good starting point. Considering that fewer companies offer results for the enhancement schemes and each company has a different scheme, it will be a good start to focus on the observations for baseline performance. The observations by comparing different cases, e.g. the bottlenecks of DL and UL, can be further discussed after a stable version on the observation of baseline.  Comparing the capacity evaluation results from different companies, it appears that there exist some cases where MU-MIMO has worse capacity performance than SU-MIMO. However, if we compare the two scheduling algorithms’ capacity evaluation results from a single company, it is obviously that MU-MIMO capacity performance is much better than SU-MIMO. Furthermore, if we compare the capacity evaluation results between the two scheduling algorithms purely from the summarized range of capacity, it may lead to misleading conclusions. Therefore, it is recommended that companies can provide both SU-MIMO and MU-MIMO capacity evaluation results.  [Answer to **Nokia**] For the MU-MIMO scheduler in our simulation, assuming multiple UEs are covered by a single beam, multiple UEs are paired for each sub-band following these steps as below:   * Step 1: select the 1st UE with the highest PF value * Step 2: select the best N layers for the 1st UE based on CSI * Step 3: select the next UE by greedy algorithm, which can provide the highest throughput together with the previous paired UEs (the precoder is calculated by ZF algorithm) * Step 4: iterate Step 3 until all the remaining UEs are completed |
| QC | We appreciate FL efforts for summarizing results. We want to make following points.   * There are a few companies including QC who have submitted CG 8Mbps results, which seems to be missing in DL FR1 sections – 3.1.1, 3.1.2, 3.1.3. * Currently captured results are capacity numbers for different FR, deployment environment, direction-DL/UL. In addition to these, if there are any other factors (or parameters which could be potentially changed) affecting capacity notably, then, it needs to be captured. We believe this kind of observation could be informative and worth to be captured in TR. So far, we see that impact of MIMO scheme (SU-MIMO vs MU-MIMO) is the factor giving largest difference in capacity. This general trend needs to be captured. * In additional to that, for baseline performance evaluation, given that this is study item, we think some good **observations** can be made capturing   + impact of frame rates on capacity,   + impact of data rates on capacity,   + impact of heavy uplink (VR vs AR) on capacity,   + impact of PDCCH capacity on XR capacity   + impact of bandwidth   + impact of jitter   + impact of TDD configuration   + etc… |
| Intel | Thank you for the summary. Please see below our comments.   * How is the average computed? Does it include all the results in the table in section 4 (as described in the Notes column, there are some variations in the assumption)? * We share similar concerns to Huawei, HiSilicon. Considering the range of variation in the results from different companies, without a proper definition, average values can be misleading and does not provide meaningful information, e.g., comparison between SU-MIMO and MU-MIMO for InH (VR/AR, 30Mbps, 10ms PDB, 60 FPS) based on the average capacity may not provide a useful observation as the MU-MIMO data and SU-MIMO data are from different sources.   We noticed that our evaluation results are not captured in section 4. We have added the following results in Table 6 and Table 7.  Table 6   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Source** | **MU-MIMO** | | | **Notes** | | **Capacity** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell =C1** | | Intel | 7.4 | 7 | 93.2% |  |   Table 7   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Source** | **MU-MIMO** | | | **Notes** | | **Capacity** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell =C1** | | Intel | 7 | 7 | 90% |  | |

1. **Please share your comment on the observations for capacity evaluation for FR1 UL.**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| MTK | We think the observations are quite good. An observation (table) to capture the capacity bottleneck (DL or UL) for each deployment/application would be good. Also, it seems that AR (with 10Mbps UL data) does not work in FR1 Uma, and this can also be captured in the observation. |
| Nokia, NSB | It can be observed that 0.2 Mbit/s in UL (Pose/control) is not a limiting factor for capacity in both DU and InH.  Same here regarding SU-MIMO vs. MU-MIMO in InH UL scene/video/data/voice-stream, 10Mbps, 30ms PDB, 60FPS: MU-MIMO results appear to be slightly lower (in any case, not notably higher) than the ones for SU-MIMO. What is the reason for such a trend? |
| Apple | It seems MU-MIMO performs worse than SU-MIMO?  Following is observed for **UL scene/video/data/voice-stream, 10Mbps, 30ms PDB, 60FPS**   * With SU-MIMO, the capacity performances are in the range of {5.09, 13.95}, and the mean value of capacity performance is approximately [9.52]. * With MU-MIMO, the capacity performances are in the range of {7.1, 11.5}, and the mean value of capacity performance is approximately [9.3]. |
| ZTE,Sanechips | Fine |
| InterDigital | We agree with the FL’s observations. |
| Huawei, HiSilicon | Same comment as to Question 1. |
| QC | We see that large number of UEs can be supported in CG/VR UL pose only case. As we have commented in our companion tdoc for evaluation methodology, we found that, to support such a large number of Ues, large number of PDCCH capacity (in terms of symbols or CCEs) is required. This means that PDCCH capacity could be a limiting factor to UL pose capacity.  Here we copy the figure for DU scenario. As shown here, in order to support 250 UEs, on average 10 PDCCH symbols are required. If we consider peak requirement, actual PDCCH requirement could be even larger than this.  We think capturing UL results only w/o PDCCH consideration could be a bit misleading. |
| Intel | We noticed that our evaluation results are not captured in section 4. We have added the following results in Table 17.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Source** | **MU-MIMO** | | | **Notes** | | **Capacity** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell =C1** | | Intel | 14.7 | 14 | 91.33% |  | | Intel | 14.7 | 14 | 90.79% | Note 2 | | Intel | 10.6 | 10 | 94.67% | Note 4 | |

1. **Please share your comment on the observations for capacity for FR2 DL.**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| MTK | We think the observations are quite good. An observation (table) to capture the capacity bottleneck (DL or UL) for each deployment/application would be good. |
| Nokia, NSB | There may be a minor typo in Table 27, where Note 2 and Note 3 are swapped. Shouldn’t it be “Note 2~~3~~: 400MHz bandwidth”?  There may be also a minor typo in Table 32 (Note 4~~2~~: 60ms PDB). |
| Apple | For FR1 UMa DL,  the MU-MIMO performance seems to be worse than the SU-MIMO performance.  Following is observed for **VR/AR, 45Mbps, 10ms PDB, 60 FPS**   * For 60 FPS, with SU-MIMO, the capacity performances are in the range of {2.4~5.5}, and the mean value of capacity performance is approximately [4.03]. * For 60 FPS, with MU-MIMO, the capacity performances are in the range of {2.9, 4.68}, and the mean value of capacity performance is approximately [3.79]. |
| ZTE,Sanechips | Fine |
| QC | Similar comment as FR1.   * Given that this is a study item, we think some good **observations** can be made capturing followings in baseline performance   + impact of frame rates on capacity,   + impact of PDB,   + impact of bandwidth   + impact of data rate   + impact of jitter   + impact of PDCCH capacity on XR capacity   + impact of TDD configuration   + etc |

1. **Please share your comment on the observations for capacity evaluation for FR2 UL.**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| MTK | We think the observations are quite good. An observation (table) to capture the capacity bottleneck (DL or UL) for each deployment/application would be good (after the UL statistics are available). |
| Apple | For FR1 UMa UL, MU-MIMO performs worse than SU-MIMO.  Following is observed for **UL scene/video/data/voice-stream, 10Mbps, 30ms PDB, 60FPS**   * With SU-MIMO, the capacity performances are in the range of {0~1.34}, and the mean value of capacity performance is smaller than [1]. * With MU-MIMO, the capacity performances are in the range of {0, <1}, and the mean value of capacity performance is smaller than [1]. |

* 1. Power consumption
     1. FR1 InH DL

4 sources (Interdigital, Nokia, vivo, CATT) reported the evaluation results of power consumption compared to AlwaysOn (baseline) scheme, with InH, 100MHz bandwidth, DDDSU TDD format, as shown in Table 38 to Table 40. **Note that the results in red are not satisfy the capacity requirement i.e., there are at least 90% satisfied UEs in the system.**

Comparing to UE always on, following is observed for **CG, 30Mbps, 15ms PDB:**

* For R15/16CDRX power saving scheme, the power saving gain are in the range of {15.23%~27.09%} for high load.

Comparing to UE always on, following is observed for **VR/AR, 30Mbps, 10ms PDB:**

* For R15/16CDRX power saving scheme, the power saving gain are in the range of {3.67%, 5.72%} for low load with no capacity loss and {2.39%~6.14%} for high load with {0.69%~6.94%} capacity loss.

Comparing to UE always on, following is observed for **VR/AR, 45Mbps, 10ms PDB:**

* For R15/16CDRX power saving scheme, the power saving gain are in the range of {3.46%, 5.32%} for low load with no capacity loss and {2.83%, 4.68%, 25.45%} for high load with around {2.23%, 3.89%} capacity loss.
  + 1. FR1 DU DL

5 sources (Interdigital, Huawei, Ericsson, vivo, Interdigital) reported the evaluation results of power consumption compared to AlwaysOn (baseline) scheme, with DU, 100MHz bandwidth, DDDSU TDD format, as shown in Table 41 to Table 43. **Note that the results in red are not satisfy the capacity requirement i.e., there are at least 90% satisfied Ues in the system.**

Comparing to UE always on, following is observed for **VR/AR, 30Mbps, 10ms PDB:**

* For R15/16CDRX power saving scheme, the power saving gain are in the range of {3.65%, 5.57%} for low load with no capacity loss and {3.03%, 4.70%} for high load with {0.85%, 2.32%} capacity loss.

Comparing to UE always on, following is observed for **VR/AR, 45Mbps, 10ms PDB:**

* For R15/16CDRX power saving scheme, the power saving gain are in the range of {3.53%, 5.56%} for low load with no capacity loss and {3.10%, 4.69%} for high load with around {1.45%, 2.51%} capacity loss.
  + 1. FR1 Uma DL

1 sources (vivo) reported the evaluation results of power consumption compared to AlwaysOn (baseline) scheme, with Uma, 100MHz bandwidth, DDDSU TDD format, as shown in Table 44 and Table 45.

(TBD on observations)

* + 1. FR1 InH UL

1 source (vivo) reported the evaluation results of power saving performance with InH, 100MHz bandwidth, DDDSU TDD format, as shown in Table 46 to Table 48.

(TBD on observations)

* + 1. FR1 DU UL

1 source (vivo) reported the evaluation results of power saving performance with DU, 100MHz bandwidth, DDDSU TDD format, as shown in Table 49 to Table 51.

(TBD on observations)

* + 1. FR1 Uma UL

1 source (vivo) reported the evaluation results of power saving performance with Uma, 100MHz bandwidth, DDDSU TDD format, as shown in Table 52.

(TBD on observations)

* + 1. FR1 InH DL+UL

4 sources (vivo, Qualcomm, MediaTek, ZTE) reported the evaluation results of power consumption compared to AlwaysOn (baseline) scheme, with InH, 100MHz bandwidth, DDDSU TDD format, as shown in Table 53 to Table 59. **Note that the results in red are not satisfy the capacity requirement i.e., there are at least 90% satisfied Ues in the system.**

Following is observed for **DL video-stream (30Mbps, 10ms PDB) + UL pose/control-stream (0.2Mbps, 10ms PDB)**, one source (vivo) provides the following results:

* For R15/16CDRX power saving scheme, the power saving gain are in the range of {3.643%~3.71%} for low load with no capacity loss and {2.33%~3.45%} for high load with around 1% capacity loss.

Following is observed for **DL video-stream (30Mbps, 10ms PDB) + UL video-stream (10Mbps, 30ms PDB)**, one source (vivo) provides the following results

* For R15/16CDRX power saving scheme, the power saving gain are in the range of {2.59%~4.20%} for low load with no capacity loss and {1.69%~2.62%} for high load with up to 0.83% capacity loss.

Following is observed for **DL video-stream (30Mbps, 10ms PDB) + UL two-stream (pose/control-stream (0.2Mbps, 10ms PDB) + video-stream (10Mbps, 30ms PDB))**, one source (vivo) provides the following results

* For R15/16CDRX power saving scheme, the power saving gain are in the range of {1.02%~1.81%} for low load with no capacity loss and {0.83%~1.59%} for high load with up to 1.39% capacity loss.
  + 1. FR1 DU DL+UL

4 sources (vivo, Qualcomm, MediaTek, Ericsson) reported the evaluation results of power consumption compared to AlwaysOn (baseline) scheme, with dense urban, 100MHz bandwidth, DDDSU TDD format, as shown in Table 60 to Table 63. **Note that the results in red are not satisfy the capacity requirement i.e., there are at least 90% satisfied Ues in the system.**

Following is observed for Following is observed for **DL video-stream (30Mbps, 10ms PDB) + UL pose/control-stream (0.2Mbps, 10ms PDB),** two sources (vivo, Qualcomm) provide the following results

* For R15/16CDRX power saving scheme, the power saving gain are in the range of {2.44%~3.56%} for low load with no capacity loss and {2.24%~7.03%} for high load with {0.85%~2.32%} capacity loss.

Following is observed for Following is observed for **DL video-stream (30Mbps, 10ms PDB) + UL video-stream (10Mbps, 30ms PDB),** one sources (vivo) provides the following results

* For R15/16CDRX power saving scheme, the power saving gain are in the range of {2.39%~3.79%} for low load with no capacity loss and {1.62%~2.58%} for high load with up to 0.7% capacity loss.

Following is observed for Following is observed for **DL video-stream (30Mbps, 10ms PDB) + UL two-stream (pose/control-stream (0.2Mbps, 10ms PDB)+video-stream (10Mbps, 30ms PDB)),** one sources (vivo) provides the following results

* For R15/16CDRX power saving scheme, the power saving gain are in the range of {0.91%~1.63%} for low load with no capacity loss and {0.79%~1.51%} for high load with up to 0.9% capacity loss.
  + 1. FR2 InH DL

3 sources (vivo, Nokia, Qualcomm) reported the evaluation results of power saving performance with InH, 100MHz bandwidth, DDDSU TDD format, as shown in Table 64 to Table 66.

(TBD on observation)

* + 1. FR2 DU DL

1 sources (vivo) reported the evaluation results of power saving performance with Dense Urban, 100MHz bandwidth, DDDSU TDD format, as shown in Table 67 and Table 68.

(TBD on observation)

* + 1. FR2 InH UL

1 source (vivo) reported the evaluation results of power saving performance with FR2, InH, UL, pose/control stream as shown in Table 69 and Table 70.

(TBD on observation)

* + 1. FR2 DU DL

1 source (vivo) reported the evaluation results of power saving performance with FR2, DU, UL, pose/control stream as shown in Table 71 and Table 72.

(TBD on observation)

* + 1. Summary of discussion

1. **Please share your comment on the observations for power evaluation for FR1 DL.**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| MTK | The observations seem to only capture power saving results for CDRX (which seems poor). We think at least PDCCH skipping like results should be also captured. |
| Nokia, NSB | Following the same approach as agreed during the previous meeting for capacity studies (“When companies are submitting evaluation results to RAN1, it is recommended to submit results at least the following parameters in the below table.”), it may be beneficial to **select one common R15/16 CDRX configuration that provides calibration of the results among companies.** This may be, i.e., (16, 8, 8) or (16, 14, 4).  The deviations in the results may be reduced if CDRX configs with long cycle duration of less than 10ms are excluded from R15/16 and moved to the “eCDRX” category.  **More clarification is needed on how the results for “capacity loss” are obtained** (i.e., some companies report the results, where N > C1, which contradicts the general approach, where N1=C1 for baseline and N1 can be less than C1 for Optional).  Also, we have a comment regarding the note in the beginning of the section “**Note that the results in red are not satisfy the capacity requirement i.e., there are at least 90% satisfied Ues in the system.**” This note is a bit strange, as following the revised table template the “true capacity” value is not calculated during the UE power studies. Hence, there is often a case, where “UE always ON” reports 90.2% satisfied Ues, while some DRX config results in “89.3% of satisfied Ues”. We don’t see any motivation to highlight that 89.3% is lower than the capacity requirement, as true capacity is not calculated during the UE power studies. |
| CATT | The power saving results should be categorized by different power saving techniques, which in addition to legacy DRX configuration. |
| ZTE, Sanechips | Thanks for great effort in power results summary. In Table 54, we have noticed that our evaluation results for power consumption, with traffic model w.r.t. [3, 109, 91]% of mean packet size relationship, were missing. We suggest to add the following results in Table 54.   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UE** | **% of satisfied UE in DL** | **% of satisfied UE in UL** | **Average PS gain (%)** | **Notes** | | ZTE, Sanechips | AlwaysOn-baseline | 11 | 11 |  | 93.20% | 100% |  | Note 2 | | AlwaysOn-baseline | 11 | 11 |  | 93.20% | 100% |  | Note 1, 2 | | AlwaysOn-baseline | 10 | 11 |  | 93.30% | 100% |  | Note 2 | | AlwaysOn-baseline | 10 | 11 |  | 93.30% | 100% |  | Note 1,2 | | eCDRX (16\_6\_3) | 11 | 11 |  | 85.60% | 100% | 23.60% | Note 2 | | eCDRX (16\_6\_3) | 11 | 11 |  | 85.60% | 100% | 23.60% | Note 1,2 | | eCDRX (16\_6\_3) | 10 | 11 |  | 90.30% | 100% | 22.40% | Note 2 | | eCDRX (16\_6\_3) | 10 | 11 |  | 90.30% | 100% | 22.40% | Note 1,2 | | Note 1: Option 1: two-step Quantization  Note 2: the relationship of standard deviation/maximum/minimum packet size w.r.t [3, 109, 91]% of mean packet size. | | | | | | | | | |
| Huawei, HiSilicon | Same comment as to Question 1. |
| vivo | We are OK with the description of observations.  As observed from the tables, there are lots of combinations of parameter configurations for the R15/16 CDRX scheme, and the CDRX configurations have different effects on capacity and PS gain, which makes it difficult to accurately describe the relationship between PS gain and capacity loss under CDRX scheme. To make better comparison, some common R15/16 CDRX configurations e.g. (10, 8, 4) or (16, 14, 4) can be adopted for power evaluation.  In addition, it can also be seen that with some particular CDRX configurations, the capacity performance is decreased significantly. However, during previous EVM discussion, it is desired that any PS schemes should maintain a negligible capacity loss when we provide simulation results.  We are supportive of capture observations based on the results with enhanced power saving schemes. We think observations of the PDCCH skipping scheme and other enhanced schemes can be further discussed when companies provide more simulation results. |

1. **Please share your comment on the observations for power evaluation for FR1 DL+UL.**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| MTK | The observations seem to only capture power saving results for CDRX (which seems poor). We think at least PDCCH skipping like results should be also captured. |
| QC | Thanks for the great efforts. We make a few points here.   * In observation part, FL use the term “capacity loss”. The meaning of “capacity loss” needs to be clearly defined. In our guess, this is the difference of “% of satisfied UE” between two cases: AlwaysOn and PS scheme of interest for the same number of UEs. So, it would be better to be names as “% of satisfied UE loss” rather than “capacity loss” since capacity in our definition is in the number of Ues. * To make the results more informative, we support FL approach to capture “capacity loss” and “power saving gain” together. * In current data collection method by FL, red colored data points are excluded since they are less than 90% of satisfied UE. This hard restriction based on absolute threshold (of 90%) may not be consistent in data collection. For example, suppose that company A can have S = 94% and company B could have S = 91%, where S is the % of satisfied UE for AlwaysOn. Then, company A’s PS scheme gives S’=90% and company B’s PS scheme gives S’=89%, where S’ is the % of satisfied UE for a PS scheme. In this case, company B’s results will **not** be captured since it falls below 90%. To avoid such cases, it would be better to have the threshold be set to the relative value w.r.t the S value, for example, S-5%, or S-10%. * In capturing the baseline results, in addition to range of PSGs for each case (FR, Scenario, direction), to make this SI more informative, we can also make some observations capturing   + tradeoff between capacity and power   + impact of UL 1st BLER target on power   + impact of pose periodicity   + impact of frame rate on power   + impact of data rate on power   + impact of power periodicity on power   + difference of power between DL/UL only and joint DL+UL   \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*  **Question to Nokia**  In 4.5.1.1. InH Scenario, InH, CG, 30Mbps, 15ms PDB, 100MHz bandwidth, DDDSU TDD format  For Nokia results - R15/16CDRX (4\_2\_2) and (8\_4\_4), how is the % of satisfied UE be 100% when evaluation is done in capacity regime where (ave #UE=C1=10). According to evaluation methodology, the % of satisfied UE should be around or less than 90% with power saving scheme enabled.  **Question to InterDigital**  In 4.5.1.1 InH Scenario  For InterDigital's results, when N1=C1 (i.e., capacity regime), what is % of satisfied UE is 100%? According to evaluation methodology, the % of satisfied UE should be around or less than 90% with power saving scheme enabled. And, DL satisfied UE % is missing in MTK results.  **Question to MTK**  In 4.5.3.1. InH Sceario, InH, CG: DL video-stream (30Mbps, 15ms PDB) + UL pose/control-stream (0.2Mbps, 10ms PDB) 100MHz bandwidth, DDDSU TDD format  In the MTK's results of Table 53, why is the % of UE is 100% if this is simulated in high load (capacity regime, avg# UE = C1=9)? According to evaluation methodology, the % of satisfied UE should be around or less than 90% with power saving scheme enabled.  **Question to ZTE**  In 4.5.3.1 InH Scenarios,  In ZTE's results, we see there are % of satisfied UE in DL, and % of satisfied UE for UL. But, we don't see the % of satisfied UE (which is determined based on both DL satisfaction and UL satisfaction for each UE). This needs to be reported (possibly together with DL and UL satisfied UE). |
| MTK2 | Regarding QC’s “**Question to MTK**” for Table 53:   * Why is the % of UE is 100% if this is simulated in high load (capacity regime, avg# UE = C1=9)? According to evaluation methodology, the % of satisfied UE should be around or less than 90% with power saving scheme enabled |

1. Evaluation Results

(Note: in this section, the evaluation results are summarized in form of tables for different cases, with capturing the key information and performance metrics from the excel file. The intention is that the evaluation results could be appropriately presented in the TR. The detailed assumptions for the evaluation results can refer to the excel file. Another intention is that it can be helpful to make observation based on these results in the tables.)

* 1. Capacity Results: FR1 DL
     1. InH Scenario

**InH, CG, 8Mbps, 15ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 1 System capacity of CG (8Mbps) application in FR1 DL InH scenario

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **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** |
| MediaTek | >20 | >20 | N/A |  |  |  |  |
| Interdigital |  |  |  | 12 | 12 | 100% |  |
| CMCC |  |  |  | 9.00 | 9 | 97.22% | Note 1 |
| Qualcomm | 22.3 | 22 | 94% | 44.1 | 44 | 90% |  |
| Note 1: 10ms PDB | | | | | | | |

**InH, CG, 30Mbps, 15ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 2 System capacity of CG (30Mbps) application in FR1 DL InH scenario

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **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** |
| Nokia | 5.96 | 5 | 99% |  |  |  |  |
| Ericsson | 4.7 | 4 |  |  |  |  |  |
| MediaTek | 9 | 9 | 89.55% |  |  |  |  |
| Interdigital |  |  |  | 6 | 6 | 92% |  |
| CATT |  |  |  | 15 | 15 | 90% | Note 1, 7 |
| ZTE, Sanechips |  |  |  | 12.9 | 12 | 90% | Note 7 |
| ZTE, Sanechips |  |  |  | 13.3 | 13 | 92% | Note 2, 7 |
| ZTE, Sanechips | 8.6 | 8 | 93% |  |  |  | Note 3, 7 |
| ZTE, Sanechips | 6.4 | 6 | 92% |  |  |  | Note 4, 7 |
| ZTE, Sanechips | 6 | 6 | 90% |  |  |  | Note 5, 7 |
| Qualcomm | 8.4 | 8 | 97.5 | 12.8 | 12 | 95% |  |
| vivo | 10.14 | 10 | 91.67% | 16.2 | 16 | 91.15% |  |
| vivo | 11.43 | 11 | 96.06% | 16.67 | 16 | 92.01% | Note 6 |
| Note 1: jitter range equals [0, 8]ms with 2ms STD  Note 2: the relationship of standard deviation/maximum/minimum packet size w.r.t [3, 109, 91]% of mean packet size  Note 3: Precise Preemption  Note 4: Rel-15 Preemption  Note 5: Scheduling uRLLC traffic and delaying XR traffic when collision occurs  Note 6: adopting delay-aware (DA) scheduling  Note 7: Max MCS modulation: 64QAM | | | | | | | |

**InH, VR/AR, 30Mbps, 10ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 3 System capacity of VR/AR (30Mbps) application in FR1 DL InH scenario

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **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** |
| Nokia | 5.2 | 5 | 94% |  |  |  |  |
| Ericsson | 4 | 4 |  |  |  |  |  |
| MediaTek | 8 | 8 | 88.13% |  |  |  |  |
| ZTE, Sanechips |  |  |  | 11.4 | 11 | 92% | Note 5 |
| ZTE, Sanechips |  |  |  | 11.8 | 11 | 94% | Note 1, 5 |
| CMCC |  |  |  | 5.00 | 5 | 100.00% |  |
| Interdigital |  |  |  | 2 | 2 | 97.5% |  |
| CATT |  |  |  | 12 | 12 | 96% | Note 2, 5 |
| Qualcomm | 7 | 7 | 91% | 10.3 | 10 | 93% |  |
| vivo | 8.27 | 8 | 92.71% | 10.8 | 10 | 92.50% |  |
| vivo | 10.77 | 10 | 95.20% | 12.4 | 12 | 93.06% | Note 3 |
| vivo |  |  |  | 16.53 | 16 | 92.71% | Note 4 |
| Note 1: the relationship of standard deviation/maximum/minimum packet size w.r.t [3, 109, 91]% of mean packet size  Note 2: jitter range equals [0, 8]ms with 2ms STD  Note 3: adopting delay-aware (DA) scheduling  Note 4: separate packet arrivals in time for dual-eye buffer with 120FPS  Note 5: Max MCS modulation: 64QAM | | | | | | | |

**InH, VR/AR, 45Mbps, 10ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 4 System capacity of VR/AR (45Mbps) application in FR1 DL InH scenario

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **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** |
| Nokia | 3.27 | 3 | 97% |  |  |  |  |
| MediaTek | 4.6 | 4 | 96.30% |  |  |  |  |
| Interdigital |  |  |  | 2 | 2 | 92.5% |  |
| ZTE, Sanechips |  |  |  | 7.2 | 7 | 92% | Note 4 |
| ZTE, Sanechips |  |  |  | 7.3 | 7 | 93% | Note 1, 4 |
| CATT |  |  |  | 12 | 12 | 94% | Note 2, 4 |
| Qualcomm | 4.3 | 4 | 97% | 6.4 | 6 | 93% |  |
| vivo |  |  |  | 5.91 | 5 | 96.67% |  |
| vivo |  |  |  | 9.22 | 9 | 91.36% | Note 3 |
| Note 1: the relationship of standard deviation/maximum/minimum packet size w.r.t [3, 109, 91]% of mean packet size  Note 2: jitter range equals [0, 8]ms with 2ms STD  Note 3: separate packet arrivals in time for dual-eye buffer with 120FPS  Note 4: Max MCS modulation: 64QAM | | | | | | | |

* + 1. DU Scenario

**DU, CG, 8Mbps, 15ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 5 System capacity of CG (8Mbps) application in FR1 DL Dense Urban scenario

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **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** |
| MediaTek | >20 | >20 | N/A |  |  |  |  |
| Interdigital |  |  |  | 8 | 8 | 100% |  |
| CMCC |  |  |  | 9.00 | 9 | 100.00% | Note 1 |
| Qualcomm | 24.4 | 24 | 93% | 56.6 | 56 | 92% |  |
| Note 1: 10ms PDB | | | | | | | |

**DU, CG, 30Mbps, 15ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 6 System capacity of CG (30Mbps) application in FR1 DL Dense Urban scenario

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **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** |
| OPPO | 10.2 | 10 | 92% |  |  |  |  |
| OPPO | 10.3 | 10 | 93% |  |  |  | Note 1A |
| OPPO | 10.3 | 10 | 94% |  |  |  | Note 1B |
| OPPO | 10.5 | 10 | 94% |  |  |  | Note 2 |
| OPPO | 11 | 11 | 91% |  |  |  | Note 1A，2 |
| OPPO | 10.1 | 10 | 93% |  |  |  | Note 1B，2 |
| Nokia | 8.5 | 8 | 97% |  |  |  |  |
| CATT | 10 | 10 | 92% |  |  |  | Note 3, 6 |
| Ericsson | 5.1 | 5 |  |  |  |  |  |
| MediaTek | 13 | 13 | 90.41% |  |  |  |  |
| Interdigital |  |  |  | 4 | 4 | 97.5% |  |
| ZTE, Sanechips |  |  |  | 14.7 | 14 | 93% | Note 6 |
| ZTE, Sanechips |  |  |  | 14.8 | 14 | 93% | Note 4, 6 |
| Huawei | 7.6 | 7 | 92.52% | 16.1 | 16 | 90.77% |  |
| Qualcomm | 10 | 10 | 91% | 16.5 | 16 | 93% |  |
| vivo | 11.68 | 11 | 94.81% | 19.65 | 19 | 92.56% |  |
| vivo | 13.58 | 13 | 94.90% | 19.75 | 19 | 92.86% | Note 5 |
| Intel |  |  |  | 7.4 | 7 | 93.202% |  |
|  |  |  | 8.2 | 8 | 90.14% | Note 2 |
| Note 1A: the interval of packet arrival among UEs are equal  Note 1B: the interval of packet arrival among UEs are zero, i.e. packet arrival among UEs are synchronized  Note 2: without jitter  Note 3: jitter range equals [0, 8]ms with 2ms STD  Note 4: the relationship of standard deviation/maximum/minimum packet size w.r.t [3, 109, 91]% of mean packet size  Note 5: adopting delay-aware (DA) scheduling  Note 6: Max MCS modulation: 64QAM | | | | | | | |

**DU, VR/AR, 30Mbps, 10ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 7 System capacity of VR/AR (30Mbps) application in FR1 DL Dense Urban scenario

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **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** |
| OPPO | 8.4 | 8 | 95% |  |  |  |  |
| OPPO | 9.2 | 9 | 91% |  |  |  | Note 1A |
| OPPO | 7.4 | 7 | 95% |  |  |  | Note 1B |
| OPPO | 9 | 9 | 90% |  |  |  | Note 2 |
| OPPO | 10.5 | 10 | 94% |  |  |  | Note 1A，2 |
| OPPO | 7.1 | 7 | 92% |  |  |  | Note 2 |
| Nokia | 6.54 | 6 | 97% |  |  |  |  |
| CATT | 8 | 8 | 91% |  |  |  | Note 1, 10 |
| Ericsson | 4.2 | 4 |  |  |  |  |  |
| MediaTek | 10.6 | 10 | 94.30% |  |  |  |  |
| ZTE, Sanechips |  |  |  | 12.5 | 12 | 90% | Note 10 |
| ZTE, Sanechips |  |  |  | 13.6 | 13 | 92% | Note 2, 10 |
| CMCC |  |  |  | 3.00 | 3 | 100.00% |  |
| Interdigital |  |  |  | 2 | 2 | 95.5% |  |
| Huawei | 5.1 | 5 | 91.43% | 11.6 | 11 | 92.86% |  |
| Huawei |  |  |  | 6.3 | 6 | 91.67% | Note 3 |
| Huawei |  |  |  | 19.3 | 19 | 90.54% | Note 4 |
| Huawei |  |  |  | 14 | 14 | 90.08% | Note 5 |
| Qualcomm | 8.2 | 8 | 93% | 13.4 | 13 | 92% |  |
| vivo | 9.49 | 9 | 94.18% | 13.59 | 13 | 92.43% |  |
| vivo | 12.67 | 12 | 95.12% | 14.4 | 14 | 91.84% | Note 6 |
| vivo |  |  |  | 20.78 | 20 | 92.54% | Note 7 |
| FUTUREWEI |  |  |  | 8.7 | 8 | 94% |  |
|  |  |  | 16.4 | 16 | 92% | Note 8 |
| Intel |  |  |  | 7 | 7 | 90% |  |
|  |  |  | 7.5 | 7 | 95.71% | Note 9 |
| Note 1: jitter range equals [0, 8]ms with 2ms STD  Note 2: the relationship of standard deviation/maximum/minimum packet size w.r.t [3, 109, 91]% of mean packet size  Note 3: 7ms PDB  Note 4: 13ms PDB  Note 5: Frame Level Integrated Transmission (FLIT)  Note 6: adopting delay-aware (DA) scheduling  Note 7: separate packet arrivals in time for dual-eye buffer with 120FPS  Note 8: cooperative MIMO/precoding  Note 9: no jitter  Note 10: Max MCS modulation: 64QAM | | | | | | | |

**DU, VR/AR, 45Mbps, 10ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 8 System capacity of VR/AR (45Mbps) application in FR1 DL Dense Urban scenario

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **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** |
| Interdigital |  |  |  | 0 | 0 | 0% |  |
| Xiaomi | 9 | 9 | 91% |  |  |  | Note 1 |
| Xiaomi | 7 | 7 | 90% |  |  |  |  |
| Nokia | 4.1 | 4 | 92% |  |  |  |  |
| MediaTek | 6 | 6 | 91.75% |  |  |  |  |
| MediaTek | 0 | 0 | N/A |  |  |  | Note 2A |
| MediaTek | 4.2 | 4 | 91.93% |  |  |  | Note 2B |
| MediaTek | 10.3 | 10 | 91.53% |  |  |  | Note 2C |
| MediaTek | 12.3 | 12 | 92.15% |  |  |  | Note 2D |
| ZTE, Sanechips |  |  |  | 7.8 | 7 | 97% | Note 5 |
| ZTE, Sanechips |  |  |  | 7.9 | 7 | 97% | Note 3, 5 |
| Qualcomm | 5.2 | 5 | 93% | 8.4 | 8 | 92% |  |
| vivo |  |  |  | 6.91 | 6 | 95.63% |  |
| vivo |  |  |  | 11.42 | 11 | 91.77% | Note 4 |
| Note 1: UE/stream satisfied if DL packet success rate > 95%  Note 2A: DDDDD DDDUU (2.6GHz)  Note 2B: DSUDD SUUDD (4.9GHz)  Note 2C: DDDDD DDDUU (2.6GHz) + DSUDD SUUDD (4.9GHz)  Note 2D: DDDDD DDDUU (2.6GHz) + DSUDD SUUDD (4.9GHz)  Note 3: the relationship of standard deviation/maximum/minimum packet size w.r.t [3, 109, 91]% of mean packet size  Note 4: separate packet arrivals in time for dual-eye buffer with 120FPS  Note 5: Max MCS modulation: 64QAM | | | | | | | |

**DU, I/P-frame Option 1A slice-based multi-stream model, 30Mbps, 100MHz bandwidth, DDDSU TDD format**

Table x1 System capacity of Option 1A slice-based multi-stream model in FR1 DL Dense Urban scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source** | **MU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |
| vivo | 13.62 | 13 | 92.49% | Note 1A, 2A |
| vivo | 13.62 | 13 | 92.49% | Note 1A, 2B |
| vivo | 16.14 | 16 | 91.52% | Note 1A, 2C |
| vivo | 16.14 | 16 | 91.52% | Note 1A, 2D |
| vivo | 13.54 | 13 | 92.43% | Note 1B, 2A |
| vivo | 13.54 | 13 | 92.43% | Note 1B, 2B |
| vivo | 16.23 | 16 | 91.67% | Note 1B, 2C |
| vivo | 16.23 | 16 | 91.67% | Note 1B, 2D |
| ZTE | 16.4 | 16 | 92% | Note 1C, 2E |
| Note 1A: alpha=1.5  Note 1B: alpha=3  Note 1C: alpha=2  Note 2A: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [1%, 1%, 10ms, 10ms]  Note 2B: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [5%, 1%, 10ms, 10ms]  Note 2C: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [1%, 5%, 10ms, 10ms]  Note 2D: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [5%, 5%, 10ms, 10ms]  Note 2E: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [1%, 10%, 20ms, 20ms] | | | | |

**DU, I/P-frame Option 1B GOP-based multi-stream model, 30Mbps, 100MHz bandwidth, DDDSU TDD format**

Table x2 System capacity of Option 1B GOP-based multi-stream model (30Mbps) in FR1 DL Dense Urban scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source** | **MU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |
| vivo | 6.89 | 6 | 93.12% | Note 1A, 2A |
| vivo | 12.16 | 12 | 91.53% | Note 1A, 2B |
| vivo | 14.63 | 14 | 92.40% | Note 1A, 2C |
| vivo | 12.53 | 12 | 92.06% | Note 1A, 2D |
| vivo | 14.38 | 14 | 91.84% | Note 1A, 2E |
| vivo | 16.23 | 16 | 90.67% | Note 1A, 2F |
| vivo | 14.73 | 14 | 92.74% | Note 1A, 2G |
| vivo | 2.21 | 2 | 92.86% | Note 1B, 2A |
| vivo | 5.15 | 5 | 91.02% | Note 1B, 2B |
| vivo | 8.23 | 8 | 90.67% | Note 1B, 2C |
| vivo | 5.15 | 5 | 91.02% | Note 1B, 2D |
| vivo | 6.69 | 6 | 94.97% | Note 1B, 2E |
| vivo | 8.23 | 8 | 90.67% | Note 1B, 2F |
| vivo | 2.21 | 2 | 92.86% | Note 1B, 2G |
| Huawei | 10 | 10 | 90.08% | Note 1C, 2A |
| Huawei | 6.7 | 6 | 93.12% | Note 1D, 2A |
| Huawei | 8.8 | 8 | 94.35% | Note 1D, 2H |
| Huawei | 6.7 | 6 | 93.12% | Note 1D, 2I |
| Huawei | 9.1 | 9 | 90.87% | Note 1D, 2B |
| Huawei | 9.6 | 9 | 92.06% | Note 1D, 2D |
| Huawei | 6 | 6 | 90.08% | Note 1D, 2J |
| Huawei | 7.4 | 7 | 91.38% | Note 1D, 2J, 3 |
| Huawei | 8.6 | 8 | 95.44% | Note 1D, 2J, 3, 4 |
| ZTE | 14.5 | 14 | 92% | Note 1D, 2K |
| Note 1A: alpha=1.5  Note 1B: alpha=3  Note 1C: alpha=1  Note 1D: alpha=2  Note 2A: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [1 %, 1 %, 10ms, 10ms]  Note 2B: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [1%, 1%, 15ms, 10ms]  Note 2C: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [1%, 1%, 20ms, 10ms]  Note 2D: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [1%, 5%, 15ms, 10ms]  Note 2E: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [5%, 1%, 15ms, 10ms]  Note 2F: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [1%, 5%, 20ms, 10ms]  Note 2G: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [5 %, 1%, 20ms, 10ms]  Note 2H: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [1%, 1%, 15ms, 9ms]  Note 2I: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [1%, 5%, 10ms, 10ms]  Note 2J: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [0.5%, 1%, 10ms, 10ms]  Note 2K: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [1%, 10%, 10ms, 10ms]  Note 3: prioritize to schedule the I-frame  Note 4: Frame Level Integrated Transmission (FLIT) | | | | |

**DU, I/P-frame Option 1B GOP-based multi-stream model, 45Mbps, 100MHz bandwidth, DDDSU TDD format**

Table x3 System capacity of Option 1B GOP-based multi-stream model (45Mbps) in FR1 DL Dense Urban scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source** | **SU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |
| MTK | <2 | <2 | N/A | Note 1A, 2A |
| MTK | 2 | 2 | 87.62% | Note 1A, 2A, 3 |
| MTK | 2 | 2 | 89.53% | Note 1A, 2B, 3 |
| MTK | 4 | 4 | 89.77% | Note 1A, 2C, 3 |
| MTK | 2 | 2 | 89.05% | Note 1B, 2A |
| MTK | 3 | 3 | 89.53% | Note 1B, 2A, 3 |
| MTK | 3 | 3 | 90.16% | Note 1B, 2B, 3 |
| MTK | 4 | 4 | 89.77% | Note 1B, 2C, 3 |
| Note 1A: alpha=3  Note 1B: alpha=1.5  Note 2A: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [1%, 1%, 10ms, 10ms]  Note 2B: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [1%, 5%, 10ms, 10ms]  Note 2C: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [1%, 1%, 17ms, 9ms]  Note 3: adopting delay-aware (DA) scheduling | | | | |

* + 1. Uma Scenario

**Uma, CG, 8Mbps, 15ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 9 System capacity of CG (8Mbps) application in FR1 DL Uma scenario

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **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** |
| MediaTek | >20 | >20 | N/A |  |  |  |  |
| China Unicom | >30 | >30 | 99% |  |  |  | Note 1, 2 |
| Qualcomm | 17.5 | 16 | 94% | 23.8 | 23 | 93% |  |
| Note 1: 10ms PDB  Note 2: Max MCS modulation: 64QAM | | | | | | | |

**Uma, CG, 30Mbps, 15ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 10 System capacity of CG (30Mbps) application in FR1 DL Uma scenario

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **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** |
| MediaTek | 9.5 | 9 | 92.35% |  |  |  |  |
| China Unicom | 7.9 | 7 | 93.8% |  |  |  | Note 1 |
| ZTE, Sanechips |  |  |  | 11.6 | 11 | 93% | Note 1 |
| Huawei | 6.5 | 6 | 92.86% | 12.4 | 12 | 92.46% |  |
| Qualcomm | 5.4 | 5 | 92% | 8 | 8 | 90% |  |
| vivo | 10.33 | 10 | 91.90% | 14.33 | 14 | 91.33% |  |
| vivo | 11.94 | 11 | 93.78% | 14.45 | 14 | 91.73% | Note 2 |
| Note 1: Max MCS modulation: 64QAM  Note 2: adopting delay-aware (DA) scheduling | | | | | | | |

**Uma, VR/AR, 30Mbps, 10ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 11 System capacity of VR/AR (30Mbps) application in FR1 DL Uma scenario

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **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** |
| China Unicom | 5.5 | 5 | 92.4% |  |  |  | Note 4 | | | | |
| MediaTek | 8 | 8 | 89.05% |  |  |  |  | | | | |
| ZTE, Sanechips |  |  |  | 10 | 10 | 90% | Note 4 | | | | |
| Huawei | 4.5 | 4 | 92.38% | 9.3 | 9 | 91.22% |  | | | | |
| Qualcomm | 4.4 | 4 | 94% | 5.2 | 5 | 91% |  | | | | |
| vivo | 7.24 | 7 | 92.48% | 8.82 | 8 | 93.75% |  | | | | |
| vivo | 8.56 | 8 | 92.64% | 9.55 | 9 | 92.30% | Note 1 | | | | |
| vivo |  |  |  | 14.59 | 14 | 92.06% | Note 2 | | | | |
| FUTUREWEI | | |  | | |  |  | 6.1 | 6 | 91% |  |
|  | | |  |  | 9.5 | 9 | 91% | Note 3 |
| Note 1: adopting delay-aware (DA) scheduling  Note 2: separate packet arrivals in time for dual-eye buffer with 120FPS  Note 3: cooperative MIMO/precoding  Note 4: Max MCS modulation: 64QAM | | | | | | | | | | | |

**Uma, VR/AR, 45Mbps, 10ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 12 System capacity of VR/AR (45Mbps) application in FR1 DL Uma scenario

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **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** |
| MediaTek | 4.2 | 4 | 92.86% |  |  |  |  |
| China Unicom | 4.6 | 4 | 92.7% |  |  |  | Note 1 |
| Qualcomm | 2.4 | 2 | 93% | 2.9 | 2 | 93% |  |
| vivo |  |  |  | 4.68 | 4 | 94.05% |  |
| vivo |  |  |  | 8.12 | 8 | 90.87% | Note 2 |
| Note 2: Max MCS modulation: 64QAM  Note 1: separate packet arrivals in time for dual-eye buffer with 120FPS | | | | | | | |

* 1. Capacity Results: FR1 UL
     1. InH Scenario

**InH, pose/control-stream, 0.2Mbps, 10ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 13 System capacity of pose/control (0.2Mbps) application in FR1 UL InH scenario

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **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** |
| Nokia | >10 | >10 | 100% |  |  |  |  |
| CATT | >12 | >12 |  |  |  |  | Note 1, 3 |
| MediaTek | >30 | >30 | 100% |  |  |  | Note 2 |
| vivo | >20 | >20 | 100.00% |  |  |  |  |
| Interdigital |  |  |  | 20 | 20 | 100% | Note 3 |
| Qualcomm | 198 | 192 | 99% | >240 | 240 | 99% |  |
| Note 1: DDDUU  Note 2: the interval of packet arrival among UEs are equal  Note 3: Max MCS modulation: 64QAM | | | | | | | |

**InH, scene/video/data/voice-stream, 10Mbps, 30ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 14 System capacity of scene/video/data/voice (10Mbps) application in FR1 UL InH scenario

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **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** |
| CATT | 6 | 6 | 100% |  |  |  | Note 1 |
| MediaTek | 5.09 | 5 | 90% |  |  |  | Note 2 |
| vivo | 13.95 | 13 | 93.59% |  |  |  |  |
| Interdigital |  |  |  | 11.5 | 11 | 94.5% | Note 3 |
| Qualcomm |  |  |  | 7.1 | 7 | 95% |  |
| Note 1: DDDUU  Note 2: the interval of packet arrival among UEs are equal  Note 3: with jitter | | | | | | | |

**InH, pose/control-stream (0.2Mbps, 10ms PDB) + scene/video/data/voice-stream (10Mbps, 30msPDB)**

**100MHz bandwidth, DDDSU TDD format**

Table 15 System capacity of pose/control (0.2Mbps) and scene/video/data/voice (10Mbps) application in FR1 UL InH scenario

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **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** |
| MediaTek | 5.56 | 5 | 93.23% |  |  |  | Note 1 |
| vivo | 12.71 | 12 | 93.29% |  |  |  |  |
| Interdigital |  |  |  | 7.2 | 7 | 94% | Note 2 |
| Qualcomm |  |  |  | 3.4 | 3 | 94% |  |
| Note 1: the interval of packet arrival among UEs are equal  Note 2: video-traffic with jitter | | | | | | | |

* + 1. DU Scenario

**DU, pose/control-stream, 0.2Mbps, 10ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 16 System capacity of pose/control (0.2Mbps) application in FR1 UL Dense Urban scenario

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **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** |
| Nokia | >10 | >10 | 100% |  |  |  |  |
| Ericsson | 15 | 15 |  |  |  |  |  |
| MediaTek | >30 | >30 | 100% |  |  |  | Note 1 |
| vivo | >20 | >20 | 99.99% |  |  |  |  |
| Interdigital |  |  |  | 8 | 8 | 96.5% | Note 1 |
| Huawei |  |  |  | >15 |  | 100% |  |
| Qualcomm | 224.9 | 224 | 92% | >240 | 240 | 99% |  |
| Note 1: the interval of packet arrival among UEs are equal | | | | | | | |

**DU, scene/video/data/voice-stream, 10Mbps, 30ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 17 System capacity of scene/video/data/voice (10Mbps) application in FR1 UL Dense Urban scenario

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **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** |
| Ericsson | 5 | 5 |  |  |  |  |  |
| MediaTek | 9.39 | 9 | 90% |  |  |  | Note 1 |
| vivo | 9.49 | 9 | 92.95% |  |  |  |  |
| ZTE, Sanechips |  |  |  | 10.9 | 10 | 92% | Note 6 |
| Interdigital |  |  |  | 2.3 | 2 | 96% | Note 2 |
| Huawei |  |  |  | 8.1 | 8 | 91.67% |  |
| Huawei |  |  |  | <1 |  |  | Note 3 |
| Huawei |  |  |  | 5.4 | 5 | 92.19% | Note 4 |
| Huawei |  |  |  | 8.3 | 8 | 93.81% | Note 5 |
| Qualcomm |  |  |  | 7.3 | 7 | 90% |  |
| Intel |  |  |  | 14.7 | 14 | 91.33% |  |
| Intel |  |  |  | 14.47 | 14 | 90.79% | Note 2 |
|  |  |  | 14.7 | 14 | 91.33% |  |
|  |  |  | 8.7 | 8 | 93.36% | Note 2, 4 |
| Intel |  |  |  | 10.6 | 10 | 94.67% | Note 4 |
| Note 1: the interval of packet arrival among UEs are equal  Note 2: with jitter  Note 3: 10 ms PDB  Note 4: 15ms PDB  Note 5: 60ms PDB  Note 6: Max MCS modulation: 64QAM | | | | | | | |

**DU, pose/control-stream (0.2Mbps, 10ms PDB) + scene/video/data/voice-stream (10Mbps, 30msPDB)**

**100MHz bandwidth, DDDSU TDD format**

Table 18 System capacity of pose/control (0.2Mbps) and scene/video/data/voice (10Mbps) application in FR1 UL Dense Urban scenario

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **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** |
| MediaTek | 10.78 | 10 | 93.93% |  |  |  | Note 1 |
| Ericsson | 5 | 5 |  |  |  |  |  |
| vivo | 7.43 | 7 | 92.29% |  |  |  |  |
| Interdigital |  |  |  | 0 | 0 | 0% | Note 2 |
| Qualcomm |  |  |  | 3.1 | 3 | 91% |  |
| Note 1: the interval of packet arrival among UEs are equal  Note 2: with jitter | | | | | | | |

* + 1. Uma Scenario

**Uma, pose/control-stream, 0.2Mbps, 10ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 19 System capacity of pose/control (0.2Mbps) application in FR1 UL Uma scenario

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **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** |
| Ericsson | 15 | 15 |  |  |  |  |  |
| MediaTek | >30 | >30 | 100% |  |  |  | Note 1 |
| vivo | >20 | >20 | 97.70% |  |  |  |  |
| Huawei |  |  |  | >15 |  | 95.56% |  |
| Qualcomm | 143 | 136 | 94% | >240 | 240 | 93% |  |
| Note 1: the interval of packet arrival among UEs are equal | | | | | | | |

**Uma, scene/video/data/voice-stream, 10Mbps, 30ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 20 System capacity of scene/video/data/voice (10Mbps) application in FR1 UL Uma scenario

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **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** |
| Ericsson | 0 | 0 |  |  |  |  |  |
| MediaTek | 1.34 | 1 | 90% |  |  |  | Note 1 |
| vivo | <1 | <1 | 74.60% |  |  |  |  |
| Huawei |  |  |  | <1 |  |  |  |
| Qualcomm |  |  |  | 0 | 0 | 0% |  |
| Note 1: the interval of packet arrival among UEs are equal | | | | | | | |

**Uma, pose/control-stream (0.2Mbps, 10ms PDB) + scene/video/data/voice-stream (10Mbps, 30msPDB)**

**100MHz bandwidth, DDDSU TDD format**

Table 21 System capacity of pose/control (0.2Mbps) and scene/video/data/voice (10Mbps) application in FR1 UL Uma scenario

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **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** |
| Ericsson | 0 | 0 |  |  |  |  |  |
| Qualcomm |  |  |  | 0 | 0 | 0% |  |

* 1. Capacity Results: FR2 DL
     1. InH Scenario

**InH, CG, 8Mbps, 15ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 22 System capacity of CG (8Mbps) application in FR2 DL InH scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source** | **SU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |
| MediaTek | >20 | >20 | N/A |  |
| Qualcomm | 27.5 | 27 | 92% | Note 1 |
| Qualcomm | >30 | >30 | 90% | Note 1, 2 |
| Note 1: the interval of packet arrival among UEs are equal  Note 2: 400MHz bandwidth | | | | |

**InH, CG, 30Mbps, 15ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 23 System capacity of CG (30Mbps) application in FR2 DL InH scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source** | **SU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |
| Nokia | >10 | >10 | 100% |  |
| Ericsson | 3.9 | 3 |  |  |
| MediaTek | 11 | 11 | 90.46% |  |
| ZTE, Sanechips | 9.9 | 9 | 93% | Note 4 |
| Qualcomm | 6 | 6 | 90% | Note 1 |
| Qualcomm | 28 | 28 | 90% | Note 1, 2 |
| vivo | 9.91 | 9 | 95.37% |  |
| vivo | 10.23 | 10 | 91.11% | Note 3 |
| Note 1: the interval of packet arrival among UEs are equal  Note 2: 400MHz bandwidth  Note 3: adopting delay-aware (DA) scheduling  Note 4: Max MCS modulation: 64QAM | | | | |

**InH, VR/AR, 30Mbps, 10ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 24 System capacity of VR/AR (30Mbps) application in FR2 DL InH scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source** | **SU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |
| Nokia | >10 | >10 | 99% |  |
| Ericsson | 3.3 | 3 |  |  |
| MediaTek | 10 | 10 | 89.00% |  |
| ZTE, Sanechips | 8.2 | 8 | 91% | Note 5 |
| Qualcomm | 5.5 | 5 | 98% | Note 1 |
| Qualcomm | 26 | 26 | 90% | Note 1, 2 |
| vivo | 8.72 | 8 | 92.01% |  |
| vivo | 8.83 | 8 | 92.36% | Note 3 |
| vivo | 10.23 | 10 | 91.94% | Note 4 |
| Note 1: the interval of packet arrival among UEs are equal  Note 2: 400MHz bandwidth  Note 3: adopting delay-aware (DA) scheduling  Note 4: separate packet arrivals in time for dual-eye buffer with 120FPS  Note 5: Max MCS modulation: 64QAM | | | | |

**InH, VR/AR, 45Mbps, 10ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 25 System capacity of VR/AR (45Mbps) application in FR2 DL InH scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source** | **SU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |
| Nokia | 6.13 | 6 | 98% |  |
| MediaTek | 4.7 | 4 | 96.26% |  |
| Qualcomm | 3 | 3 | 90% | Note 1 |
| Qualcomm | 20.5 | 20 | 92% | Note 1, 2 |
| vivo | 4.67 | 4 | 94.44% |  |
| vivo | 6.03 | 6 | 90.28% | Note 3 |
| Note 1: the interval of packet arrival among UEs are equal  Note 2: 400MHz bandwidth  Note 3: separate packet arrivals in time for dual-eye buffer with 120FPS | | | | |

**InH, I/P-frame Option 1A slice-based multi-stream model, 30Mbps,, 100MHz bandwidth, DDDSU TDD format**

Table x4 System capacity of Option 1A slice-based multi-stream model (30Mbps) in FR2 DL InH scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source** | **SU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |
| vivo | 8.24 | 8 | 92.53% | Note 1A, 2A |
| vivo | 8.24 | 8 | 92.53% | Note 1A, 2B |
| vivo | 10.51 | 10 | 92.08% | Note 1A, 2C |
| vivo | 10.51 | 10 | 92.08% | Note 1A, 2D |
| vivo | 8.24 | 8 | 92.53% | Note 1B, 2A |
| vivo | 8.24 | 8 | 92.53% | Note 1B, 2B |
| vivo | 10.51 | 10 | 92.08% | Note 1B, 2C |
| vivo | 10.51 | 10 | 92.08% | Note 1B, 2D |
| Note 1A: 1.5  Note 1B: 3  Note 2A: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [1%, 1%, 10ms, 10ms]  Note 2B: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [5%, 1%, 10ms, 10ms]  Note 2C: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [1%, 5%, 10ms, 10ms]  Note 2D: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [5%, 5%, 10ms, 10ms] | | | | |

**InH, I/P-frame Option 1B GOP-based multi-stream model, 30Mbps, 100MHz bandwidth, DDDSU TDD format**

Table x5 System capacity of Option 1B GOP-based multi-stream model (30Mbps) in FR2 DL InH scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source** | **SU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |
| vivo | 5.43 | 5 | 91.44% | Note 1, 2A |
| vivo | 7.43 | 7 | 91.36% | Note 1, 2B |
| vivo | 8.16 | 8 | 90.63% | Note 1, 2C |
| vivo | 7.43 | 7 | 91.36% | Note 1, 2D |
| vivo | 8.07 | 8 | 90.28% | Note 1, 2E |
| vivo | 9.03 | 9 | 90.21% | Note 1, 2F |
| vivo | 9.89 | 9 | 91.67% | Note 1, 2G |
| vivo | 2.29 | 2 | 93.06% | Note 2, 2A |
| vivo | 3.29 | 3 | 92.83% | Note 2, 2B |
| vivo | 3.64 | 3 | 93.12% | Note 2, 2C |
| vivo | 3.29 | 3 | 92.83% | Note 2, 2D |
| vivo | 4.39 | 4 | 93.06% | Note 2, 2E |
| vivo | 3.64 | 3 | 93.12% | Note 2, 2F |
| vivo | 5.47 | 5 | 91.36% | Note 2, 2G |
| Note 1A: 1.5  Note 1B: 3  Note 2A: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [1%, 1%,10ms,10ms]  Note 2B: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [1%, 1%, 15ms,10ms]  Note 2C: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [1%, 1%, 20ms,10ms]  Note 2D: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [1%, 5%, 15ms,10ms]  Note 2E: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [5%, 1%, 15ms,10ms]  Note 2F: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [1%, 5%, 20ms,10ms]  Note 2G: [PER\_I, PER\_P, PDB\_I, PDB\_P] = [5%, 1%, 20ms,10ms] | | | | |

* + 1. DU Scenario

**DU, CG, 8Mbps, 15ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 26 System capacity of CG (8Mbps) application in FR2 DL Dense Urban scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source** | **SU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |
| MediaTek | >20 | >20 | N/A |  |
| Qualcomm | 24 | 24 | 90% | Note 1 |
| Qualcomm | >30 | >30 | 90% | Note 1, 2 |
| Note 1: the interval of packet arrival among UEs are equal  Note 2: 400MHz bandwidth | | | | |

**DU, CG, 30Mbps, 15ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 27 System capacity of CG (30Mbps) application in FR2 DL Dense Urban scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source** | **SU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |
| Nokia | 8.25 | 8 | 93% |  |
| Ericsson | 6.2 | 6 |  |  |
| MediaTek | 11 | 11 | 90.60% |  |
| Qualcomm | 6 | 6 | 90% | Note 1 |
| Qualcomm | 25 | 25 | 90% | Note 1, 2 |
| vivo | 16.16 | 16 | 92.36% |  |
| vivo | 16.82 | 16 | 96.73% | Note 3 |
| Note 1: the interval of packet arrival among UEs are equal  Note 2: 400MHz bandwidth  Note 3: adopting delay-aware (DA) scheduling | | | | |

**DU, VR/AR, 30Mbps, 10ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 28 System capacity of VR/AR (30Mbps) application in FR2 DL Dense Urban scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source** | **SU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |
| Nokia | 6.35 | 6 | 96% |  |
| Ericsson | 5.3 | 5 |  |  |
| MediaTek | 10 | 10 | 88.58% |  |
| Qualcomm | 5.5 | 5 | 97% | Note 1 |
| Qualcomm | 23.5 | 23 | 91% | Note 1, 2 |
| vivo | 13.44 | 13 | 95.24% |  |
| vivo | 14.16 | 14 | 91.27% | Note 3 |
| vivo | 16.28 | 16 | 93.55% | Note 4 |
| Note 1: the interval of packet arrival among UEs are equal  Note 2: 400MHz bandwidth  Note 3: adopting delay-aware (DA) scheduling  Note 4: separate packet arrivals in time for dual-eye buffer with 120FPS | | | | |

**DU, VR/AR, 45Mbps, 10ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 29 System capacity of VR/AR (45Mbps) application in FR2 DL Dense Urban scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source** | **SU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |
| Nokia | 3.94 | 3 | 98% |  |
| MediaTek | 4.7 | 4 | 92.62% |  |
| Qualcomm | 2 | 2 | 90% | Note 1 |
| Qualcomm | 19 | 19 | 90% | Note 1, 2 |
| vivo | 8.2 | 8 | 93.25% |  |
| vivo | 10.32 | 10 | 93.97% | Note 3 |
| vivo | >16 | >16 | 100.00% | Note 2 |
| Note 1: separate packet arrivals in time for dual-eye buffer with 120FPS  Note 2: 400MHz bandwidth  Note 3: adopting delay-aware (DA) scheduling | | | | |

* 1. Capacity Results: FR2 UL

**InH, pose/control-stream, 0.2Mbps, 10ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 30 System capacity of pose/control (0.2Mbps) application in FR2 UL InH scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source** | **SU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |
| MediaTek | 12.09 | 12 | 90.28% | Note 1 |
| Qualcomm | 8 | 8 | 90% | Note 1 |
| Qualcomm | 7 | 7 | 90% | Note 1, 2 |
| Qualcomm | 15 | 15 | 90% | Note 1, 3 |
| Qualcomm | 23 | 23 | 90% | Note 1, 4 |
| Qualcomm | > 30 | >30 | 90% | Note 1, 5 |
| Qualcomm | 23 | 23 | 90% | Note 1, 6 |
| vivo | >20 | >20 | 97.69% |  |
| Note 1: the interval of packet arrival among UEs are equal  Note 2: 400MHz bandwidth  Note 3: Regular slot, FDM/SDM  Note 4: mini-slot, Full Antenna  Note 5: mini-slot, FDM/SDM  Note 6: DDDUU | | | | |

**InH, scene/video/data/voice-stream, 10Mbps, 30ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 31 System capacity of scene/video/data/voice (10Mbps) application in FR2 UL InH scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source** | **SU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |
| MediaTek | 1 | 1 | 90% | Note 1 |
| Qualcomm | 10 | 10 | 90% | Note 2 |
| vivo | 8.59 | 8 | 95.14% |  |
| Note 1: the interval of packet arrival among UEs are equal  Note 2: DDDUU | | | | |

**InH, scene/video/data/voice-stream, 20Mbps, 30ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 32 System capacity of scene/video/data/voice (20Mbps) application in FR2 UL InH scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source** | **SU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |
| Qualcomm | 6 | 6 | 90% | Note 1,2 |
| Qualcomm | 5 | 5 | 92% | Note 1,2,3 |
| Qualcomm | 6 | 6 | 90% | Note 1,2,4 |
| Note 1: the interval of packet arrival among UEs are equal  Note 2: DDDUU  Note 3: 15ms PDB  Note 4: 60ms PDB | | | | |

**InH, pose/control-stream (0.2Mbps, 10ms PDB) + scene/video/data/voice-stream (10Mbps/20Mbps, 30msPDB)**

Table 33 System capacity of pose/control (0.2Mbps) and scene/video/data/voice (10Mbps/20Mbps) application in FR2 UL InH scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source** | **SU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |
| MediaTek | 1.26 | 1 | 93.75% | Note 1 |
| Qualcomm | 3.5 | 3 | 93% | Note 1, 2 |
| Qualcomm | 6 | 6 | 90% | Note 1, 2, 4 |
| Qualcomm | 15.5 | 15 | 94% | Note 1, 2,3,4 |
| Qualcomm | 8 | 8 | 90% | Note 1, 2,4,5 |
| Qualcomm | 5 | 5 | 90% | Note 1, 2,4,6 |
| Note 1: the interval of packet arrival among UEs are equal  Note 2: video-stream with jitter  Note 3: 400MHz bandwidth  Note 4: DDDUU  Note 5: adopting delay-aware (DA) scheduling  Note 6: scene/video/data/voice-stream: 20Mbps, 30ms PDB | | | | |

* + 1. DU Scenario

**DU, pose/control-stream, 0.2Mbps, 10ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 34 System capacity of pose/control (0.2Mbps) application in FR2 UL Dense Urban scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source** | **SU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |
| MediaTek | >30 | >30 | 99% | Note 1 |
| Qualcomm | 10 | 10 | 90% | Note 1 |
| Qualcomm | 10 | 10 | 90% | Note 1, 2 |
| Qualcomm | 16 | 16 | 90% | Note 1, 3 |
| Qualcomm | 21.5 | 21 | 91% | Note 1, 4 |
| Qualcomm | >30 | >30 | 90% | Note 1, 5 |
| Qualcomm | 22 | 22 | 90% | Note 1, 6 |
| vivo | >20 | >20 | 96.51% |  |
| Note 1: the interval of packet arrival among UEs are equal  Note 2: 400MHz bandwidth  Note 3: Regular slot, FDM/SDM  Note 4: mini-slot, Full Antenna  Note 5: mini-slot, FDM/SDM  Note 6: DDDUU | | | | |

**DU, scene/video/data/voice-stream, 10Mbps, 30ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 35 System capacity of scene/video/data/voice (10Mbps) application in FR2 UL Dense Urban scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source** | **SU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |
| MediaTek | 1.29 | 1 | 90% | Note 1 |
| Qualcomm | 9 | 9 | 90% | Note 2 |
| vivo | 8.3 | 8 | 92.66% |  |
| Note 1: the interval of packet arrival among UEs are equal  Note 2: DDDUU | | | | |

**DU, scene/video/data/voice-stream, 20Mbps, 30ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 36 System capacity of scene/video/data/voice (20Mbps) application in FR2 UL Dense Urban scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source** | **SU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |
| Qualcomm | 5 | 5 | 90% | Note 1,2 |
| Qualcomm | 3.5 | 3 | >90% | Note 1,2,3 |
| Qualcomm | 5 | 5 | 90% | Note 1,2,4 |
| Note 1: the interval of packet arrival among UEs are equal  Note 2: DDDUU  Note 3: 15ms PDB  Note 2: 60ms PDB | | | | |

**DU, pose/control-stream (0.2Mbps, 10ms PDB) + scene/video/data/voice-stream (10Mbps/20Mbps, 30msPDB)**

Table 37 System capacity of pose/control (0.2Mbps) and scene/video/data/voice (10Mbps/20Mbps) application in FR2 UL Dense Urban scenario

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source** | **SU-MIMO** | | | **Notes** |
| **Capacity** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell =C1** |
| MediaTek | 10 | 10 | 90% | Note 1 |
| Qualcomm | 2 | 2 | 90% | Note 1, 2 |
| Qualcomm | 5 | 5 | 90% | Note 1, 2, 4 |
| Qualcomm | 10 | 10 | 90% | Note 1, 2,3,4 |
| Qualcomm | 12.5 | 12 | 93% | Note 1, 2,4,5 |
| Qualcomm | 2.5 | 2 | 92.50% | Note 1, 2,4,6 |
| Note 1: the interval of packet arrival among UEs are equal  Note 2: video-stream with jitter  Note 3: 400MHz bandwidth  Note 4: DDDUU  Note 5: adopting delay-aware (DA) scheduling  Note 6: scene/video/data/voice-stream: 20Mbps, 30ms PDB | | | | |

* 1. UE Power Consumption Results: FR1
     1. DL power consumption
        1. InH Scenario

**InH, CG, 30Mbps, 15ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 38 Power consumption results of CG (30Mbps) application in FR1 DL InH scenario

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell = N1** | **Average PS gain (%)** |
| Interdigital | AlwaysOn - baseline | 6 | 6 | 92% | - |
| R15/16CDRX (16\_4\_12) | 2 | 2 | 100% | 5.28% |
| R15/16CDRX (4\_2\_2) | 4 | 4 | 90.5% | 16.41% |
| Nokia | R15/16CDRX (4\_2\_2) | 5 | 5 | 97.00% | 27.09% |
| R15/16CDRX (8\_4\_4) | 5 | 5 | 96.05% | 23.57% |
| R15/16CDRX (16\_8\_8) | 5 | 5 | 94.33% | 15.23% |

**InH, VR/AR, 30Mbps, 10ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 39 Power consumption results of VR/AR (30Mbps) application in FR1 DL InH scenario

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell = N1** | **Average PS gain (%)** | **Notes** |
| vivo | AlwaysOn - baseline | 5 | 10 | 100.00% | - |  |
| R15/16CDRX (10\_8\_4) | 5 | 10 | 100.00% | 5.72% |  |
| R15/16CDRX (16\_14\_4) | 5 | 10 | 100.00% | 3.67% |  |
| eCDRX (16\_6\_4) | 5 | 10 | 100.00% | 28.38% |  |
| R17 PDCCH skipping | 5 | 10 | 100.00% | 35.18% |  |
| AlwaysOn - baseline | 10 | 10 | 92.50% | - |  |
| R15/16CDRX (10\_8\_4) | 10 | 10 | 91.25% | 4.88% |  |
| R15/16CDRX (16\_14\_4) | 10 | 10 | 91.81% | 3.24% |  |
| eCDRX (16\_6\_4) | 10 | 10 | 91.25% | 23.84% |  |
| R17 PDCCH skipping | 10 | 10 | 90.70% | 31.34% |  |
| Interdigital | AlwaysOn - baseline | 2 | 2 | 97.5% | - |  |
| R15/16CDRX (16\_4\_12) | 2 | 0 | 0% | 6.42% |  |
| R15/16CDRX (4\_2\_2) | 2 | 0 | 0% | 17.39% |  |
| Nokia | R15/16CDRX (4\_2\_2) | 5 | 5 | 89.33% | 27.09% |  |
| R15/16CDRX (8\_4\_4) | 5 | 5 | 84.00% | 23.57% |  |
| R15/16CDRX (16\_8\_8) | 5 | 5 | 0.50% | 15.23% |  |
| CATT | AlwaysOn - baseline | 12 | 12 | 95.83% |  |  |
| R15/16CDRX (16\_12\_4) | 12 | 12 | 90.97% | 2.39% |  |
| R15/16CDRX (6\_4\_2) | 12 | 12 | 88.89% | 6.14% |  |
| XR-dedicated PDCCH monitoring window | 12 | 12 | 90.00% | 3.87% | Note 1A |
| XR-dedicated PDCCH monitoring window | 12 | 12 | 86.67% | 3.87% | Note 1B |
| XR-dedicated PDCCH monitoring window with UE playout buffer | 12 | 12 | 91.67% | 17.44% | Note 1C  Note 2 |
| C-DRX with UE playout buffer (16\_8\_4) | 12 | 12 | 91.67% | 12.57% | Note 2 |
| Note 1A: Monitoring cycle=8ms; Monitoring window=6ms  Note 1B: Monitoring cycle=16ms; Monitoring window=12ms  Note 1C: Monitoring cycle=16ms; Monitoring window=8ms  Note 2: UE playout buffer size = 5ms | | | | | | |

**InH, VR/AR, 45Mbps, 10ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 40 Power consumption results of VR/AR (45Mbps) application in FR1 DL InH scenario

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell = N1** | **Average PS gain (%)** |
| vivo | AlwaysOn - baseline | 3 | 5 | 100.00% | - |
| R15/16CDRX (10\_8\_4) | 3 | 5 | 100.00% | 5.32% |
| R15/16CDRX (16\_14\_4) | 3 | 5 | 100.00% | 3.46% |
| eCDRX (16\_6\_4) | 3 | 5 | 100.00% | 26.74% |
| R17 PDCCH skipping | 3 | 5 | 100.00% | 34.28% |
| AlwaysOn - baseline | 5 | 5 | 96.67% | - |
| R15/16CDRX (10\_8\_4) | 5 | 5 | 92.78% | 4.68% |
| R15/16CDRX (16\_14\_4) | 5 | 5 | 94.44% | 2.83% |
| eCDRX (16\_6\_4) | 5 | 5 | 93.89% | 22.61% |
| R17 PDCCH skipping | 5 | 5 | 93.89% | 30.64% |
| Interdigital | AlwaysOn - baseline | 2 | 2 | 92.5% | - |
| R15/16CDRX (16\_4\_12) | 2 | 0 | 0% | 5.84% |
| R15/16CDRX (4\_2\_2) | 2 | 0 | 0% | 16.30% |
| Nokia | R15/16CDRX (4\_2\_2) | 3 | 3 | 94.72% | 25.45% |
| R15/16CDRX (8\_4\_4) | 3 | 3 | 83.88% | 21.04% |
| R15/16CDRX (16\_8\_8) | 3 | 3 | 0.00% | 13.04% |

* + - 1. DU Scenario

**DU, CG, 30Mbps, 15ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 41 Power consumption results of CG (30Mbps) application in FR1 DL Dense Urban scenario

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell = N1** | **Average PS gain (%)** |
| Interdigital | AlwaysOn - baseline | 4 | 4 | 97.5% | - |
| R15/16CDRX (16\_4\_12) | 2 | 2 | 100% | 6.64% |
| R15/16CDRX (4\_2\_2) | 2 | 2 | 100% | 17.65% |
| Huawei | AlwaysOn - baseline | 7 | 7 | 90.88% |  |
| R15/16CDRX (10\_5\_4) | 7 | 7 | 49.52% | 7.00% |
| R15/16CDRX (10\_8\_4) | 7 | 7 | 86.26% | 2.76% |
| R15/16CDRX (16\_8\_8) | 7 | 7 | 43.20% | 5.93% |
| Ericsson | AlwaysOn - baseline | 4 | 4 | 90.00% |  |
| Genie | 4 | 4 | 90.00% | 40.00% |
| R15/16CDRX (10\_8\_3) | 4 | 4 | 87.00% | 4.00% |
| R15/16CDRX (10\_5\_5) | 4 | 4 | 76.00% | 8.00% |
| eCDRX (16.6666\_8\_3) | 4 | 4 | 80.00% | 21.00% |

**DU, VR/AR, 30Mbps, 10ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 42 Power consumption results of VR/AR (30Mbps) application in FR1 DL Dense Urban scenario

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell = N1** | **Average PS gain (%)** |
| vivo | AlwaysOn - baseline | 7 | 13 | 100.00% | - |
| R15/16CDRX (10\_8\_4) | 7 | 13 | 100.00% | 5.57% |
| R15/16CDRX (16\_14\_4) | 7 | 13 | 100.00% | 3.65% |
| eCDRX (16\_6\_4) | 7 | 13 | 100.00% | 27.49% |
| R17 PDCCH skipping | 7 | 13 | 100.00% | 34.71% |
| AlwaysOn - baseline | 13 | 13 | 92.43% | - |
| R15/16CDRX (10\_8\_4) | 13 | 13 | 90.11% | 4.70% |
| R15/16CDRX (16\_14\_4) | 13 | 13 | 91.58% | 3.03% |
| eCDRX (16\_6\_4) | 13 | 13 | 91.22% | 21.72% |
| R17 PDCCH skipping | 13 | 13 | 91.21% | 29.90% |
| Interdigital | AlwaysOn - baseline | 2 | 2 | 95.5% | - |
| R15/16CDRX (16\_4\_12) | 2 | 0 | 0% | 7.09% |
| R15/16CDRX (4\_2\_2) | 2 | 2 | 90.5% | 18.05% |
| Huawei | AlwaysOn - baseline | 5 | 5 | 92.00% |  |
| R15/16CDRX (10\_5\_4) | 5 | 5 | 23.71% | 7.39% |
| R15/16CDRX (10\_8\_4) | 5 | 5 | 85.71% | 2.89% |
| R15/16CDRX (16\_8\_8) | 5 | 5 | 0.00% | 7.62% |
| Ericsson | AlwaysOn - baseline | 4 | 4 | 90.00% |  |
| Genie | 4 | 4 | 90.00% | 44.00% |
| R15/16CDRX (10\_8\_3) | 4 | 4 | 82.00% | 5.00% |
| R15/16CDRX (10\_5\_5) | 4 | 4 | 27.00% | 10.00% |
| eCDRX (16.6666\_8\_3) | 4 | 4 | 84.00% | 23.00% |

**DU, VR/AR, 45Mbps, 10ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 43 Power consumption results of VR/AR (45Mbps) application in FR1 DL Dense Urban scenario

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell = N1** | **Average PS gain (%)** |
| vivo | AlwaysOn - baseline | 3 | 3 | 100.00% | - |
| R15/16CDRX (10\_8\_4) | 3 | 3 | 100.00% | 5.56% |
| R15/16CDRX (16\_14\_4) | 3 | 3 | 100.00% | 3.53% |
| eCDRX (16\_6\_4) | 3 | 3 | 99.47% | 27.26% |
| R17 PDCCH skipping | 3 | 3 | 99.47% | 34.64% |
| AlwaysOn - baseline | 6 | 6 | 95.63% | - |
| R15/16CDRX (10\_8\_4) | 6 | 6 | 93.12% | 4.69% |
| R15/16CDRX (16\_14\_4) | 6 | 6 | 94.18% | 3.10% |
| eCDRX (16\_6\_4) | 6 | 6 | 94.18% | 22.95% |
| R17 PDCCH skipping | 6 | 6 | 93.39% | 30.75% |
| Interdigital | AlwaysOn - baseline | 2 | 0 | 0% | - |
| R15/16CDRX (16\_4\_12) | 2 | 0 | 0% | 6.39% |
| R15/16CDRX (4\_2\_2) | 2 | 0 | 0% | 16.93% |

* + - 1. Uma Scenario

**Uma, VR/AR, 30Mbps, 10ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 44 Power consumption results of VR/AR (30Mbps) application in FR1 DL Urban Macro scenario

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell = N1** | **Average PS gain (%)** |
| vivo | AlwaysOn - baseline | 4 | 8 | 98.81% | - |
| R15/16CDRX (10\_8\_4) | 4 | 8 | 98.41% | 6.26% |
| R15/16CDRX (16\_14\_4) | 4 | 8 | 98.81% | 4.05% |
| eCDRX (16\_6\_4) | 4 | 8 | 97.22% | 29.06% |
| R17 PDCCH skipping | 4 | 8 | 96.38% | 35.75% |
| AlwaysOn - baseline | 8 | 8 | 93.75% | - |
| R15/16CDRX (10\_8\_4) | 8 | 8 | 91.47% | 5.02% |
| R15/16CDRX (16\_14\_4) | 8 | 8 | 92.85% | 3.23% |
| eCDRX (16\_6\_4) | 8 | 8 | 91.87% | 23.33% |
| R17 PDCCH skipping | 8 | 8 | 92.06% | 31.98% |

**Uma, VR/AR, 45Mbps, 10ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 45 Power consumption results of VR/AR (45Mbps) application in FR1 DL Urban Macro scenario

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell = N1** | **Average PS gain (%)** |
| vivo | AlwaysOn - baseline | 2 | 4 | 96.83% | - |
| R15/16CDRX (10\_8\_4) | 2 | 4 | 96.83% | 5.81% |
| R15/16CDRX (16\_14\_4) | 2 | 4 | 96.83% | 3.97% |
| eCDRX (16\_6\_4) | 2 | 4 | 96.83% | 27.33% |
| R17 PDCCH skipping | 2 | 4 | 96.83% | 34.73% |
| AlwaysOn - baseline | 4 | 4 | 94.05% | - |
| R15/16CDRX (10\_8\_4) | 4 | 4 | 92.46% | 4.92% |
| R15/16CDRX (16\_14\_4) | 4 | 4 | 93.25% | 3.13% |
| eCDRX (16\_6\_4) | 4 | 4 | 91.67% | 23.59% |
| R17 PDCCH skipping | 4 | 4 | 91.67% | 32.17% |

* + 1. UL power consumption
       1. InH Scenario

**InH, pose/control-stream, 0.2Mbps, 10ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 46 Power consumption results of pose/control (0.2Mbps) application in FR1 UL InH scenario

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell = N1** | **Average PS gain (%)** |
| vivo | AlwaysOn - baseline | 20 | >20 | 100.00% | - |
| R15/16CDRX (4\_2\_1) | 20 | >20 | 94.31% | 26.33% |
| R15/16CDRX (8\_3\_1) | 20 | >20 | 93.33% | 36.83% |

**InH, scene/video/data/voice-stream, 10Mbps, 30ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 47 Power consumption results of scene/video/data/voice (10Mbps) application in FR1 UL InH scenario

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell = N1** | **Average PS gain (%)** |
| vivo | AlwaysOn - baseline | 7 | 13 | 100.00% | - |
| R15/16CDRX (10\_8\_4) | 7 | 13 | 100.00% | 8.39% |
| R15/16CDRX (16\_14\_4) | 7 | 13 | 100.00% | 5.21% |
| eCDRX (16\_6\_4) | 7 | 13 | 100.00% | 35.41% |
| R17 PDCCH skipping | 7 | 13 | 100.00% | 39.50% |
| AlwaysOn - baseline | 13 | 13 | 93.59% | - |
| R15/16CDRX (10\_8\_4) | 13 | 13 | 92.22% | 7.98% |
| R15/16CDRX (16\_14\_4) | 13 | 13 | 92.86% | 5.02% |
| eCDRX (16\_6\_4) | 13 | 13 | 92.38% | 33.54% |
| R17 PDCCH skipping | 13 | 13 | 92.56% | 38.89% |

**InH, pose/control-stream (0.2Mbps, 10ms PDB) + scene/video/data/voice-stream (10Mbps, 30msPDB)**

**100MHz bandwidth, DDDSU TDD format**

Table 48 Power consumption results of pose/control (0.2Mbps) and scene/video/data/voice (10Mbps) application in FR1 UL InH scenario

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell = N1** | **Average PS gain (%)** |
| vivo | AlwaysOn - baseline | 6 | 12 | 100.00% | - |
| R15/16CDRX (10\_8\_4) | 6 | 12 | 100.00% | 3.45% |
| R15/16CDRX (16\_14\_4) | 6 | 12 | 100.00% | 2.04% |
| eCDRX (16\_6\_4) | 6 | 12 | 100.00% | 22.16% |
| R17 PDCCH skipping | 6 | 12 | 100.00% | 27.83% |
| AlwaysOn - baseline | 12 | 12 | 93.29% | - |
| R15/16CDRX (10\_8\_4) | 12 | 12 | 92.13% | 3.36% |
| R15/16CDRX (16\_14\_4) | 12 | 12 | 92.59% | 1.84% |
| eCDRX (16\_6\_4) | 12 | 12 | 91.90% | 21.37% |
| R17 PDCCH skipping | 12 | 12 | 92.36% | 25.59% |

* + - 1. DU Scenario

**DU, pose/control-stream, 0.2Mbps, 10ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 49 Power consumption results of pose/control (0.2Mbps) application in FR1 UL Dense Urban scenario

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell = N1** | **Average PS gain (%)** |
| vivo | AlwaysOn - baseline | 20 | >20 | 99.99% | - |
| R15/16CDRX (4\_2\_1) | 20 | >20 | 94.84% | 26.62% |
| R15/16CDRX (8\_3\_1) | 20 | >20 | 93.81% | 37.27% |

**DU, scene/video/data/voice-stream, 10Mbps, 30ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 50 Power consumption results of scene/video/data/voice (10Mbps) application in FR1 UL Dense Urban scenario

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell = N1** | **Average PS gain (%)** |
| vivo | AlwaysOn - baseline | 5 | 9 | 97.14% | - |
| R15/16CDRX (10\_8\_4) | 5 | 9 | 97.14% | 7.13% |
| R15/16CDRX (16\_14\_4) | 5 | 9 | 97.14% | 4.49% |
| eCDRX (16\_6\_4) | 5 | 9 | 95.56% | 32.48% |
| R17 PDCCH skipping | 5 | 9 | 97.14% | 36.32% |
| AlwaysOn - baseline | 9 | 9 | 92.95% | - |
| R15/16CDRX (10\_8\_4) | 9 | 9 | 91.35% | 6.89% |
| R15/16CDRX (16\_14\_4) | 9 | 9 | 91.17% | 4.37% |
| eCDRX (16\_6\_4) | 9 | 9 | 91.60% | 29.49% |
| R17 PDCCH skipping | 9 | 9 | 91.77% | 34.87% |

**DU, pose/control-stream (0.2Mbps, 10ms PDB) + scene/video/data/voice-stream (10Mbps, 30msPDB)**

**100MHz bandwidth, DDDSU TDD format**

Table 51 Power consumption results of pose/control (0.2Mbps) and scene/video/data/voice (10Mbps) application in FR1 UL Dense Urban scenario

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell = N1** | **Average PS gain (%)** |
| vivo | AlwaysOn - baseline | 4 | 7 | 100.00% | - |
| R15/16CDRX (10\_8\_4) | 4 | 7 | 100.00% | 3.17% |
| R15/16CDRX (16\_14\_4) | 4 | 7 | 100.00% | 1.74% |
| eCDRX (16\_6\_4) | 4 | 7 | 100.00% | 20.92% |
| R17 PDCCH skipping | 4 | 7 | 100.00% | 23.97% |
| AlwaysOn - baseline | 7 | 7 | 92.29% | - |
| R15/16CDRX (10\_8\_4) | 7 | 7 | 90.70% | 3.11% |
| R15/16CDRX (16\_14\_4) | 7 | 7 | 92.06% | 1.42% |
| eCDRX (16\_6\_4) | 7 | 7 | 90.48% | 19.58% |
| R17 PDCCH skipping | 7 | 7 | 91.16% | 22.65% |

* + - 1. Uma Scenario

**Uma, pose/control-stream, 0.2Mbps, 10ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 52 Power consumption results of pose/control (0.2Mbps) application in FR1 UL Uma scenario

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell = N1** | **Average PS gain (%)** |
| vivo | AlwaysOn - baseline | 20 | >20 | 97.70% | - |
| R15/16CDRX (4\_2\_1) | 20 | >20 | 94.37% | 28.10% |
| R15/16CDRX (8\_3\_1) | 20 | >20 | 92.94% | 38.93% |

* + 1. DL and UL evaluating together
       1. InH Scenario

**InH, CG:** **DL video-stream (30Mbps, 15ms PDB) + UL pose/control-stream (0.2Mbps, 10ms PDB)**

**100MHz bandwidth, DDDSU TDD format**

Table 53 Power consumption results of DL CG (30Mbps) and UL pose/control (0.2Mbps) application in FR1 InH scenario

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UE** | **% of satisfied UE in DL** | **% of satisfied UE in UL** | **Average PS gain (%)** | **Notes** |
| MediaTek | AlwaysOn - baseline | 9 | 9 | 100.00% |  | 100.00% | 0% |  |
| Cross slot scheduling | 9 | 9 | 100.00% |  | 100.00% | 20.56% |  |
| R17 PDCCH skipping | 9 | 9 | 100.00% |  | 100.00% | 15.29% |  |
| Custom R17 PDCCH skipping + cross slot | 9 | 9 | 100.00% |  | 100.00% | 28.60% |  |
| ZTE, Sanechips | AlwaysOn-baseline | 12 | 12 |  | 96.53% | 100% |  |  |
| AlwaysOn-baseline | 12 | 12 |  | 96.53% | 100% |  | Note 1 |
| eCDRX (16\_6\_3) | 12 | 12 |  | 88.19% | 100% | 21.40% |  |
| eCDRX (16\_6\_3) | 12 | 12 |  | 88.19% | 100% | 21.30% | Note 1 |
| Qualcomm | AlwaysOn - baseline | 11 | 11 | 91.97% | 91.97% | 100% |  |  |
| Note 1: Option 1: two-step Qauntization | | | | | | | | |

**InH, VR: DL video-stream (30Mbps, 10ms PDB) + UL pose/control-stream (0.2Mbps, 10ms PDB)**

**100MHz bandwidth, DDDSU TDD format**

Table 54 Power consumption results of DL VR (30Mbps) and UL pose/control (0.2Mbps) application in FR1 InH scenario

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UE** | **% of satisfied UE in DL** | **% of satisfied UE in UL** | **Average PS gain (%)** | **Notes** | |
| vivo | AlwaysOn - baseline | 5 | 10 | 100.00% |  |  | - |  | |
| R15/16CDRX (10\_8\_4) | 5 | 10 | 100.00% |  |  | 3.71% |  | |
| R15/16CDRX (16\_14\_4) | 5 | 10 | 100.00% |  |  | 3.64% |  | |
| eCDRX (16\_6\_4) | 5 | 10 | 100.00% |  |  | 25.12% |  | |
| R17 PDCCH skipping | 5 | 10 | 100.00% |  |  | 35.23% |  | |
| AlwaysOn - baseline | 10 | 10 | 92.50% |  |  | - |  | |
| R15/16CDRX (10\_8\_4) | 10 | 10 | 91.25% |  |  | 3.45% |  | |
| R15/16CDRX (16\_14\_4) | 10 | 10 | 91.81% |  |  | 2.33% |  | |
| eCDRX (16\_6\_4) | 10 | 10 | 90.70% |  |  | 23.56% |  | |
| R17 PDCCH skipping | 10 | 10 | 91.25% |  |  | 31.78% |  | |
| ZTE, Sanechips | AlwaysOn-baseline | 11 | 11 |  | 93.18% | 100% |  |  | |
| AlwaysOn-baseline | 11 | 11 |  | 93.18% | 100% |  | Note 1 | |
| AlwaysOn-baseline | 10 | 11 |  | 93% | 100% |  |  | |
| AlwaysOn-baseline | 10 | 11 |  | 93% | 100% |  | Note 1 | |
| eCDRX (16\_6\_3) | 11 | 11 |  | 83% | 100% | 22.60% |  | |
| eCDRX (16\_6\_3) | 11 | 11 |  | 83% | 100% | 22.60% | Note 1 | |
| eCDRX (16\_6\_3) | 10 | 11 |  | 85.83% | 100% | 21.50% |  | |
| eCDRX (16\_6\_3) | 10 | 11 |  | 85.83% | 100% | 21.40% | Note 1 | |
| AlwaysOn-baseline | 11 | 11 |  | 93.20% | 100% |  | Note 2 |
| AlwaysOn-baseline | 11 | 11 |  | 93.20% | 100% |  | Note 1,2 |
| AlwaysOn-baseline | 10 | 11 |  | 93.30% | 100% |  | Note 2 |
| AlwaysOn-baseline | 10 | 11 |  | 93.30% | 100% |  | Note 1,2 |
| eCDRX (16\_6\_3) | 11 | 11 |  | 85.60% | 100% | 23.60% | Note 2 |
| eCDRX (16\_6\_3) | 11 | 11 |  | 85.60% | 100% | 23.60% | Note 1,2 |
| eCDRX (16\_6\_3) | 10 | 11 |  | 90.30% | 100% | 22.40% | Note 2 |
| eCDRX (16\_6\_3) | 10 | 11 |  | 90.30% | 100% | 22.40% | Note 1,2 |
| Qualcomm | AlwaysOn - baseline | 9 | 9 | 92.196% | 92.196% | 100% | 0% |  | |
| Note 1: Option 1: two-step Qauntization  Note 2: the relationship of standard deviation/maximum/minimum packet size w.r.t [3, 109, 91]% of mean packet size. | | | | | | | | | |

**InH, VR: DL video-stream (45Mbps, 10ms PDB) + UL pose/control-stream (0.2Mbps, 10ms PDB)**

**100MHz bandwidth, DDDSU TDD format**

Table 55 Power consumption results of DL VR (45Mbps) and UL pose/control (0.2Mbps) application in FR1 InH scenario

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UE** | **% of satisfied UE in DL** | **% of satisfied UE in UL** | **Average PS gain (%)** | **Notes** |
| ZTE, Sanechips | AlwaysOn-baseline | 7 | 7 |  | 91% | 100% |  |  |
| AlwaysOn-baseline | 7 | 7 |  | 91% | 100% |  | Note 1 |
| eCDRX (16\_6\_3) | 7 | 7 |  | 81% | 100% | 21.40% |  |
| eCDRX (16\_6\_3) | 7 | 7 |  | 81% | 100% | 21.30% | Note 1 |
| Note 1: Option 1: two-step Qauntization | | | | | | | | |

**InH, AR: DL video-stream (30Mbps, 10ms PDB) + UL video-stream (10Mbps, 30ms PDB)**

**100MHz bandwidth, DDDSU TDD format**

Table 56 Power consumption results of DL AR (30Mbps) and UL video (10Mbps) application in FR1 InH scenario

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UE** | **% of satisfied UE in DL** | **% of satisfied UE in UL** | **Average PS gain (%)** |
| vivo | AlwaysOn - baseline | 5 | 10 | 100.00% |  |  | - |
| R15/16CDRX (10\_8\_4) | 5 | 10 | 100.00% |  |  | 4.20% |
| R15/16CDRX (16\_14\_4) | 5 | 10 | 100.00% |  |  | 2.59% |
| eCDRX (16\_6\_4) | 5 | 10 | 100.00% |  |  | 23.61% |
| R17 PDCCH skipping | 5 | 10 | 100.00% |  |  | 31.34% |
| AlwaysOn - baseline | 10 | 10 | 92.50% |  |  | - |
| R15/16CDRX (10\_8\_4) | 10 | 10 | 91.67% |  |  | 2.62% |
| R15/16CDRX (16\_14\_4) | 10 | 10 | 91.94% |  |  | 1.69% |
| eCDRX (16\_6\_4) | 10 | 10 | 90.83% |  |  | 14.77% |
| R17 PDCCH skipping | 10 | 10 | 91.39% |  |  | 19.90% |

**InH, AR: DL video-stream (45Mbps, 10ms PDB) + UL video-stream (10Mbps, 30ms PDB)**

**100MHz bandwidth, DDDSU TDD format**

Table 57 Power consumption results of DL AR (45Mbps) and UL video (10Mbps) application in FR1 InH scenario

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UE** | **% of satisfied UE in DL** | **% of satisfied UE in UL** | **Average PS gain (%)** |
| MediaTek | AlwaysOn - baseline | 4 | 4 | 100.00% |  | 100.00% | 0% - baseline |
| Cross slot scheduling | 4 | 4 | 100.00% |  | 100.00% | 23.87% |
| R17 PDCCH skipping | 4 | 4 | 100.00% |  | 100.00% | 17.65% |
| Custom: R17 PDCCH skipping + cross slot | 4 | 4 | 100.00% |  | 100.00% | 31.56% |

**InH, AR: DL video-stream (30Mbps, 10ms PDB) + UL two-stream (pose/control-stream (0.2Mbps, 10ms PDB)+video-stream (10Mbps, 30ms PDB))**

**100MHz bandwidth, DDDSU TDD format**

Table 58 Power consumption results of DL AR (30Mbps) and UL pose/control (0.2Mbps) and UL video (10Mbps) application in FR1 InH scenario

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UE** | **% of satisfied UE in DL** | **% of satisfied UE in UL** | **Average PS gain (%)** |
| vivo | AlwaysOn - baseline | 5 | 10 | 100.00% |  |  | - |
| R15/16CDRX (10\_8\_4) | 5 | 10 | 100.00% |  |  | 1.81% |
| R15/16CDRX (16\_14\_4) | 5 | 10 | 100.00% |  |  | 1.02% |
| eCDRX (16\_6\_4) | 5 | 10 | 100.00% |  |  | 16.65% |
| R17 PDCCH skipping | 5 | 10 | 100.00% |  |  | 19.98% |
| AlwaysOn - baseline | 10 | 10 | 92.22% |  |  | - |
| R15/16CDRX (10\_8\_4) | 10 | 10 | 90.83% |  |  | 1.59% |
| R15/16CDRX (16\_14\_4) | 10 | 10 | 91.67% |  |  | 0.83% |
| eCDRX (16\_6\_4) | 10 | 10 | 90.56% |  |  | 13.96% |
| R17 PDCCH skipping | 10 | 10 | 91.11% |  |  | 16.13% |
| Qualcomm | AlwaysOn - baseline | 3 | 3 | 89.72% | 99.44% | 90.28% | 0% |

**InH, AR: DL video-stream (45Mbps, 10ms PDB) + UL two-stream (pose/control-stream (0.2Mbps, 10ms PDB)+video-stream (10Mbps, 30ms PDB))**

**100MHz bandwidth, DDDSU TDD format**

Table 59 Power consumption results of DL AR (45Mbps) and UL pose/control (0.2Mbps) and UL video (10Mbps) application in FR1 InH scenario

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UE** | **% of satisfied UE in DL** | **% of satisfied UE in UL** | **Average PS gain (%)** |
| MediaTek | AlwaysOn - baseline | 4 | 4 | 91.67% | 91.67% |  | 0% - baseline |
| R15/16CDRX (10\_5\_5) | 4 | 4 | 70.83% | 70.83% |  | 4.45% |
| Custom : cross-slot + MIMO layer adaptation by BWP switching | 4 | 4 | 88.73% | 88.73% |  | 8.84% |
| Custom : cross-slot + MIMO layer adaptation +PDCCH skipping by BWP switching | 4 | 4 | 84.80% | 84.80% |  | 9.31% |
| R17 PDCCH skipping | 4 | 4 | 90.00% | 90.00% |  | 14.41% |

* + - 1. DU Scenario

**DU, CG: DL video-stream (30Mbps, 15ms PDB) + UL pose/control-stream (0.2Mbps, 10ms PDB)**

**100MHz bandwidth, DDDSU TDD format**

Table 60 Power consumption results of DL CG (30Mbps) and UL pose/control (0.2Mbps) application in FR1 Dense Urban scenario

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UE** | **% of satisfied UE in DL** | **% of satisfied UE in UL** | **Average PS gain (%)** |
| Ericsson | AlwaysOn - baseline | 4 | 4 | 90.00% |  |  |  |
| Genie | 4 | 4 | 90.00% |  |  | 17.00% |
| R15/16CDRX (4\_3\_0) | 4 | 4 | 84.00% |  |  | 7.00% |
| eCDRX (16.666\_13\_0) | 4 | 4 | 88.00% |  |  | 6.00% |
| MediaTek | AlwaysOn - baseline | 13 | 13 | 100.00% |  | 100.00% | 0% - baseline |
| Cross slot scheduling | 13 | 13 | 100.00% |  | 100.00% | 20.48% |
| R17 PDCCH skipping | 13 | 13 | 100.00% |  | 100.00% | 15.32% |
| Custom : R17 PDCCH skipping + cross slot | 13 | 13 | 100.00% |  | 100.00% | 28.58% |
| Qualcomm | AlwaysOn - baseline | 15 | 15 | 91.94% | 91.94% | 99.87% | 0% |

**DU, VR: DL video-stream (30Mbps, 10ms PDB) + UL pose/control-stream (0.2Mbps, 10ms PDB)**

**100MHz bandwidth, DDDSU TDD format**

Table 61 Power consumption results of DL VR (30Mbps) and UL pose/control (0.2Mbps) application in FR1 Dense Urban scenario

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UE** | **% of satisfied UE in DL** | **% of satisfied UE in UL** | **Average PS gain (%)** |
| vivo | AlwaysOn - baseline | 7 | 13 | 100.00% |  |  | - |
| R15/16CDRX (10\_8\_4) | 7 | 13 | 100.00% |  |  | 3.56% |
| R15/16CDRX (16\_14\_4) | 7 | 13 | 100.00% |  |  | 2.44% |
| eCDRX (16\_6\_4) | 7 | 13 | 100.00% |  |  | 23.49% |
| R17 PDCCH skipping | 7 | 13 | 100.00% |  |  | 33.57% |
| AlwaysOn - baseline | 13 | 13 | 92.43% |  |  | - |
| R15/16CDRX (10\_8\_4) | 13 | 13 | 90.11% |  |  | 3.31% |
| R15/16CDRX (16\_14\_4) | 13 | 13 | 91.58% |  |  | 2.24% |
| eCDRX (16\_6\_4) | 13 | 13 | 91.21% |  |  | 21.93% |
| R17 PDCCH skipping | 13 | 13 | 91.21% |  |  | 29.18% |
| Qualcomm | AlwaysOn - baseline | 11 | 11 | 94.37% | 94.37% | 99.74% | 0 |
| R15/16CDRX (8\_6\_4) | 11 | 11 | 38.96% | 75.07% | 50.82% | 11.7333% |
| R15/16CDRX (8\_4\_6) | 11 | 11 | 92.47% | 92.47% | 99.74% | 7.0319% |
| R15/16CDRX (8\_6\_6) | 11 | 11 | 92.04% | 92.04% | 99.74% | 5.3899% |
| Genie | 11 | 11 | 94.37% | 94.37% | 99.74% | 18.1882% |
| eCDRX (16/16/17\_12\_14) | 11 | 11 | 72.38% | 91.95% | 79.05% | 21.3424% |

**DU, AR: DL video-stream (30Mbps, 10ms PDB) + UL video-stream (10Mbps, 30ms PDB)**

**100MHz bandwidth, DDDSU TDD format**

Table 62 Power consumption results of DL AR (30Mbps) and UL video (10Mbps) application in FR1 Dense Urban scenario

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UE** | **% of satisfied UE in DL** | **% of satisfied UE in UL** | **Average PS gain (%)** |
| vivo | AlwaysOn - baseline | 5 | 9 | 96.51% |  |  | - |
| R15/16CDRX (10\_8\_4) | 5 | 9 | 96.19% |  |  | 3.79% |
| R15/16CDRX (16\_14\_4) | 5 | 9 | 96.51% |  |  | 2.39% |
| eCDRX (16\_6\_4) | 5 | 9 | 95.87% |  |  | 20.77% |
| R17 PDCCH skipping | 5 | 9 | 96.19% |  |  | 27.18% |
| AlwaysOn - baseline | 9 | 9 | 92.59% |  |  | - |
| R15/16CDRX (10\_8\_4) | 9 | 9 | 91.89% |  |  | 2.58% |
| R15/16CDRX (16\_14\_4) | 9 | 9 | 92.06% |  |  | 1.62% |
| eCDRX (16\_6\_4) | 9 | 9 | 90.83% |  |  | 14.04% |
| R17 PDCCH skipping | 9 | 9 | 91.18% |  |  | 19.12% |

**DU, AR: DL video-stream (30Mbps, 10ms PDB) + UL two-stream (pose/control-stream (0.2Mbps, 10ms PDB)+video-stream (10Mbps, 30ms PDB))**

**100MHz bandwidth, DDDSU TDD format**

Table 63 Power consumption results of DL AR (30Mbps) and UL pose/control (0.2Mbps) and UL video (10Mbps) application in FR1 Dense Urban scenario

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UE** | **% of satisfied UE in DL** | **% of satisfied UE in UL** | **Average PS gain (%)** |
| vivo | AlwaysOn - baseline | 4 | 7 | 100.00% |  |  | - |
| R15/16CDRX (10\_8\_4) | 4 | 7 | 100.00% |  |  | 1.63% |
| R15/16CDRX (16\_14\_4) | 4 | 7 | 100.00% |  |  | 0.91% |
| eCDRX (16\_6\_4) | 4 | 7 | 100.00% |  |  | 14.34% |
| R17 PDCCH skipping | 4 | 7 | 100.00% |  |  | 17.63% |
| AlwaysOn - baseline | 7 | 7 | 92.06% |  |  | - |
| R15/16CDRX (10\_8\_4) | 7 | 7 | 91.16% |  |  | 1.51% |
| R15/16CDRX (16\_14\_4) | 7 | 7 | 91.61% |  |  | 0.79% |
| eCDRX (16\_6\_4) | 7 | 7 | 90.48% |  |  | 13.19% |
| R17 PDCCH skipping | 7 | 7 | 90.70% |  |  | 15.93% |
| Ericsson | AlwaysOn - baseline | 3 | 3 | 90.00% |  |  |  |
| Genie | 3 | 3 | 90.00% |  |  | 18.00% |
| R15/16CDRX (4\_3\_0) | 3 | 3 | 78.00% |  |  | 7.00% |
| eCDRX (16.6666\_13\_0) | 3 | 3 | 88.00% |  |  | 6.00% |
| Qualcomm | AlwaysOn - baseline | 3 | 3 | 91.27% | 100.00% | 91.468% | 0% |

* 1. UE Power Consumption Results: FR2
     1. DL power consumption
        1. InH Scenario

**InH, CG, 30Mbps, 15ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 64 Power consumption results of CG (30Mbps) application in FR2 DL InH scenario

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell = N1** | **Average PS gain (%)** |
| Nokia | R15/16CDRX (4\_2\_2) | 10 | 10 | 100.00% | 25.78% |
| R15/16CDRX (8\_4\_4) | 10 | 10 | 100.00% | 21.63% |
| R15/16CDRX (16\_8\_8) | 10 | 10 | 97.83% | 12.97% |

**InH, VR/AR, 30Mbps, 10ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 65 Power consumption results of VR/AR (30Mbps) application in FR2 DL InH scenario

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell = N1** | **Average PS gain (%)** |
| vivo | AlwaysOn - baseline | 4 | 8 | 100.00% | - |
| R15/16CDRX (10\_8\_4) | 4 | 8 | 99.31% | 10.06% |
| R15/16CDRX (16\_14\_4) | 4 | 8 | 99.31% | 6.28% |
| eCDRX (16\_8\_4) | 4 | 8 | 98.61% | 34.89% |
| R17 PDCCH skipping | 4 | 8 | 100.00% | 48.70% |
| AlwaysOn - baseline | 8 | 8 | 92.01% | - |
| R15/16CDRX (10\_8\_4) | 8 | 8 | 90.63% | 9.53% |
| R15/16CDRX (16\_14\_4) | 8 | 8 | 91.37% | 5.81% |
| eCDRX (16\_8\_4) | 8 | 8 | 90.97% | 33.68% |
| R17 PDCCH skipping | 8 | 8 | 91.32% | 47.84% |
| Nokia | R15/16CDRX (4\_2\_2) | 10 | 10 | 92.50% | 25.78% |
| R15/16CDRX (8\_4\_4) | 10 | 10 | 24.33% | 21.63% |
| R15/16CDRX (16\_8\_8) | 10 | 10 | 0.08% | 12.97% |

**InH, VR/AR, 45Mbps, 10ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 66 Power consumption results of VR/AR (45Mbps) application in FR2 DL InH scenario

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell = N1** | **Average PS gain (%)** |
| vivo | AlwaysOn - baseline | 2 | 4 | 100.00% | - |
| R15/16CDRX (10\_8\_4) | 2 | 4 | 98.61% | 9.52% |
| R15/16CDRX (16\_14\_4) | 2 | 4 | 98.61% | 5.98% |
| eCDRX (16\_8\_4) | 2 | 4 | 100.00% | 29.25% |
| R17 PDCCH skipping | 2 | 4 | 100.00% | 47.71% |
| AlwaysOn - baseline | 4 | 4 | 94.44% | - |
| R15/16CDRX (10\_8\_4) | 4 | 4 | 91.67% | 9.15% |
| R15/16CDRX (16\_14\_4) | 4 | 4 | 93.75% | 5.73% |
| eCDRX (16\_8\_4) | 4 | 4 | 91.67% | 28.37% |
| R17 PDCCH skipping | 4 | 4 | 90.36% | 46.96% |
| Nokia | R15/16CDRX (4\_2\_2) | 6 | 6 | 82.08% | 23.69% |
| R15/16CDRX (8\_4\_4) | 6 | 6 | 9.80% | 19.75% |
| R15/16CDRX (16\_8\_8) | 6 | 6 | 0.00% | 11.43% |
| Qualcomm | ALWAYS ON | 3 | 3 | 90% | 0% |
| Cross-slot scheduling | 3 | 3 | 90% | 12.2% |
| PDCCH Skipping | 3 | 3 | 90% | 29.8% |
| PDCCH Skipping + Cross-slot skipping | 3 | 3 | 90% | 30% |

* + - 1. DU Scenario

**DU, VR/AR, 30Mbps, 10ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 67 Power consumption results of VR/AR (30Mbps) application in FR2 DL Dense Urban scenario

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell = N1** | **Average PS gain (%)** |
| vivo | AlwaysOn - baseline | 7 | 13 | 99.55% | - |
| R15/16CDRX (10\_8\_4) | 7 | 13 | 98.64% | 10.15% |
| R15/16CDRX (16\_14\_4) | 7 | 13 | 99.32% | 6.40% |
| eCDRX (16\_8\_4) | 7 | 13 | 99.09% | 32.63% |
| R17 PDCCH skipping | 7 | 13 | 99.32% | 49.02% |
| AlwaysOn - baseline | 13 | 13 | 95.24% | - |
| R15/16CDRX (10\_8\_4) | 13 | 13 | 91.82% | 9.50% |
| R15/16CDRX (16\_14\_4) | 13 | 13 | 93.53% | 5.96% |
| eCDRX (16\_8\_4) | 13 | 13 | 91.97% | 31.30% |
| R17 PDCCH skipping | 13 | 13 | 92.67% | 48.48% |

**DU, VR/AR, 45Mbps, 10ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 68 Power consumption results of VR/AR (45Mbps) application in FR2 DL Dense Urban scenario

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell = N1** | **Average PS gain (%)** |
| vivo | AlwaysOn - baseline | 4 | 8 | 100.00% | - |
| R15/16CDRX (10\_8\_4) | 4 | 8 | 100.00% | 9.20% |
| R15/16CDRX (16\_14\_4) | 4 | 8 | 100.00% | 6.06% |
| eCDRX (16\_8\_4) | 4 | 8 | 100.00% | 28.57% |
| R17 PDCCH skipping | 4 | 8 | 100.00% | 41.55% |
| AlwaysOn - baseline | 8 | 8 | 93.25% | - |
| R15/16CDRX (10\_8\_4) | 8 | 8 | 91.67% | 8.29% |
| R15/16CDRX (16\_14\_4) | 8 | 8 | 92.26% | 4.98% |
| eCDRX (16\_8\_4) | 8 | 8 | 91.47% | 27.16% |
| R17 PDCCH skipping | 8 | 8 | 92.06% | 39.60% |

* + 1. UL power consumption
       1. InH Scenario

**InH, pose/control-stream, 0.2Mbps, 10ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 69 Power consumption results of pose/control (0.2Mbps) application in FR2 UL InH scenario

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell = N1** | **Average PS gain (%)** |
| vivo | AlwaysOn - baseline | 20 | >20 | 97.69% | - |
| R15/16CDRX (4\_2\_1) | 20 | >20 | 95.90% | 35.99% |
| R15/16CDRX (8\_3\_1) | 20 | >20 | 92.82% | 45.07% |

**InH, scene/video/data/voice-stream, 10Mbps, 30ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 70 Power consumption results of scene/video/data/voice (10Mbps) application in FR2 UL InH scenario

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell = N1** | **Average PS gain (%)** |
| vivo | AlwaysOn - baseline | 4 | 8 | 100.00% | - |
| R15/16CDRX (10\_8\_4) | 4 | 8 | 100.00% | 10.24% |
| R15/16CDRX (16\_14\_4) | 4 | 8 | 100.00% | 6.96% |
| eCDRX (16\_8\_4) | 4 | 8 | 100.00% | 38.35% |
| R17 PDCCH skipping | 8 | 8 | 100.00% | 52.35% |
| AlwaysOn - baseline | 8 | 8 | 95.14% | - |
| R15/16CDRX (10\_8\_4) | 8 | 8 | 92.71% | 9.74% |
| R15/16CDRX (16\_14\_4) | 8 | 8 | 94.10% | 6.58% |
| eCDRX (16\_8\_4) | 8 | 8 | 92.36% | 36.79% |
| R17 PDCCH skipping | 8 | 8 | 93.06% | 51.32% |

* + - 1. DU Scenario

**DU, pose/control-stream, 0.2Mbps, 10ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 71 Power consumption results of pose/control (0.2Mbps) application in FR2 UL Dense Urban scenario

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell = N1** | **Average PS gain (%)** |
| vivo | AlwaysOn - baseline | 20 | >20 | 96.51% | - |
| R15/16CDRX (4\_2\_1) | 20 | >20 | 94.13% | 35.29% |
| R15/16CDRX (8\_3\_1) | 20 | >20 | 92.30% | 42.51% |

**DU, scene/video/data/voice-stream, 10Mbps, 30ms PDB, 100MHz bandwidth, DDDSU TDD format**

Table 72 Power consumption results of scene/video/data/voice (10Mbps) application in FR2 UL Dense Urban scenario

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Source** | **Power Saving scheme** | **avg # UEs/ cell = N1** | **C1=floor(Capacity)** | **% of satisfied UEs when #UEs/cell = N1** | **Average PS gain (%)** |
| vivo | AlwaysOn - baseline | 4 | 8 | 100.00% | - |
| R15/16CDRX (10\_8\_4) | 4 | 8 | 99.60% | 9.36% |
| R15/16CDRX (16\_14\_4) | 4 | 8 | 100.00% | 6.41% |
| eCDRX (16\_8\_4) | 4 | 8 | 99.60% | 32.97% |
| R17 PDCCH skipping | 8 | 8 | 100.00% | 51.43% |
| AlwaysOn - baseline | 8 | 8 | 92.66% | - |
| R15/16CDRX (10\_8\_4) | 8 | 8 | 91.07% | 9.18% |
| R15/16CDRX (16\_14\_4) | 8 | 8 | 91.67% | 6.18% |
| eCDRX (16\_8\_4) | 8 | 8 | 90.67% | 31.72% |
| R17 PDCCH skipping | 8 | 8 | 91.27% | 46.21% |

List of contributions in 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

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 |