**3GPP TSG-RAN WG1 Meeting #122bis**  **R1-2507953**

**Prague, Czech Republic, October 13 – 17, 2025**

**Agenda Item: 11.2**

**Source: Moderator (Huawei)**

**Title: FLS#1 on evaluation assumptions for 6GR air interface**

**Document for: Discussion and Decision**

# Introduction

Evaluation assumptions for 6GR air interface (in AI 11.2 from chair notes)

*Discussions on models, scenarios, parameters, and methodology, metrics/criteria, as well as traffic model that can be commonly used for evaluating technology proposals.*

[122bis-R20-6GR-Evaluation] Email discussion on Rel-20 6GR-Evaluation – Jinhuan (Huawei)

* To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, tdoc number of the moderator summary for online session, etc

As confirmed in the last RAN1 meeting, this agenda will continue discussing:

* The common evaluation assumptions including antenna modelling and system-level simulation assumptions for each TN scenario taking the collected companies views via post-122 email discussion as baseline.
* Traffic models;
* Link budget;

These issues will be discussed in each of subsequent sections. In addition, as agreed in the last meeting as well that the common evaluations assumptions for NTN will be separately provided and additional assumptions for TN can also be discussed in this agenda if any are identified. Based on a lot of inputs on NTN for this meeting, the discussions will be organized in another separate section in this summary, which will mainly start from the carrier frequency and a blank template preparation first.

Nevertheless, companies in their contributions additionally discussed the assumptions for other topics, e.g., power model for energy efficiency, performance metrics for different topics, MIMO specific assumptions, etc. The reasons why those proposals will have to be discussed in this agenda were not explained in the contributions nor clear to moderator per the moderator’s assessment. In any case, one section for identifying potential other common assumptions was created, so companies can share views/suggestions there if any.

Kinder Note for the discussions in this summary:

* Different rounds with proposals with label [FL1, FL2, …] of discussion may be created in this summary for proposal update based on the online/offline progress. It’s companies’ discretion to provide your comments to either round but just being reminded that the discussion is supposed to carry on the proposal in the latest round in principle.
* Please use the following convention for uploading your comments:
  + Filename\_v001\_Moderator
  + Filename\_v002\_Moderator\_CompanyA
  + Filename\_v003\_CompanyA\_CompanyB
  + Filename\_v004\_CompanyB\_CompanyC
  + Etc

# Antenna modeling for TN

## Collected views from RAN1#122

Companies’ views collected over post-122 email discussion are summarized in R1-2507292.

### Discussion

*Summary on the views:*

#### Around 700MHz

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| **TXRU mapping** | **Mentioned by** |
| Option 1, a single TXRU is mapped per panel per subarray per polarization, Per panel reuse models in TR 36.897 | Huawei, vivo, OPPO, CATT, Ericsson, ZTE, Qualcomm, CMCC, DCM, Xiaomi, Samsung, Sony, Intel, Ofinno, Nokia, Futurewei, AT&T, MTK |
| Option 2, Fully connected TXRU mapping within a panel per polarization | Huawei, vivo, OPPO, Ericsson, ZTE, CMCC, DCM, Samsung, Sony, Ofinno, Nokia, Futurewei, AT&T |
| Option 3, single TXRU is mapped per panel per polarization | DCM |

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| **Antenna configuration** | | **Mentioned by** |
| Number of antenna elements | 4 | Samsung |
| 8 | Samsung |
| 16 | Interdigital |
| 24 | Futurewei |
| 32 | Huawei, OPPO, CATT, Ericsson, ZTE, Nokia, AT&T |
| 64 | Huawei, CATT, vivo, Interdigital, Qualcomm, CMCC, DCM, MTK, Sony, Intel, Ofinno, Futurewei |
| Maximum antenna ports | 4 | Ericsson, Interdigital, Qualcomm, Futurewei |
| 8 | OPPO, CMCC |
| 16 | Huawei, vivo, OPPO, CATT, Interdigital, DCM, vivo, Sony, Intel, Ofinno, Nokia, Futurewei |
| 32 | ZTE |
| 64 | vivo |

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| **700 MHz BS Antenna configuration** | | **Mentioned by** |
| elements, ports |  |  |
| 4, 4 | (M, N, P, Mg, Ng; Mp, Np) = (2, 2, 2, 1, 1, 2, 2); (dH, dV)=(0.5, 0.8)λ | Samsung |
| 8, 8 | (M, N, P, Mg, Ng; Mp, Np) = (1, 2, 2, 1, 1, 1, 2), (dH, dV)=(0.5, 0.8)λ | Samsung |
| 16, 2 | (M, N, P, Mg, Ng; Mp, Np) = (4, 2, 2, 1, 1, 1, 1), (dH, dV)=(0.5, 0.8)λ | Qualcomm |
| 16, 4 | (M, N, P, Mg, Ng;Mp, Np) = (4, 2, 2, 1, 1;1, 2), (dH, dV)=(0.5, 0.8)λ | Interdigital, ZTE, Qualcomm |
| 16, 8 | (M, N, P, Mg, Ng, Mp, Np) = (4, 2, 2, 1, 1, 2, 2), (dH, dV)=(0.5, 0.5)λ | ZTE |
| 16, 8 | (M, N, P, Mg, Ng, Mp, Np) = (4, 2, 2, 1, 1, 2, 2), (dH, dV)=(0.5, 0.8)λ | ZTE |
| 24, 4 | (M, N, P, Mg, Ng; Mp, Np) = (6, 2, 2, 1, 1, 1, 2) | Futurewei |
| 32, 4 | (M, N, P, Mg, Ng;Mp, Np) = (8, 2, 2, 1, 1, 1, 2), (dH, dV)=(0.5, 0.5)λ | AT&T |
| 32, 4 | (M, N, P, Mg, Ng;Mp, Np) = (8, 2, 2, 1, 1, 1, 2), (dH, dV)=(0.5, 0.8)λ | AT&T |
| 32, 4 | (M, N, P, Mg, Ng;Mp, Np) = (8, 2, 2, 1, 1, 1, 2), (dH, dV)=(2.0 0.8)λ | Ericsson |
| 32, 8 | (M, N, P, Mg, Ng; Mp, Np)= (8, 2, 2, 1, 2, 2), (dH, dV) = (0.5, 0.8)λ | OPPO |
| 32, 16 | (M, N, P, Mg, Ng; Mp, Np)= (4, 4, 2, 1, 2, 4), (dH, dV) = (0.5, 0.8)λ | OPPO |
| 32, 16 | (M, N, P, Mg, Ng;Mp, Np) = (8, 2, 2, 1, 1, 4, 2), (dH, dV)=(0.5, 0.8)λ | Huawei, ZTE, Nokia |
| 32, 16 | (M, N, P, Mg, Ng;Mp, Np) = (8, 2, 2, 1, 1, 4, 2), (dH, dV)=(0.5, 0.5)λ | Huawei, ZTE |
| 32, 32 | (M, N, P, Mg, Ng, Mp, Np) = (8, 2, 2, 1, 1, 8, 2), (dH, dV)=(0.5, 0.5)λ | ZTE |
| 32, 32 | (M, N, P, Mg, Ng, Mp, Np) = (8, 2, 2, 1, 1, 8, 2), (dH, dV)=(0.5, 0.8)λ | ZTE |
| 64, nan | (M, N, P, Mg, Ng) = (8, 4, 2, 1, 1), (dH, dV) = (0.5, 0.5)λ | DCM |
| 64, 8 | (M, N, P, Mg, Ng;Mp, Np) = (8, 4, 2, 1, 1;1, 4), (dH, dV)=(0.5, 0.8)λ | CMCC |
| 64, 16 | (M, N, P, Mg, Ng;Mp, Np) = (8, 4, 2, 1, 1, 2, 4), (dH, dV)=(0.5, 0.5)λ | Huawei, DCM, Futurewei |
| 64, 16 | (M, N, P, Mg, Ng;Mp, Np) = (8, 4, 2, 1, 1, 2, 4), (dH, dV)=(0.5, 0.8)λ | Huawei, vivo, CATT, Interdigital, Sony, Intel, Ofinno. Futurewei |

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| **700 MHz BS Antenna configuration** | | **Mentioned by** |
| BS Polarized antenna modelling e.g., models in section 7.3.2 in TR38.901 | model1 901 | Huawei, ZTE, Ericsson, Qualcomm, CMCC |
| model2 901 | Huawei, vivo, OPPO, CATT, Ericsson, Interdigital, ZTE, Qualcomm |
| BS antenna element gain pattern | According to Table 7.3-1 in TR 38.901 | vivo, OPPO, CATT, Interdigital, ZTE, Qualcomm, CMCC, DCM, MTK, Intel Ofinno, Nokia, AT&T |

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| **700 MHz UT Antenna configuration** | | **Mentioned by** |
| Elements/ports | 2 | Intel, Nokia |
| 4 | Huawei, DCM, CATT, ZTE, Ofinno, Futurewei |
| General | 1T2R | OPPO, Interdigital, Spreadtrum |
| 2T2R | Interdigital |
| Handheld | 1Tx/2Rx | vivo, Ericsson, Qualcomm, Xiaomi |
| 1Tx/4Rx | Qualcomm |
| 2Tx/2Rx | Sony |
| low-end IoT UE/MTC | 1Tx/1Rx | Qualcomm, Xiaomi, Sony |
| 1Tx/2Rx | vivo |
| CPE/FMA | 1Tx/2Rx | Ericsson |
| 4Tx/4Rx | Sony |
| 4Tx/8Rx | vivo |
| 8Tx/8Rx | vivo, Qualcomm |
| Alt1 traditional model | (M, N, P, Mg, Ng; Mp, Np) = (1, 2, 2, 1, 1, 1, 2),  (dH, dV)=(0.5, 0.5)λ | Huawei, DCM, CATT, ZTE, CMCC, Futurewei, AT&T (handheld), Xiaomi (IoT) |
| (M, N, P, Mg, Ng; Mp, Np) = (1, 1, 1, 1, 1, 1, 1), (dH, dV)=(0.5, 0.5)λ | Spreadtrum, Sony (IoT) |
| (M, N, P, Mg, Ng; Mp, Np) = (1, 1, 2, 1, 1, 1, 1) | Samsung, AT&T (handheld) |
| (1, 2, 1, 1, 1, 1, 2), (dH, dV)=(0.5, 0.5)λ | Spreadtrum, vivo, OPPO, Futurewei |
| (M, N, P, Mg, Ng; Mp, Np) = (1, 2, 2, 1, 1, 1, 2), (dH, dV)=(0.5, 0.5)λ | Sony (CPE), Ofinno |
| Alt2 handheld model | (1, 3) | Sony (Smartphone/XR) |
| Two elements of (1, 3, 5, 7) | Intel |
| (1, 3, 5, 7) | Huawei, DCM, CATT, Futurewei |
| (2, 6) | Interdigital, Nokia |
| Also Support | Xiaomi (handheld, CPE/FMA), Samsung |

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| **700 MHz UT Antenna configuration** | | **Mentioned by** |
| UE Polarized antenna modelling,  e.g., models in section 7.3.2 in TR38.901 | Option 1, model-1 in section 7.3.2 in TR38.901 | CATT, ZTE, CMCC, DCM, Futurewei, Ofinno |
| Option 2, model-2 in section 7.3.2 in TR38.901 | vivo, OPPO, CATT, ZTE, DCM, MTK, Futurewei, Ofinno, Sony |
| Option 3, handheld UT model in section 7.3.2 in TR38.901 | CATT, DCM, Intel, Ofinno, Futurewei |
| UE antenna element gain pattern | Alt1: Omnidirectional | vivo, CATT, MTK |
| Alt2: According to Table 7.3-2 in TR 38.901 (radiation power pattern for handheld UT) | OPPO, CATT, Interdigital, ZTE, Qualcomm, DCM, Intel, Ofinno, Nokia, AT&T |

#### Around 2GHz

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| **2GHz TXRU mapping** | **Mentioned by** | |
| Indoor | outdoor |
| Option 1, a single TXRU is mapped per panel per subarray per polarization, Per panel reuse models in TR 36.897 | Huawei, vivo, OPPO, Ericsson, ZTE, Qualcomm, CMCC, DCM, Xiaomi, Sony, Intel, Ofinno, Nokia, Futurewei, AT&T | Huawei, vivo, OPPO, Ericsson, ZTE, Qualcomm, CMCC, DCM, Xiaomi, Samsung, Sony, Intel, Ofinno, Nokia, Futurewei, AT&T |
| Option 2, Fully connected TXRU mapping within a panel per polarization | Huawei, vivo, OPPO, Ericsson, ZTE, CMCC, DCM, Sony, Ofinno, Nokia, Futurewei, AT&T | Huawei, vivo, OPPO, Ericsson, ZTE, CMCC, DCM, Samsung, Sony, Ofinno, Nokia, Futurewei, AT&T |
| Option 3, Single TXRU is mapped per panel per polarization | DCM | DCM |

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| **2GHz BS Antenna configuration** | | **Mentioned by** | |
| Indoor | outdoor |
| Number of antenna elements | 4 | Sony |  |
| 16 | Xiaomi |  |
| 32 | ZTE, CMCC, DCM |  |
| 64 |  | Interdigital, CMCC, Xiaomi |
| 128 | Huawei, OPPO, vivo, Intel, Ofinno Nokia, Futurewei | Huawei, OPPO, Interdigital, DCM, Intel, Ofinno, Nokia |
| 192 | Huawei | Huawei, Samsung, Futurewei |
| 256 | Qualcomm | vivo, Qualcomm, Sony |
| 288 |  | ZTE |
| Maximum antenna ports | 4 | DCM, Sony |  |
| 16 | Qualcomm | Interdigital, Qualcomm |
| 32 | OPPO, ZTE, Ofinno, Nokia | OPPO, DCM, Intel, Ofinno, Nokia |
| 64 | vivo, Intel, Futurewei | Huawei, vivo, Interdigital, Samsung, Sony, Futurewei |
| 96 |  | ZTE |

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| **2GHz BS Antenna configuration** | | **Mentioned by** | |
| elements, ports |  | Indoor | outdoor |
| 4, 4 | (M, N, P, Mg, Ng, Mp, Np) = (2, 1, 2, 1, 1, 2, 1) (dH, dV) = (0.5, 0.5)λ | Sony |  |
| 32, 8 | (M, N, P, Mg, Ng, Mp, Np) = (4, 4, 2, 1, 1, 1, 4), (dH, dV) = (0.5, 0.8)λ |  | ZTE, Samsung |
| 32, 8 | (M, N, P, Mg, Ng, Mp, Np) = (4, 4, 2, 1, 1, 1, 4), (dH, dV) = (0.5, 0.5)λ | DCM |  |
| 32, 16 | (M, N, P, Mg, Ng; Mp, Np)= (4, 4, 2, 1, 2, 4), (dH, dV) = (0.5, 0.5)λ | Ericsson |  |
| 32, 16 | (M, N, P, Mg, Ng; Mp, Np)= (4, 4, 2, 1, 2, 4), (dH, dV) = (0.5, 0.8)λ |  | Samsung |
| 32, 16 | (M, N, P, Mg, Ng, Mp, Np) = (4, 4, 2, 1, 1, 2, 4), (dH, dV) = (0.5, 0.5)λ | Ericsson |  |
| 32, 32 | (M, N, P, Mg, Ng, Mp, Np) = (4, 4, 2, 1, 1, 4, 4), (dH, dV) = (0.5, 0.5)λ | CMCC, Xiaomi, ZTE |  |
| 64, 4 | (M, N, P, Mg, Ng; Mp, Np) = (8, 4, 2, 1, 1, 1, 2), (0.5, 0.5)λ | Qualcomm |  |
| 64, 8 | (M, N, P, Mg, Ng;Mp, Np) = (8, 4, 2, 1, 1;1, 4), (dH, dV)=(0.5, 0.5)λ | Qualcomm |  |
| 64, 16 | (M, N, P, Mg, Ng;Mp, Np) = (8, 4, 2, 1, 1, 2, 4), (dH, dV)=(0.5, 0.8)λ |  | ZTE, Qualcomm, Interdigital |
| 64, 32 | (M, N, P, Mg, Ng;Mp, Np) = (8, 4, 2, 1, 1, 4, 4) |  | Ericsson, Futurewei |
| 128, 32 | (M, N, P, Mg, Ng; Mp, Np) = (16, 4, 2, 1, 1, 4, 4), (dH, dV) = (0.5, 0.5)λ |  | Huawei |
| 128, 32 | (M, N, P, Mg, Ng; Mp, Np) = (16, 4, 2, 1, 1, 4, 4), (dH, dV) = (0.5, 0.8)λ |  | Huawei, ZTE |
| 128, 32 | (M, N, P, Mg, Ng; Mp, Np) = (8, 8, 2, 1, 1, 4, 4) | Futurewei |  |
| 128, 32 | (M, N, P, Mg, Ng, Mp, Np) = (8, 8, 2, 1, 1, 2, 8), (dH, dV) = (0.5, 0.5)λ | Nokia |  |
| 128, 32 | (M, N, P, Mg, Ng, Mp, Np) = (8, 8, 2, 1, 1, 2, 8), (dH, dV) = (0.5, 0.8)λ | OPPO, Ofinno | OPPO, CMCC, DCM, Samsung, Ofinno, Nokia |
| 128, 64 | (M, N, P, Mg, Ng, Mp, Np) = (8, 8, 2, 1, 1, 4, 8), (dH, dV) = (0.5, 0.5)λ | vivo, Intel |  |
| 128, 64 | (M, N, P, Mg, Ng, Mp, Np) = (4, 16, 2, 1, 1, 2, 16), (dH, dV) = (0.5, 0.8)λ |  | Samsung |
| 128, 64 | (M, N, P, Mg, Ng; Mp, Np) = (8, 8, 2, 1, 1;4, 8), (dH, dV)=(0.5, 0.8)λ |  | Interdigital |
| 128, 64 | (M, N, P, Mg, Ng; Mp, Np) = (8, 8, 2, 1, 1;8, 4), (dH, dV)=(0.5, 0.8)λ |  | Samsung |
| 128, 128 | (M, N, P, Mg, Ng, Mp, Np) = (8, 8, 2, 1, 1, 8, 8), (dH, dV) = (0.5, 0.8)λ |  | Xiaomi |
| 192, 64 | (M, N, P, Mg, Ng, Mp, Np) = (12, 8, 2, 1, 1, 4, 8), (dH, dV) = (0.5, 0.8)λ |  | Huawei, CMCC, Samsung, Futurewei |
| 256, 32 | (M, N, P, Mg, Ng; Mp, Np) = (16, 8, 2, 1, 1;2, 8), (dH, dV)=(0.5, 0.8)λ |  | CMCC, Sony |
| 256, 64 | (M, N, P, Mg, Ng;Mp, Np) = (16, 8, 2, 1, 1;4, 8), (dH, dV) = (0.5, 0.8)λ |  | vivo, ZTE, CMCC, Intel |
| 288, 96 | (M, N, P, Mg, Ng, Mp, Np) = (24, 6, 2, 1, 1, 8, 6), (dH, dV) = (0.5, 0.8)λ |  | ZTE |

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| **2GHz UT Antenna configuration** | | **Mentioned by** |
| Elements/ports | 4 | Huawei, ZTE, DCM, Intel, Ofinno Futurewei |
| General | 1T2R | Spreadtrum |
| 2T2R | OPPO |
| 2T4R | OPPO, Interdigital |
| Handheld | 1Tx/2Rx | Xiaomi, Samsung, vivo |
| 2Tx/2Rx | Sony |
| 2Tx/4Rx | Qualcomm, Nokia |
| 4Tx/4Rx | Ericsson |
| low-end IoT UE/MTC | 1Tx/1Rx | Ericsson, Qualcomm, Xiaomi, Sony |
| 1Tx/2Rx | Qualcomm |
| CPE/FMA | 4Tx/8Rx | Nokia |
| 8Tx/8Rx | Qualcomm, Ericsson (non-handheld/non-EMBB) |
| Alt1 traditional model | (M, N, P, Mg, Ng; Mp, Np) = (1, 2, 2, 1, 1, 1, 2),  (dH, dV)=(0.5, 0.5)λ | Huawei, ZTE, CMCC, DCM, Ofinno, Futurewei, Xiaomi (IoT), Sony (FWA/CPE), Nokia (FWA/CPE), |
| 1T(1, 1, 1, 1, 1;1, 1) 2R(1, 2, 1, 1, 1;1, 1, 2) | Spreadtrum |
| 2Tx:  (M, N, P, Mg, Ng; Mp, Np) = (1, 2, 1, 1, 1, 1, 2), (dH, dV) = (0.5, 0.5)λ  4Rx:  (M, N, P, Mg, Ng; Mp, Np) = (2, 2, 1, 1, 1, 2, 2), (dH, dV) = (0.5, 0.5)λ | vivo, OPPO |
| (M, N, P, Mg, Ng; Mp, Np) = (1, 1, 1, 1, 1, 1, 1), (dH, dV)=(0.5, 0.5)λ | Sony (IoT) |
| (M, N, P, Mg, Ng; Mp, Np) = (1, 1, 2, 1, 1, 1, 1), (dH, dV)=(0.5, 0.5)λ | Samsung |
| (M, N, P, Mg, Ng, Mp, Np) = (2, 2, 2, 1, 1, 2, 2).(dH, dV) = (0.5, 0.5)λ | Nokia (FWA/CPE) |
| Alt2 handheld model | Supported by | ZTE, Xiaomi (handheld, CPE/FMA), Nokia(handheld) Sony, Samsung, |
| (1, 3, 5, 7) | Huawei, Interdigital, DCM, Sony (Smartphone/XR), Intel, Futurewei |
| Rx: (1, 3, 5, 7) Tx: (2, 6) | Nokia (handheld) |

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| **2GHz UT Antenna configuration** | | **Mentioned by** |
| UE Polarized antenna modelling,  e.g., models in section 7.3.2 in TR38.901 | Option 1, model-1 in section 7.3.2 in TR38.901 | ZTE, CMCC, DCM, Samsung, Ofinno |
| Option 2, model-2 in section 7.3.2 in TR38.901 | vivo, OPPO, ZTE, DCM, Xiaomi, Samsung, Ofinno |
| Option 3, handheld UT model in section 7.3.2 in TR38.901 | Interdigital, ZTE, DCM, Xiaomi, Samsung, Sony, Ofinno |
| UE antenna element gain pattern | Alt1: Omnidirectional | vivo, ZTE, Samsung, Nokia, Ofinno |
| Alt2: According to Table 7.3-2 in TR 38.901 (radiation power pattern for handheld UT) | OPPO, Interdigital, ZTE, Samsung, Intel, Ofinno (handheld), Nokia |

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| **2GHz BS Antenna configuration** | | **Mentioned by** | |
| Indoor | outdoor |
| BS Polarized antenna modelling e.g., models in section 7.3.2 in TR38.901 | model 1 | CMCC, DCM, Samsung, Ofinno, Nokia, Futurewei, ZTE, Qualcomm, Samsung | Ericsson, ZTE, CMCC, DCM, Samsung, Ofinno, Nokia, Futurewei, ZTE, Qualcomm, Samsung |
| model 2 | vivo, OPPO, ZTE, Xiaomi, DCM, Samsung, Sony, intel, Ofinno, Nokia, Futurewei, ZTE, Qualcomm, Samsung | Vivo, OPPO, interdigital, ZTE, Xiaomi, DCM, Samsung, Sony, intel, Ofinno, Nokia, Futurewei, ZTE, Qualcomm, Samsung |
| BS antenna element gain pattern | Table 7.3-1 in TR 38.901 |  | vivo, OPPO, Interdigital, ZTE, Qualcomm, CMCC, DCM, Samsung, Sony, Intel, Ofinno, Nokia, ATT |
| Table A.2.1-7 in TR 38.802 | vivo, Intel |  |

#### Around 4GHz

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| **4GHz TXRU mapping** | **Mentioned by** | |
| Indoor | outdoor |
| Option 1, a single TXRU is mapped per panel per subarray per polarization, Per panel reuse models in TR 36.897 | Huawei, vivo, OPPO, CATT, Ericsson, ZTE, Qualcomm, CMCC, DCM, Xiaomi, Samsung, Sony, MTK, Intel, Ofinno, Nokia, Futurewei | Huawei, vivo, OPPO, CATT, Ericsson, ZTE, Qualcomm, CMCC, DCM, Xiaomi, Samsung, Sony, MTK, Intel, Ofinno, Nokia, Futurewei, Apple, AT&T, ETRI |
| Option 2, Fully connected TXRU mapping within a panel per polarization | Huawei, vivo, OPPO, Ericsson, ZTE, CMCC, DCM, Samsung, Sony, Ofinno, Nokia | Huawei, vivo, OPPO, Ericsson, ZTE, CMCC, DCM, Samsung, Sony, Ofinno, NOKIA, AT&T, ETRI |
| Option 3, Single TXRU is mapped per panel per polarization |  | DCM |

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| **4GHz BS Antenna configuration** | | **Mentioned by** | |
| Indoor | outdoor |
| Number of antenna elements | 4 | Sony |  |
| 32 | Ericsson, ZTE, DCM, Xiaomi, Nokia |  |
| 64 | Samsung | Interdigital |
| 128 | Intel | Interdigital, DCM, Xiaomi, Samsung |
| 192 |  | Samsung, Nokia, Apple |
| 256 | vivo, OPPO, CATT, Qualcomm, Futurewei | OPPO, CATT, Ericsson, Qualcomm, Intel, ATT, NEC |
| 384 |  | Huawei |
| 512 | Huawei | Huawei, vivo, Sony, Futurewei, ETRI |
| 576 | Huawei, Ofinno | Huawei, ZTE, Ofinno |
| Maximum antenna ports | 4 | DCM, Sony |  |
| 16 | Ericsson | Interdigital |
| 32 | ZTE, Xiaomi, Nokia | DCM, Apple |
| 64 | OPPO, Qualcomm, Samsung, Intel, Futurewei | OPPO, Ericsson, Interdigital, Qualcomm, Intel, Nokia, AT&T |
| 128 | vivo, CATT | Huawei, vivo, CATT, ZTE, Xiaomi, Sony, Futurewei, ETRI, NEC |
| 144 | Ofinno | Huawei, Ofinno |

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| **4GHz BS Antenna configuration** | | **Mentioned by** | |
| Indoor | outdoor |
| 16, 4 | (M, N, P, Mg, Ng;Mp, Np) = (4, 2, 2, 1, 1;1, 2), (dH, dV)=(0.5, 0.5)λ | Sony |  |
| 32, 4 | (M, N, P, Mg, Ng;Mp, Np) = (8, 2, 2, 1, 1, 1, 2), (dH, dV)=(0.5, 0.8)λ | DCM |  |
| 32, 16 | (M, N, P, Mg, Ng, Mp, Np) = (4, 4, 2, 1, 1, 2, 4), (dH, dV) = (0.5, 0.5)λ | Ericsson |  |
| 32, 32 | (M, N, P, Mg, Ng, Mp, Np) = (4, 4, 2, 1, 1, 4, 4), (dH, dV) = (0.5, 0.5)λ | ZTE, CMCC, Xiaomi, Nokia |  |
| 64, 16 | (M, N, P, Mg, Ng;Mp, Np) = (8, 4, 2, 1, 1, 2, 4), (dH, dV)=(0.5, 0.5)λ | Qualcomm, Futurewei |  |
| 64, 16 | (M, N, P, Mg, Ng;Mp, Np) = (8, 4, 2, 1, 1, 2, 4), (dH, dV)=(0.5, 0.8)λ | Futurewei | Interdigital |
| 64, 32 | (M, N, P, Mg, Ng;Mp, Np) = (8, 4, 2, 1, 1, 4, 4), (dH, dV)=(0.5, 0.5)λ | Qualcomm |  |
| 64, 64 | (M, N, P, Mg, Ng;Mp, Np) = (4, 8, 2, 1, 1, 4, 8), (dH, dV)=(0.5, 0.5)λ | Samsung |  |
| 96, 32 | (M, N, P, Mg, Ng, Mp, Np) = (12, 4, 2, 1, 1, 4, 4), (dH, dV) = (0.5, 0.8)λ |  | ZTE |
| 128, 32 | (M, N, P, Mg, Ng, Mp, Np) = (8, 8, 2, 1, 1, 2, 8), (dH, dV) = (0.5, 0.5)λ |  | Futurewei |
| 128, 32 | (M, N, P, Mg, Ng, Mp, Np) = (8, 8, 2, 1, 1, 2, 8), (dH, dV) = (0.5, 0.8)λ |  | CMCC, DCM, Futurewei |
| 128, 64 | (M, N, P, Mg, Ng, Mp, Np) = (8, 8, 2, 1, 1, 4, 8), (dH, dV) = (0.5, 0.5)λ | Intel |  |
| 128, 64 | (M, N, P, Mg, Ng, Mp, Np) = (8, 8, 2, 1, 1, 4, 8), (dH, dV) = (0.5, 0.8)λ |  | Interdigital, Samsung |
| 128, 64 | (M, N, P, Mg, Ng, Mp, Np) = (4, 16, 2, 1, 1, 2, 16), (dH, dV) = (0.5, 0.8)λ |  | Samsung |
| 128, 64 | (M, N, P, Mg, Ng, Mp, Np) = (16, 4, 2, 1, 1, 8, 4), (dH, dV) = (0.5, 0.8)λ |  | Samsung |
| 128, 128 | (M, N, P, Mg, Ng, Mp, Np) = (8, 8, 2, 1, 1, 8, 8), (dH, dV) = (0.5, 0.8)λ |  | Xiaomi |
| 192, 32 | (M, N, P, Mg, Ng, Mp, Np) = (12, 8, 2, 1, 1, 2, 8), (dH, dV) = (0.5, 0.8)λ |  | Apple |
| 192, 64 | (M, N, P, Mg, Ng, Mp, Np) = (12, 8, 2, 1, 1, 4, 8), (dH, dV) = (0.5, 0.8)λ |  | ZTE, Qualcomm, CMCC, Samsung, Nokia |
| 256, 32 | (M, N, P, Mg, Ng; Mp, Np) = (16, 8, 2, 1, 1;2, 8), (dH, dV)=(0.5, 0.8)λ |  | CMCC |
| 256, 64 | (M, N, P, Mg, Ng;Mp, Np) = (16, 8, 2, 1, 1;4, 8), (dH, dV) = (0.5, 0.5)λ | Futurewei | ATT |
| 256, 64 | (M, N, P, Mg, Ng;Mp, Np) = (16, 8, 2, 1, 1;4, 8), (dH, dV) = (0.5, 0.8)λ | OPPO, Futurewei | OPPO, Ericsson, CMCC, Intel, ATT |
| 256, 128 | (M, N, P, Mg, Ng;Mp, Np) = (16, 8, 2, 1, 1;8, 8), (dH, dV) = (0.5, 0.5)λ | vivo, CATT | CATT |
| 256, 128 | (M, N, P, Mg, Ng;Mp, Np) = (16, 8, 2, 1, 1;8, 8), (dH, dV) = (0.5, 0.8)λ | CATT | CATT |
| 384, 128 | (M, N, P, Mg, Ng;Mp, Np) = (24, 8, 2, 1, 1, 8, 8), (dH, dV) = (0.5, 0.8)λ |  | ZTE, Huawei |
| 384, 128 | (M, N, P, Mg, Ng;Mp, Np) = (24, 8, 2, 1, 1, 8, 8), (dH, dV) = (0.5, 0.5)λ |  | Huawei |
| 512, 128 | (M, N, P, Mg, Ng, Mp, Np) = (16, 16, 2, 1, 1, 4, 16), (dH, dV) = (0.5, 0.5)λ |  | Futurewei |
| 512, 128 | (M, N, P, Mg, Ng;Mp, Np) = (16, 16, 2, 1, 1;4, 16), (dH, dV) = (0.5, 0.8)λ |  | vivo, Sony, ETRI, Futurewei |

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| **4GHz UT Antenna configuration** | | **Mentioned by** |
| Elements/ports | 4 | ZTE, DCM, Intel, Futurewei |
| 8 | Ofinno, Futurewei |
| General | 2T4R | OPPO, Interdigital, MTK, Apple, ETRI |
| Handheld | 1TR | Qualcomm, Xiaomi |
| 1Tx/2Rx | Qualcomm, Xiaomi |
| 1T4R | Samsung |
| 2T8R | Qualcomm |
| 4Tx/4Rx | Ericsson |
| low-end IoT UE/MTC | 1Tx/1Rx | Sony, Ericsson |
| 1Tx/2Rx | vivo |
| CPE/FMA | 8Tx/8Rx | Ericsson, Qualcomm, Nokia |
| 8Tx/16Rx | Ericsson, Qualcomm, Nokia |
| Alt1 traditional model | (M, N, P, Mg, Ng; Mp, Np) = (1, 2, 2, 1, 1, 1, 2), (dH, dV)=(0.5, 0.5)λ | CATT, ZTE, CMCC, Samsung, Futurewei, ETRI, Sony (FWA/CPE), |
| 2Tx: (M, N, P, Mg, Ng; Mp, Np) = (1, 2, 1, 1, 1, 1, 2), (dH, dV) = (0.5, 0.5)λ 4Rx: (M, N, P, Mg, Ng; Mp, Np) = (2, 2, 1, 1, 1, 2, 2), (dH, dV) = (0.5, 0.5)λ | vivo, OPPO |
| (M, N, P, Mg, Ng; Mp, Np) = (1, 1, 1, 1, 1, 1, 1), (dH, dV)=(0.5, 0.5)λ | Sony (IOT) |
| (M, N, P, Mg, Ng; Mp, Np) = (2, 2, 1, 1, 1, 2, 2), (dH, dV) = (0.5, 0.5)λ | ETRI |
| (M, N, P, Mg, Ng; Mp, Np) = (1, 4, 2, 1, 1, 1, 4), (dH, dV)=(0.5, 0.5)λ | Futurewei |
| (M, N, P, Mg, Ng; Mp, Np) = (1, 4, 2, 1, 1, 4, 2), (dH, dV)=(0.5, 0.5)λ | CATT |
| (M, N, P, Mg, Ng, Mp, Np) = (2, 2, 2, 1, 1, 2, 2).(dH, dV) = (0.5, 0.5)λ | Huawei, Ofinno, Nokia (FWA/CPE), Futurewei |
| (M, N, P, Mg, Ng; Mp, Np) = (1, 2, 2, 1, 2, 1, 2), (dH, dV)=(0.5, 0.5)λ | DCM, Sony (FWA/CPE), Nokia (FWA/CPE) |
| Also supported by | Xiaomi (IOT) |
| Alt2 handheld model | Support | ZTE, Xiaomi (handheld, CPE/FMA) |
| (1, 3, 5, 7) | CATT, Interdigital, DCM, Sony (Smartphone/XR), Intel, Futurewei |
| (1-8) | Huawei, Nokia (FWA/CPE) |
| Rx: (1, 3, 5, 7) Tx: (2, 6) | Nokia (handheld) |

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| **4GHz UT Antenna configuration** | | **Mentioned by** |
| UE Polarized antenna modelling,  e.g., models in section 7.3.2 in TR38.901 | Option 1, model-1 in section 7.3.2 in TR38.901 | CATT, ZTE, Qualcomm, CMCC, Samsung, DCM, Ofinno, Nokia, Futurewei |
| Option 2, model-2 in section 7.3.2 in TR38.901 | vivo, OPPO, CATT, ZTE, Qualcomm, DCM, Xiaomi, Samsung, MTK, Sony, Ofinno, Futurewei, Apple, ETRI |
| Option 3, handheld UT model in section 7.3.2 in TR38.901 | CATT, Interdigital, ZTE, Qualcomm, DCM, Xiaomi, Samsung, Sony, Intel, Ofinno, NOKIA, Futurewei |
| UE antenna element gain pattern | Alt1: Omnidirectional | Huawei, vivo, CATT, ZTE, Samsung, MTK, Sony, Nokia, Futurewei |
| Alt2: According to Table 7.3-2 in TR 38.901 (radiation power pattern for handheld UT) | Huawei, OPPO, CATT, Interdigital, ZTE, Qualcomm, DCM, Xiaomi, Samsung, Intel, Ofinno, Nokia, Futurewei, ETRI |

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| **4GHz BS Antenna configuration** | | **Mentioned by** | |
| Indoor | Indoor |
| BS Polarized antenna modelling e.g., models in section 7.3.2 in TR38.901 | model1 | ZTE, CMCC, Samsung, Ofinno, Nokia, Futurewei | Huawei, ZTE, CMCC, Samsung, Ofinno, NOKIA, Futurewei |
| model2 | vivo, OPPO, CATT, ZTE, Xiaomi, Samsung, MTK, Sony, Intel, Ofinno, Futurewei | Huawei, vivo, OPPO, CATT, Interdigital, ZTE, Xiaomi, Samsung, MTK, Sony, Intel, Ofinno, Futurewei, Apple, ETRI |
| BS antenna element gain pattern | According to Table 7.3-1 in TR 38.901 | CATT, Interdigital, ZTE, Qualcomm, CMCC, DCM, Xiaomi, MTK, Sony, Ofinno, Nokia, Futurewei | HW, vivo, OPPO, CATT, Interdigital, ZTE, Qualcomm, CMCC, DCM, Xiaomi, Samsung, MTK, Sony, Intel, Ofinno, Nokia, Futurewei, Apple, ETRI |
| Table A.2.1-7 in TR 38.80 | vivo, Intel |  |
| 5dBi | Samsung |  |

#### Around 7GHz

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| **7GHz TXRU mapping** | **Mentioned by** | |
| **Indoor** | **outdoor** |
| Option 1, a single TXRU is mapped per panel per subarray per polarization, Per panel reuse models in TR 36.897 | Huawei, vivo, OPPO, CATT, Ericsson, ZTE, Qualcomm, CMCC, DCM, Xiaomi, Samsung, MTK, Sony, Intel, Ofinno, Nokia, Futurewei | Huawei, vivo, OPPO, CATT, Ericsson, ZTE, Qualcomm, CMCC, DCM, Xiaomi, Samsung, MTK, Sony, Intel, Ofinno, Nokia, Futurewei, Apple, ETRI |
| Option 2, Fully connected TXRU mapping within a panel per polarization | Huawei, vivo, OPPO, Ericsson, ZTE, CMCC, DCM, Samsung, Sony, Nokia, Futurewei | Huawei, vivo, OPPO, Ericsson, ZTE, CMCC, DCM, Samsung, Sony, Nokia, Futurewei, ETRI |
| Option 3, Single TXRU is mapped per panel per polarization | DCM | DCM |

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| **7GHz BS Antenna configuration** | | **Mentioned by** | |
| **Indoor** | **outdoor** |
| Number of antenna elements | 64 | Ericsson, ZTE, DCM, Sony |  |
| 96 |  | ZTE |
| 128 | Nokia, DCM, Samsung | Interdigital |
| 256 | Samsung, Intel | Ericsson |
| 512 | Futurewei, vivo, OPPO | OPPO, Ericsson, DCM, Intel |
| 768 |  | Apple, Nokia |
| 960 |  | ZTE, CMCC |
| 1024 | NEC, CATT, Qualcomm | NEC, ETRI, CATT, Ericsson, Interdigital, ZTE, Qualcomm, Samsung, Intel |
| 1536 | Huawei | Huawei |
| 2048 | Huawei, Xiaomi | Huawei, Futurewei, vivo, ZTE, Xiaomi, MTK, Sony |
| 2304 | Huawei, Xiaomi, Ofinno | Huawei, Xiaomi, Ofinno |
| Maximum antenna ports | 4 | Sony |  |
| 32 | Ericsson, ZTE, DCM | ZTE |
| 64 | Intel | Ericsson, Interdigital |
| 128 | Futurewei, Nokia, OPPO, Samsung | OPPO, CATT, Ericsson, ZTE, DCM, Samsung, Intel |
| 256 | NEC, Qualcomm, Samsung | NEC, ETRI, Apple, Futurewei, Nokia, Huawei, Ericsson, Interdigital, Qualcomm, CMCC, Samsung, Intel |
| 384 |  | ZTE |
| 512 | vivo, Xiaomi | Huawei, vivo, ZTE, Xiaomi, Sony |
| 576 |  | Huawei |
| 2304 | Ofinno | Ofinno |

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| **7GHz BS Antenna configuration** | | **Mentioned by** | |
| Indoor | outdoor |
| 32, 32 | (M, N, P, Mg, Ng, Mp, Np) = (4, 4, 2, 1, 1, 4, 4), (dH, dV) = (0.5, 0.5)λ | ZTE |  |
| 32, 32 | (M, N, P, Mg, Ng; Mp, Np) = (8, 8, 2, 1, 1;2, 8), (dH, dV)=(0.5, 0.8)λ |  | CMCC |
| 64, 2 | (M, N, P, Mg, Ng;Mp, Np) = (8, 4, 2, 1, 1, 2, 1), (dH, dV)=(0.5, 0.5)λ | Sony |  |
| 64, 32 | (M, N, P Mg, Ng, Mp, Np) = (4, 8, 2, 1, 1, 2, 8), (dH, dV) = (0.5, 0.5)λ | Ericsson |  |
| 96, 32 | (M, N, P, Mg, Ng, Mp, Np) = (12, 4, 2, 1, 1, 4, 4), (dH, dV) = (0.5, 0.8)λ |  | ZTE |
| 128, 32 | (M, N, P, Mg, Ng, Mp, Np) = (8, 8, 2, 1, 1, 2, 8), (dH, dV) = (0.5, 0.5)λ |  | DCM |
| 128, 64 | (M, N, P, Mg, Ng; Mp, Np) = (8, 8, 2, 1, 1;4, 8), (dH, dV)=(0.5, 0.8)λ |  | Interdigital |
| 128, 128 | (M, N, P, Mg, Ng, Mp, Np) = (8, 8, 2, 1, 1, 8, 8), (dH, dV) = (0.5, 0.5)λ | Nokia |  |
| 192, 64 | (M, N, P, Mg, Ng, Mp, Np) = (12, 8, 2, 1, 1, 4, 8), (dH, dV) = (0.5, 0.8)λ |  | CMCC |
| 256, 16 | (M, N, P, Mg, Ng; Mp, Np) = (16, 8, 2, 1, 1, 1, 8), (dH, dV) = (0.5, 0.5)λ | Qualcomm |  |
| 256, 32 | (M, N, P, Mg, Ng; Mp, Np) = (16, 8, 2, 1, 1;2, 8), (dH, dV)=(0.5, 0.8)λ |  | CMCC |
| 256, 32 | (M, N, P, Mg, Ng; Mp, Np) = (8, 16, 2, 1, 1, 1, 16), (dH, dV) = (0.5, 0.5)λ | Qualcomm |  |
| 256, 64 | (M, N, P, Mg, Ng, Mp, Np) = (8, 16, 2, 1, 1, 2, 16), (dH, dV) = (0.5, 0.8 )λ |  | Ericsson |
| 256, 64 | (M, N, P, Mg, Ng;Mp, Np) = (16, 8, 2, 1, 1;4, 8), (dH, dV) = (0.5, 0.5)λ | Intel |  |
| 256, 64 | (M, N, P, Mg, Ng;Mp, Np) = (16, 8, 2, 1, 1;4, 8), (dH, dV) = (0.5, 0.8)λ |  | CMCC |
| 256, 128 | (M, N, P, Mg, Ng; Mp, Np) = (16, 8, 2, 1, 1, 8, 8), (dH, dV) = (0.5, 0.8)λ |  | Qualcomm |
| 384, 128 | (M, N, P, Mg, Ng;Mp, Np) = (12, 16, 2, 1, 1, 4, 16), (dH, dV) = (0.5, 0.8)λ |  | CMCC |
| 512, 128 | (M, N, P, Mg, Ng, Mp, Np) = (16, 16, 2, 1, 1, 4, 16), (dH, dV) = (0.5, 0.5)λ | OPPO | OPPO |
| 512, 128 | (M, N, P, Mg, Ng;Mp, Np) = (16, 16, 2, 1, 1;4, 16), (dH, dV) = (0.5, 0.8)λ |  | DCM, Ericsson, Intel |
| 512, 128 | (M, N, P, Mg, Ng;Mp, Np) = (32, 8, 2, 1, 1, 8, 8), (dH, dV) = (0.5, 0.5)λ | Futurewei |  |
| 512, 128 | (M, N, P, Mg, Ng;Mp, Np) = (32, 8, 2, 1, 1, 8, 8), (dH, dV) = (0.5, 0.8)λ | Futurewei |  |
| 512, 512 | (M, N, P, Mg, Ng) = (16, 16, 2, 1, 1, 16, 16), (dH, dV) = (0.5, 0.5)λ | vivo |  |
| 768, 2 | (M, N, P, Mg, Ng; Mp, Np) = (24, 16, 2, 1, 1; 1, 1), (dH, dV) = (0.5, 0.8)λ |  |  |
| 768, 256 | (M, N, P, Mg, Ng; Mp, Np) = (24, 16, 2, 1, 1, 8, 16), (dH, dV) = (0.5, 0.8)λ |  | Qualcomm, CMCC |
| 768, 256 | (M, N, P, Mg, Ng; Mp, Np) = (8, 6, 16, 2, 1, 8, 16), (dH, dV) = (0.5, 0.8)λ |  | Apple |
| 768, 256 | (M, N, P, Mg, Ng; Mp, Np) = (12, 32, 2, 1, 1, 4, 32), (dH, dV) = (0.5, 0.8)λ |  | Nokia |
| 960, 240 | (M, N, P, Mg, Ng, Mp, Np) = (24, 20, 2, 1, 1, 6, 20), (dH, dV) = (0.5, 0.8)λ |  | ZTE |
| 1024, 64 | (M, N, P, Mg, Ng; Mp, Np) = (32, 16, 2, 1, 1, 4, 8), (0.5, 0.5)λ |  | Futurewei |
| 1024, 64 | (M, N, P, Mg, Ng; Mp, Np) = (32, 16, 2, 1, 1, 4, 8), (0.5, 0.8)λ |  | Futurewei |
| 1024, 128 | (M, N, P, Mg, Ng, Mp, Np) = (32, 16, 2, 1, 1, 4, 16), (dH, dV) = (0.5, 0.5)λ |  | CATT |
| 1024, 128 | (M, N, P, Mg, Ng, Mp, Np) = (32, 16, 2, 1, 1, 4, 16), (dH, dV) = (0.5, 0.8)λ |  | ZTE, CATT |
| 1024, 256 | (M, N, P, Mg, Ng, Mp, Np) = (32, 16, 2, 1, 1, 8, 16), (dH, dV) = (0.5, 0.8 )λ |  | Ericsson, Interdigital, ETRI |
| 1024, 256 | (M, N, P, Mg, Ng; Mp, Np) = (16, 32, 2, 1, 1, 4, 32) (dH, dV)=(0.5, 0.8)λ |  | Intel |
| 1536, 256 | (M, N, P, Mg, Ng; Mp, Np) = (48, 16, 2, 1, 1, 8, 16), (dH, dV)=(0.5, 0.5)λ |  | Huawei |
| 1536, 256 | (M, N, P, Mg, Ng, Mp, Np) = (48, 16, 2, 1, 1, 8, 16), (dH, dV) = (0.5, 0.8)λ |  | ZTE, Huawei |
| 2048, 256 | (M, N, P, Mg, Ng;Mp, Np) = (32, 32, 2, 1, 1, 8, 16), (dH, dV)=(0.5, 0.5)λ |  | Futurewei |
| 2048, 256 | (M, N, P, Mg, Ng, Mp, Np) = (32, 32, 2, 1, 1, 8, 16), (dH, dV) = (0.5, 0.8)λ |  | Futurewei |
| 2048, 512 | (M, N, P, Mg, Ng;Mp, Np) = (64, 16, 2, 1, 1; 16, 16), (dH, dV) = (0.5, 0.5)λ | Xiaomi |  |
| 2048, 512 | (M, N, P, Mg, Ng, Mp, Np) = (64, 16, 2, 1, 1, 16, 16), (dH, dV) = (0.5, 0.8)λ |  | ZTE, Xiaomi, Huawei |
| 2048, 512 | (M, N, P, Mg, Ng; Mp, Np) = (64, 16, 2, 1, 1, 16, 16), (dH, dV)=(0.5, 0.5)λ |  | Huawei |
| 2048, 512 | (M, N, P, Mg, Ng, Mp, Np) = (32, 32, 2, 1, 1, 8, 32), (dH, dV) = (0.5, 0.8)λ |  | vivo, Sony |
| 2048, 512 | (M, N, P, Mg, Ng;Mp, Np) = (32, 32, 2, 1, 1; 8, 32), (dH, dV)=(0.5, 0.5)λ | Xiaomi |  |
| 2304, 384 | (M, N, P, Mg, Ng;Mp, Np) = (48, 24, 2, 1, 1; 8, 24), (dH, dV)=(0.5, 0.5)λ | Xiaomi |  |
| 2304, 384 | (M, N, P, Mg, Ng;Mp, Np) = (48, 24, 2, 1, 1; 8, 24), (dH, dV)=(0.5, 0.8)λ |  | ZTE, Xiaomi |
| 2304, 468 | (M, N, P, Mg, Ng; Mp, Np)=(72, 16, 2, 1, 1, 18, 16);(dH, dV)=(0.5, 0.5)λ | Ofinno | Ofinno, Huawei |
| 2304, 576 | (M, N, P, Mg, Ng; Mp, Np) = (72, 16, 2, 1, 1, 18, 16), (dH, dV)=(0.5, 0.8)λ |  | Huawei |

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| **7GHz UT Antenna configuration** | | **Mentioned by** |
| Elements/ports | 4, 4 | DCM, Intel, Futurewei |
| 8, 8 | ZTE, Ofinno |
| General | 2T4R | OPPO, MTK, Spreadtrum, NEC |
| 4T8R | Interdigital, MTK |
| Handheld | 1T4R | Samsung |
| 2Tx/4Rx | Xiaomi, Sony |
| 4Tx/4Rx | NOKIA |
| 3Tx/6Rx | Xiaomi |
| 4Tx/6Rx | Xiaomi |
| 4Tx/8Rx | Nokia, Ericsson, Qualcomm |
| low-end IoT UE/MTC | 1Tx/1Rx | Sony, Ericsson, Qualcomm |
| 1Tx/2Rx | vivo, Qualcomm |
| CPE/FMA | 8Tx/8Rx | Ericsson, Qualcomm, LGE |
| 8Tx/16Rx | Qualcomm |
| 16T16R | Nokia |
| Alt1 traditional model | (M, N, P, Mg, Ng; Mp, Np) = (1, 2, 2, 1, 1, 1, 2),  (dH, dV)=(0.5, 0.5)λ | ZTE, CMCC, Samsung, Futurewei, CATT, Sony (FWA/CPE), |
| 2Tx: (M, N, P, Mg, Ng; Mp, Np) = (1, 2, 1, 1, 1, 1, 2), (dH, dV) = (0.5, 0.5)λ 4Rx: (M, N, P, Mg, Ng; Mp, Np) = (2, 2, 1, 1, 1, 2, 2), (dH, dV) = (0.5, 0.5)λ | vivo, OPPO, ETRI, Spreadtrum |
| (M, N, P, Mg, Ng; Mp, Np) = (1, 1, 1, 1, 1, 1, 1), (dH, dV)=(0.5, 0.5)λ | Sony (IOT) |
| (M, N, P, Mg, Ng; Mp, Np) = (1, 4, 2, 1, 1, 4, 2), (dH, dV)=(0.5, 0.5)λ | CATT |
| (M, N, P, Mg, Ng, Mp, Np) = (2, 2, 2, 1, 1, 2, 2).(dH, dV) = (0.5, 0.5)λ | ZTE |
| (M, N, P, Mg, Ng; Mp, Np) = (1, 2, 2, 1, 2, 1, 2), (dH, dV)=(0.5, 0.5)λ | CATT |
| (M, N, P, Mg, Ng; Mp, Np) = ((2, 4, 2, 1, 1, 2, 4), (dH, dV)=(0.5, 0.5)λ | Huawei, Ofinno, Futurewei |
| (M, N, P, Mg, Ng, Mp, Np) = (4, 2, 2, 1, 1, 4, 2), (dH, dV) = (0.5, 0.5)λ | Nokia (FWA/CPE) |
| Alt2 handheld model | Support | Qualcomm, Xiaomi (handheld), NEC |
| (1, 3) | Huawei |
| (1, 3, 5, 7) | DCM, Intel, Sony (Smartphone/XR), Nokia |
| (1-8) | Interdigital |
| Rx: (1-8) Tx: (1, 3, 5, 7) | Nokia (handheld) |

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| **7GHz UT Antenna configuration** | | **Mentioned by** |
| UE Polarized antenna modelling,  e.g., models in section 7.3.2 in TR38.901 | Option 1, model-1 in section 7.3.2 in TR38.901 | Huawei, ZTE, CMCC, DCM, Samsung, Ofinno, Nokia, Futurewei |
| Option 2, model-2 in section 7.3.2 in TR38.901 | Huawei, vivo, OPPO, ZTE, DCM, Xiaomi, Samsung, MTK, Sony, Ofinno, Futurewei, Apple, ETRI |
| Option 3, handheld UT model in section 7.3.2 in TR38.901 | Huawei, Interdigital, ZTE, DCM, Xiaomi, Samsung, Sony, Intel, Ofinno, Nokia, Futurewei |
| UE antenna element gain pattern | Alt1: Omnidirectional | Huawei, vivo, ZTE, Samsung, MTK, Nokia, Futurewei |
| Alt2: According to Table 7.3-2 in TR 38.901 (radiation power pattern for handheld UT) | Huawei, OPPO, Interdigital, ZTE, DCM, Xiaomi, Samsung, Sony, Intel, Ofinno, Nokia, Futurewei, ETRI |

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| **7GHz BS Antenna configuration** | | **Mentioned by** | |
| **Indoor** | **Outdoor** |
| BS Polarized antenna modelling e.g., models in section 7.3.2 in TR38.901 | model1 | Ericsson, ZTE, CMCC, DCM, Samsung, Nokia, Futurewei | Huawei, Ericsson, ZTE, CMCC, DCM, Samsung, Ofinno, Nokia, Futurewei |
| model2 | vivo, OPPO, Ericsson, ZTE, DCM, Xiaomi, Samsung, MTK, Sony, Intel, Futurewei | Huawei, vivo, OPPO, Ericsson, Interdigital, ZTE, DCM, Xiaomi, Samsung, MTK, Sony, Intel, Ofinno, Futurewei, Apple, ETRI |
| BS antenna element gain pattern | Table 7.3-1 in TR 38.901 | OPPO, Ericsson, Interdigital, ZTE, CMCC, DCM, Xiaomi, MTK, Sony, Nokia, Futurewei | Huawei, vivo, OPPO, Ericsson, Interdigital, ZTE, CMCC, DCM, Xiaomi, Samsung, MTK, Sony, Intel, Ofinno, Nokia, Futurewei, Apple, ETRI |
| Table A.2.1-7 in TR 38.802 | vivo, Intel |  |
| 5dBi | Samsung |  |

#### Around 15GHz

|  |  |  |
| --- | --- | --- |
| **15GHz TXRU mapping** | **Mentioned by** | |
| Indoor | outdoor |
| Option 1, a single TXRU is mapped per panel per subarray per polarization, Per panel reuse models in TR 36.897 | Huawei, ZTE, DCM, Samsung, Intel, Nokia, Futurewei | Huawei, ZTE, DCM, Samsung, Intel, Nokia, Futurewei |
| Option 2, Fully connected TXRU mapping within a panel per polarization | ZTE, DCM, Samsung, Nokia | ZTE, DCM, Samsung, Nokia |
| Option 3, Single TXRU is mapped per panel per polarization | DCM | DCM |

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| **15GHz BS Antenna configuration** | | **Mentioned by** | |
| Indoor | outdoor |
| Number of antenna elements | 128 | ZTE, DCM |  |
| 256 | Samsung |  |
| 512 | Nokia | DCM |
| 768 |  | Nokia |
| 1024 | Futurewei |  |
| 2048 |  | Intel |
| 2304 | Huawei | Huawei, ZTE, Futurewei |
| 4096 |  | Samsung |
| Maximum antenna ports | 32 | DCM |  |
| 128 | ZTE, Futurewei | DCM |
| 144 | Samsung, Nokia | Samsung, Nokia, Futurewei |
| 256 |  | ZTE, Intel |
| 512 |  | ZTE, Intel |
| 576 |  | Huawei |

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| --- | --- | --- | --- |
| **15GHz BS Antenna configuration** | | **Mentioned by** | |
| Indoor | outdoor |
| 96, 32 | (M, N, P, Mg, Ng, Mp, Np) = (12, 4, 2, 1, 1, 4, 4), (dH, dV) = (0.5, 0.8)λ |  | ZTE |
| 128, 16 | (M, N, P, Mg, Ng, Mp, Np) = (8, 8, 2, 1, 1, 2, 4), (dH, dV) = (0.5, 0.5)λ | Futurewei |  |
| 128, 16 | (M, N, P, Mg, Ng, Mp, Np) = (8, 8, 2, 1, 1, 2, 4), (dH, dV) = (0.5, 0.8)λ | Futurewei |  |
| 128, 32 | (M, N, P, Mg, Ng, Mp, Np) = (8, 8, 2, 1, 1, 2, 8), (dH, dV) = (0.5, 0.5)λ | DCM |  |
| 128, 128 | (M, N, P, Mg, Ng, Mp, Np) = (8, 8, 2, 1, 1, 8, 8), (dH, dV) = (0.5, 0.5)λ | ZTE |  |
| 256, 256 | (M, N, P, Mg, Ng, Mp, Np) = (8, 16, 2, 1, 1, 8, 16); (dH, dV)=(0.5, 0.5)λ | Samsung |  |
| 512, 128 | (M, N, P, Mg, Ng;Mp, Np) = (16, 16, 2, 1, 1;4, 16), (dH, dV) = (0.5, 0.8)λ |  | DCM |
| 512, 256 | (M, N, P, Mg, Ng, Mp, Np) = (16, 16, 2, 1, 1, 8, 16), (dH, dV) = (0.5, 0.5)λ | Nokia |  |
| 768, 256 | (M, N, P, Mg, Ng; Mp, Np) = (12, 32, 2, 1, 1, 4, 32), (dH, dV) = (0.5, 0.8)λ |  | Nokia |
| 960, 240 | (M, N, P, Mg, Ng, Mp, Np) = (24, 20, 2, 1, 1, 6, 20), (dH, dV) = (0.5, 0.8)λ |  | ZTE |
| 1024, 64 | (M, N, P, Mg, Ng; Mp, Np) = (32, 16, 2, 1, 1, 4, 8), (0.5, 0.5)λ |  | Futurewei |
| 1024, 64 | (M, N, P, Mg, Ng; Mp, Np) = (32, 16, 2, 1, 1, 4, 8), (0.5, 0.8)λ |  | Futurewei |
| 1024, 128 | (M, N, P, Mg, Ng, Mp, Np) = (32, 16, 2, 1, 1, 8, 8), (dH, dV) = (0.5, 0.5)λ | Futurewei |  |
| 1024, 128 | (M, N, P, Mg, Ng, Mp, Np) = (32, 16, 2, 1, 1, 8, 8), (dH, dV) = (0.5, 0.8)λ | Futurewei | ZTE |
| 1536, 256 | (M, N, P, Mg, Ng; Mp, Np) = (48, 16, 2, 1, 1, 8, 16), (dH, dV)=(0.5, 0.5)λ |  | ZTE, Samsung |
| 2048, 64 | (M, N, P, Mg, Ng; Mp, Np) = (32, 32, 2, 1, 1, 4, 8), (dH, dV) = (0.5, 0.5)λ |  | Futurewei |
| 2048, 64 | (M, N, P, Mg, Ng; Mp, Np) = (32, 32, 2, 1, 1, 4, 8), (dH, dV) = (0.5, 0.8)λ |  | Futurewei |
| 2048, 512 | (M, N, P, Mg, Ng;Mp, Np) = (64, 16, 2, 1, 1; 16, 16), (dH, dV) = (0.5, 0.5)λ |  | Huawei |
| 2048, 512 | (M, N, P, Mg, Ng, Mp, Np) = (64, 16, 2, 1, 1, 16, 16), (dH, dV) = (0.5, 0.8)λ |  | ZTE, Intel, Huawei |
| 2304, 384 | (M, N, P, Mg, Ng;Mp, Np) = (48, 24, 2, 1, 1; 8, 24), (dH, dV)=(0.5, 0.8)λ |  | ZTE |
| 2304, 256 | (M, N, P, Mg, Ng; Mp, Np) = (48, 24, 2, 1, 1, 8, 16), (dH, dV) = (0.5, 0.5)λ |  | Futurewei |
| 2304, 256 | (M, N, P, Mg, Ng; Mp, Np) = (48, 24, 2, 1, 1, 8, 16), (dH, dV) = (0.5, 0.8)λ |  | Futurewei |
| 2304, 576 | (M, N, P, Mg, Ng; Mp, Np) = (72, 16, 2, 1, 1, 18, 16), (dH, dV)=(0.5, 0.8)λ |  | Huawei |
| 2304, 576 | (M, N, P, Mg, Ng; Mp, Np) = (72, 16, 2, 1, 1, 18, 16), (dH, dV)=(0.5, 0.5)λ |  | Huawei |

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| **15 GHz UT Antenna configuration** | | **Mentioned by** |
| Elements/ports | 4, 4 | Intel, Futurewei (Typical) |
| 8, 8 | ZTE, DCM |
| 16, 16 | Huawei, Futurewei (Max) |
| General | 4T8R | Spreadtrum |
| Handheld | 1T4R | Samsung |
| 4Tx/4Rx | Nokia |
| 4Tx/8Rx | Nokia |
| CPE/FMA | 16 Tx/Rx: | Nokia |
| Alt1 traditional model | (M, N, P, Mg, Ng; Mp, Np) = (1, 2, 2, 1, 1, 1, 2),  (dH, dV) =(0.5, 0.5)λ | Samsung, Futurewei, ZTE |
| 4T(2, 2, 1, 1, 1;1, 2, 2) 8R(2, 4, 1, 1, 1;1, 2, 4) | Spreadtrum |
| (M, N, P, Mg, Ng, Mp, Np) = (2, 2, 2, 1, 1, 2, 2).(dH, dV) = (0.5, 0.5)λ | ZTE |
| (M, N, P, Mg, Ng; Mp, Np) = ((2, 4, 2, 1, 1, 2, 4), (dH, dV)=(0.5, 0.5)λ | Huawei, Futurewei |
| (M, N, P, Mg, Ng, Mp, Np) = (4, 2, 2, 1, 1, 4, 2), (dH, dV) = (0.5, 0.5)λ | Nokia (FWA/CPE) |
| Alt2 handheld model | Support | Samsung |
| (1, 3, 5, 7) | ZTE, DCM, Intel, Nokia |
| (1-8) | Huawei, Spreadtrum |
| Rx: (1-8) Tx: (1, 3, 5, 7) | Nokia |

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| **15 GHz UT Antenna configuration** | | **Mentioned by** |
| UE Polarized antenna modelling,  e.g., models in section 7.3.2 in TR38.901 | Option 1, model-1 in section 7.3.2 in TR38.901 | Huawei, ZTE, DCM, Samsung, Futurewei, Nokia |
| Option 2, model-2 in section 7.3.2 in TR38.901 | Huawei, ZTE, DCM, Samsung, Futurewei |
| Option 3, handheld UT model in section 7.3.2 in TR38.901 | Huawei, ZTE, DCM, Samsung, Futurewei, Nokia, Intel |
| UE antenna element gain pattern | Alt1: Omnidirectional | Huawei, ZTE, Nokia, Futurewei, Samsung |
| Alt2: According to Table 7.3-2 in TR 38.901 (radiation power pattern for handheld UT) | Huawei, ZTE, Nokia, Intel, DCM, Samsung, Futurewei |

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| **15 GHz BS Antenna configuration** | | **Mentioned by** | |
| Indoor | outdoor |
| BS Polarized antenna modelling e.g., models in section 7.3.2 in TR38.901 | model1 | ZTE, DCM, Samsung, Nokia, Futurewei (optionally) | Huawei, ZTE, DCM, Samsung, Nokia, Futurewei (optionally) |
| model2 | ZTE, DCM, Samsung, Intel, Futurewei | Huawei, ZTE, DCM, Samsung, Intel, Futurewei |
| BS antenna element gain pattern | Table 7.3-1 in TR38.901 | ZTE, Nokia, DCM, Futurewei | Huawei, ZTE, Nokia, Intel, DCM, Samsung, Futurewei |
| Table A.2.1-7 in TR38.802 | Intel |  |
| 5dBi | Samsung |  |

#### Around 30GHz

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| --- | --- | --- |
| **30 GHz TXRU mapping** | **Mentioned by** | |
| Indoor | outdoor |
| Option 1, a single TXRU is mapped per panel per subarray per polarization, Per panel reuse models in TR 36.897 | Huawei, vivo, OPPO, Ericsson, ZTE, Qualcomm, CMCC, DCM, Ofinno, Futurewei | Huawei, vivo, OPPO, Ericsson, ZTE, Qualcomm, CMCC, DCM, Ofinno, Futurewei |
| Option 2, Fully connected TXRU mapping within a panel per polarization | vivo, OPPO, ZTE, CMCC, DCM, Ofinno | vivo, OPPO, ZTE, CMCC, DCM, Ofinno |
| Option 3, Single TXRU is mapped per panel per polarization | Ericsson, DCM, Samsung | Ericsson, DCM, Samsung |

|  |  |  |  |
| --- | --- | --- | --- |
| **30GHz BS Antenna configuration** | | **Mentioned by** | |
| **Indoor** | **outdoor** |
| Number of antenna elements | 64 | Ericsson, CMCC, DCM | Interdigital |
| 128 | ZTE, Qualcomm |  |
| 256 |  | DCM, CMCC |
| 512 | vivo | Qualcomm |
| 1024 | OPPO, Samsung | OPPO, Ericsson, Samsung |
| 2048 | Futurewei |  |
| 4096 | Huawei, Ofinno | Huawei, vivo, ZTE, Ofinno, Futurewei |
| Maximum antenna ports | 2 | Qualcomm | Qualcomm |
| 4 | Samsung | Interdigital, Samsung |
| 8 | OPPO, ZTE | OPPO, CMCC |
| 16 | DCM |  |
| 32 | CMCC | ZTE |
| 64 | Futurewei | DCM, Futurewei |
| 256 | vivo, Ofinno | vivo, Ofinno |
| 512 | vivo, Ofinno | vivo, Ofinno |

|  |  |  |  |
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| **30 GHz BS Antenna configuration** | | **Mentioned by** | |
| **Indoor** | **outdoor** |
| 64, N/A | (M, N, P, Mg, Ng) = (4, 8, 2, 1, 1), (dH, dV) = (0.5, 0.5)λ | Ericsson |  |
| 64, 4 | (M, N, P, Mg, Ng; Mp, Np) = (4, 8, 2, 1, 1; 1, 2), (dH, dV)=(0.5, 0.5)λ |  | Interdigital |
| 64, 8 | (M, N, P, Mg, Ng;Mp, Np) = (8, 4, 2, 1, 1;1, 4), (dH, dV)=(0.5, 0.5)λ | CMCC |  |
| 64, 16 | (M, N, P, Mg, Ng;Mp, Np) = (4, 8, 2, 1, 1, 1, 8), (dH, dV)=(0.5, 0.5)λ | DCM |  |
| 64, 32 | (M, N, P, Mg, Ng;Mp, Np) = (8, 4, 2, 1, 1, 4, 4), (dH, dV)=(0.5, 0.5)λ | CMCC |  |
| 128, 2 | (M, N, P, Mg, Ng; Mp, Np) = (8, 8, 2, 1, 1, 1, 1), (dH, dV) = (0.5, 0.5)λ | Qualcomm |  |
| 128, 8 | (M, N, P, Mg, Ng, Mp, Np) = (8, 8, 2, 1, 1, 2, 2), (dH, dV) = (0.5, 0.5)λ | ZTE |  |
| 128, 16 | (M, N, P, Mg, Ng, Mp, Np) = (8, 8, 2, 1, 1, 2, 4), (dH, dV) = (0.5, 0.5)λ | Futurewei |  |
| 128, 16 | (M, N, P, Mg, Ng, Mp, Np) = (8, 8, 2, 1, 1, 2, 4), (dH, dV) = (0.5, 0.8)λ | Futurewei |  |
| 256, 8 | (M, N, P, Mg, Ng; Mp, Np) = (4, 8, 2, 2, 2; 1, 1), (dH, dV)=(0.5, 0.5)λ, (dg, H, dg, V) = (4.0, 2.0)λ |  | CMCC |
| 256, 64 | (M, N, P, Mg, Ng, Mp, Np) = (4, 8, 2, 2, 2, 1, 8), (dH, dV) = (0.5, 0.5)λ, (dg, H, dg, V) = (4.0, 2.0)λ |  | DCM |
| 512, 512 | (M, N, P, Mg, Ng) = (16, 16, 2, 1, 1, 16, 16), (dH, dV) = (0.5, 0.5)λ | vivo |  |
| 768, 2 | (M, N, P, Mg, Ng; Mp, Np) = (24, 16, 2, 1, 1; 1, 1), (dH, dV) = (0.5, 0.8)λ | Samsung | Samsung |
| 1024, N/A | (M, N, P, Mg, Ng) = (32, 16, 2, 1, 1), (dH, dV) = (0.5, 0.5)λ |  | Ericsson |
| 1024, 4 | (M, N, P, Mg, Ng; Mp, Np) = (16, 16, 2, 2, 1; 1, 1), (dH, dV) = (0.5, 0.5)λ | Samsung | Samsung |
| 1024, 8 | (M, N, P, Mg, Ng, Mp, Np) = (16, 8, 2, 2, 2, 1, 1), (dV, dH) = (0.5, 0.5)λ, (dg, V, dg, H) = (2.0, 4.0)λ |  | OPPO |
| 1024, 8 | (M, N, P, Mg, Ng, Mp, Np) = (8, 16, 2, 2, 2, 1, 1) |  | ZTE |
| 2048, 8 | (M, N, P, Mg, Ng; Mp, Np) = (8, 32, 2, 2, 2, 1, 1), (dH, dV) = (0.5, 0.5)λ, (dg, H, dg, V) = (4.0, 2.0)λ |  | Qualcomm |
| 2048, 16 | (M, N, P, Mg, Ng, Mp, Np) = (8, 16, 2, 4, 2, 1, 1) |  | ZTE |
| 2048, 64 | (M, N, P, Mg, Ng; Mp, Np) = (32, 32, 2, 1, 1, 4, 8), (dH, dV) = (0.5, 0.5)λ | Futurewei |  |
| 2048, 64 | (M, N, P, Mg, Ng; Mp, Np) = (32, 32, 2, 1, 1, 4, 8), (dH, dV) = (0.5, 0.8)λ | Futurewei |  |
| 4096, 64 | (M, N, P, Mg, Ng; Mp, Np) = (64, 32, 2, 1, 1, 4, 8), (dH, dV) = (0.5, 0.5)λ or (0.5, 0.8)λ |  | Futurewei |
| 4096, 512 | (M, N, P, Mg, Ng, Mp, Np) = (32, 16, 2, 2, 2, 8, 8), (dHg, dVg) = (8, 16)λ, (dH, dV) = (0.5, 0.5)λ |  | vivo |

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| **30 GHz UT Antenna configuration** | | **Mentioned by** |
| Elements, ports | 4, 4 | Futurewei (Typical) |
| 8, 2 | Samsung |
| 8, 8 | DCM |
| 16, 4 | OPPO, Interdigital |
| 16, 16 | Huawei, Futurewei (Max) |
| 32, 4 | CMCC ZTE |
| 32, 8 | CMCC |
| 32, 32 | vivo, Ofinno |
| 128, 2 | Samsung |
| General | 8T8R | Spreadtrum |
| 32T32R | Qualcomm |
| Alt1 traditional model | (M, N, P, Mg, Ng; Mp, Np) = (1, 2, 2, 1, 1, 1, 2),  (dH, dV)=(0.5, 0.5)λ | Futurewei |
| (M, N, P, Mg, Ng; Mp, Np) = (2, 2, 1, 2, 2, 1, 1), (dH, dV) = (0.5, 0.5)λ,  (dg, V, dg, H) = (0, 0)λ | OPPO |
| (M, N, P, Mg, Ng; Mp, Np) = ((2, 4, 2, 1, 1, 2, 4), (dH, dV)=(0.5, 0.5)λ | Futurewei, vivo |
| (M, N, P, Mg, Ng; Mp, Np) = (2, 4, 2, 1, 2; 1, 1) (dH, dV) = (0.5, 0.5)λ, (dg, H, dg, V) = (0, 0)λ | CMCC |
| (M, N, P, Mg, Ng; Mp, Np) = (2, 4, 2, 1, 2; 1, 2) (dH, dV) = (0.5, 0.5)λ, (dg, H, dg, V) = (0, 0)λ | Interdigital, CMCC |
| (M, N, P, Mg, Ng; Mp, Np) = (4, 1, 2, 1, 1, 1, 1, ), (dH, dV)=(0.5, 0.5)λ | Samsung |
| (M, N, P, Mg, Ng; Mp, Np) = (8, 8, 2, 1, 1, 1, 1), (dH, dV)=(0.5, 0.5)λ | Samsung |
| Alt2 handheld model | Support | Intel |
| (1, 3, 5, 7) | DCM |

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| --- | --- | --- |
| **30 GHz UT Antenna configuration** | | **Mentioned by** |
| UE Polarized antenna modelling,  e.g., models in section 7.3.2 in TR38.901 | Option 1, model-1 in section 7.3.2 in TR38.901 | ZTE, CMCC, DCM, Samsung, Ofinno, Futurewei |
| Option 2, model-2 in section 7.3.2 in TR38.901 | vivo, OPPO, ZTE, DCM, Samsung, Ofinno, Futurewei |
| Option 3, handheld UT model in section 7.3.2 in TR38.901 | Interdigital, ZTE, DCM, Samsung, Ofinno, Ericsson, Qualcomm, Intel |
| UE antenna element gain pattern | Alt1: Omnidirectional |  |
| Alt2: According to Table 7.3-2 in TR 38.901 (radiation power pattern for handheld UT) | Intel, Interdigital, OPPO, Ofinno, Ericsson, Samsung |
| Table A.2.1-8 in the TR 38.80 | vivo, ZTE, Qualcomm, DCM |

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| **30 GHz BS Antenna configuration** | | **Mentioned by** | |
| Indoor | outdoor |
| BS Polarized antenna modelling e.g., models in section 7.3.2 in TR38.901 | model1 | Ericsson, Qualcomm, DCM, ZTE, CMCC, Samsung, Ofinno, Futurewei(optionally) | Ericsson, Qualcomm, DCM, ZTE, CMCC, Samsung, Ofinno, Futurewei(optionally) |
| model2 | Ericsson, Qualcomm, DCM, vivo, OPPO, ZTE, Samsung, Intel, Ofinno, Futurewei | Ericsson, Qualcomm, DCM, vivo, OPPO, Interdigital, ZTE, Samsung, Intel, Ofinno, Futurewei |
| BS antenna element gain pattern | Table 7.3-1 in TR38.901 | Ericsson, ZTE, CMCC, Interdigital, OPPO, Ofinno, Futurewei | Ericsson, vivo, ZTE, Qualcomm, CMCC, Intel, Interdigital, Samsung, OPPO, Ofinno, Futurewei |
| Table A.2.1-7 in TR38.802 | DCM, vivo, Qualcomm, DCM, Intel | Qualcomm, DCM |

#### (FL1) Proposal in Attachment1

**Please check the ‘moderator’s proposal’ as attached for the antenna modelling for each of carrier frequencies.**

*Any comments/suggestions, please leave them here.*

|  |  |
| --- | --- |
| **Company** | **Comments** |
|  |  |
|  |  |

## Other views in TDoc

|  |  |
| --- | --- |
| **Company** | **Views/proposals** |
| *Futurewei* | *Proposed to study energy consumption* *by different antenna models/architectures.*  *Proposed to study mixed antenna architectures (with additional fully-digital 1-bit ADC receiver at the base station) for mmWave FR2.* |

# SLS assumptions for TN

## Collected views from RAN1#122

### Discussions

*Controversial views are summarized here:*

#### Indoor Hotspot

|  |  |
| --- | --- |
| **Carrier frequency** | **Mentioned by** |
| Around 2GHz | Huawei, OPPO, Ericsson, Qualcomm, CMCC, DCM, Samsung, Sony, Intel, Ofinno |
| Around 4GHz | Huawei, vivo, OPPO, CATT, Ericsson, ZTE, Qualcomm, CMCC, DCM, Samsung, MTK, Sony, Intel, Ofinno, Nokia, Futurewei |
| Around 7GHz | Huawei, vivo, OPPO, CATT, Ericsson, ZTE, Qualcomm, CMCC, DCM, Xiaomi, Samsung, MTK, Sony, Intel, Ofinno, Nokia, Futurewei |
| Around 15GHz | Huawei, OPPO, Ericsson, DCM, Samsung, Intel, Ofinno |
| Around 30GHz | Huawei, OPPO, Ericsson, ZTE, Qualcomm, CMCC, DCM, Samsung, Intel, Ofinno |
| Around 4GHz + Around 7GHz | ZTE |

|  |  |  |
| --- | --- | --- |
| **Frequency** | **Aggregated system bandwidth** | **Mentioned by** |
| Around 2GHz | Up to 200MHz (DL+UL) | Huawei, OPPO, Ericsson, Qualcomm, CMCC, DCM, Sony, Intel, Ofinno, |
| Around 4GHz | Up to 300MHz (DL+UL) | Huawei, vivo, OPPO, Ericsson, Qualcomm, CMCC, DCM, Sony, Intel, Ofinno, Nokia, |
| Up to 200MHz (DL+UL) | ZTE, MTK, Futurewei |
| Around 7GHz | Up to 400MHz (DL+UL) | Huawei, vivo, OPPO, Ericsson, ZTE, Qualcomm, CMCC, DCM, Xiaomi, Sony, Intel, Ofinno, Nokia, Futurewei |
| Up to 200MHz (DL+UL) | MTK |
| Around 15GHz | Up to 400MHz (DL+UL) | Huawei, OPPO, Ericsson, DCM, Sony, Intel, Ofinno, |
| Around 30GHz | Up to 1GHz (DL+UL) | Huawei, OPPO, Ericsson, ZTE, Qualcomm, CMCC, DCM, Sony, Intel, Ofinno, |

|  |  |  |
| --- | --- | --- |
| **Frequency** | **Simulation bandwidth** | **Mentioned by** |
| Around 2GHz | 200MHz per CC | Huawei, DCM, Sony, Ofinno, |
| 100MHz per CC | CMCC, Samsung, Intel, |
| 20MHz per CC | OPPO, Ericsson, ZTE, Qualcomm, Samsung, |
| 10MHz per CC | Samsung, |
| Around 4GHz | 300MHz per CC | Huawei, Sony, Ofinno, |
| 200MHz per CC | DCM, Intel, Futurewei |
| 100MHz per CC | vivo, Ericsson, CMCC, Samsung, Nokia, |
| 20MHz per CC | OPPO, CATT, ZTE, Qualcomm, Samsung, MTK, |
| 10MHz per CC | Samsung, |
| Around 7GHz | 400MHz per CC | Huawei, vivo, Ericsson, CMCC, Sony, Ofinno, Futurewei, |
| 200MHz per CC | vivo, CMCC, DCM, Xiaomi, Samsung, Intel, Nokia |
| 100MHz per CC | Qualcomm, Samsung, |
| 80MHz per CC | ZTE, |
| 20MHz per CC | OPPO, CATT, Samsung, MTK |
| Around 15GHz | 400MHz per CC | Huawei, Samsung, Intel, Ofinno, |
| 200MHz per CC | DCM, Samsung, |
| 100MHz per CC | Samsung, |
| 80MHz per CC | OPPO, Ericsson, |
| 20MHz per CC | Samsung, |
| Around 30GHz | 1GHz per CC | Ofinno, |
| 800MHz per CC | Samsung, Intel, |
| 400MHz per CC | Ericsson, DCM, Samsung, |
| 200MHz per CC | Samsung, |
| 100MHz per CC | Qualcomm, Samsung, |
| 80MHz per CC | OPPO, ZTE |

|  |  |  |
| --- | --- | --- |
| **Frequency** | **Total transmit power per BS** | **Mentioned by** |
| Around 2GHz | 24dBm/20MHz | Huawei, OPPO, CATT, Ericsson, ZTE, Qualcomm, DCM, Samsung, MTK, Sony, Intel, Ofinno, Nokia, Futurewei |
| Around 4GHz | 24dBm/20MHz | Huawei, OPPO, CATT, Ericsson, ZTE, Qualcomm, DCM, Samsung, MTK, Sony, Intel, Ofinno, Nokia, Futurewei |
| Around 7GHz | 24dBm/20MHz | Huawei, OPPO, CATT, ZTE, Qualcomm, DCM, Xiaomi, Samsung, MTK, Sony, Intel, Ofinno, Nokia, Futurewei |
| 23dBm/80MHz | Ericsson |
| Around 15GHz | 23dBm/20MHz, EIRP not exceed 58dBm | Huawei, ZTE, DCM, Intel, Nokia |
| 24dBm/20MHz | Samsung, |
| 23dBm/80MHz | Ericsson |
| Around 30GHz | 23dBm/20MHz, EIRP not exceed 58dBm | Huawei, ZTE, Qualcomm, DCM, Intel, Nokia |
| 26.6dBm/100MHz | Samsung, |
| 23dBm/80MHz | Ericsson |

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| **Frequency** | **UE power class** | **Mentioned by** |
| Around 7GHz and below | 23dBm (FDD and TDD) | Huawei, vivo, OPPO, Ericsson, ZTE, Qualcomm, DCM, Samsung, MTK, Sony, Intel, Nokia, Futurewei |
| 26dBm (TDD) | Huawei, vivo, OPPO, CATT, Ericsson, ZTE, Qualcomm, Samsung, MTK, Intel, Ofinno, Nokia, Futurewei |
| 29dBm (TDD) | Huawei, Qualcomm, Nokia, Futurewei |
| 31dBm (CPE/FWA) | ZTE, |
| Around 15GHz and above | 23dBm, EIRP not exceed 43dBm | Huawei, OPPO, Ericsson, DCM, Samsung, Intel, |
| 29dBm | Nokia, |
| 26dBm | Samsung, Nokia, |
| 12dBm | Qualcomm, |

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| **Frequency** | **UE noise figure** | **Mentioned by** |
| Around 7GHz and below | 7dB | Xiaomi, Samsung, |
| 8dB | Huawei, |
| 9dB | Huawei, vivo, OPPO, Ericsson, ZTE, Qualcomm, DCM, MTK, Sony, Intel, Ofinno, Nokia, Futurewei |
| Around 15GHz | 10dB | Huawei, OPPO, Ericsson, ZTE, DCM, Samsung, |
| 13dB | Huawei, OPPO, Ericsson, ZTE, Intel, |
| Around 30GHz | 10dB | Huawei, OPPO, Ericsson, ZTE, DCM, Samsung, |
| 13dB | Huawei, OPPO, Ericsson, ZTE, Qualcomm, Samsung, Intel, Nokia, |

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| **Traffic model** | **Mentioned by** |
| Full buffer | Huawei, CATT, Qualcomm, CMCC, DCM, Xiaomi, MTK, Ofinno, Nokia, |
| FTP1 | CATT, ZTE, Qualcomm, Xiaomi, Samsung, |
| FTP2 |  |
| FTP3 | Huawei, vivo, CATT, ZTE, Qualcomm, CMCC, DCM, Samsung, MTK, Sony, Ofinno, Nokia, Futurewei |
| XR | vivo, ZTE, Ericsson, CMCC, DCM, Sony, Nokia, Futurewei |
| VoIP | Ericsson, Samsung, |
| IM | Samsung, |
| FTP3 variant with packet delay budget requirement | Huawei, |
| a mixed/variable packet size and the associated time domain behaviors | Ericsson, Ofinno, |
| AI/ML services | Huawei, Ofinno, |
| Immersive communication services | Huawei, Ericsson, Sony, Futurewei |
| Other/Feature-dependent | OPPO, ZTE, Intel, Interdigital |

#### Dense Urban

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| **Network layer** | **Carrier frequency** | **Mentioned by** |
| Macro or micro layer | Around 700MHz | Huawei, OPPO, Ericsson, Qualcomm, CMCC, DCM, Intel, Ofinno, AT&T, |
| Around 2GHz | Huawei, OPPO, Ericsson, ZTE, Qualcomm, CMCC, DCM, Sony, Intel, Ofinno, Nokia, Futurewei, AT&T, |
| Around 4GHz | Huawei, vivo, OPPO, CATT, Ericsson, ZTE, Qualcomm, CMCC, DCM, MTK, Sony, Intel, Ofinno, Nokia, Futurewei, Apple, AT&T, ETRI |
| Around 7GHz | Huawei, vivo, OPPO, CATT, Ericsson, ZTE, Qualcomm, CMCC, DCM, MTK, Sony, Intel, Ofinno, Nokia, Futurewei, Apple, AT&T, ETRI |
| Around 15GHz | Huawei, OPPO, Ericsson, DCM, Intel, Ofinno, Futurewei, AT&T, |
| Around 2GHz + Around 4GHz | Huawei, OPPO, CMCC, DCM, Intel, Ofinno, AT&T, |
| Around 4GHz + Around 7GHz | Huawei, OPPO, ZTE, CMCC, DCM, Intel, Ofinno, Nokia, AT&T, ETRI |
| Around 7GHz + Around 4GHz + Around 2GHz + Around 700MHz | Huawei, OPPO, CMCC, DCM, Intel, Ofinno, AT&T, |
| Micro layer | Around 7GHz | Huawei, vivo, OPPO, CATT, Ericsson, ZTE, Qualcomm, CMCC, DCM, MTK, Sony, Intel, Ofinno, Futurewei, Apple, AT&T, |
| Around 15GHz | Huawei, OPPO, Ericsson, DCM, Intel, Ofinno, Futurewei, AT&T, |
| Around 30GHz | Huawei, OPPO, Ericsson, DCM, Intel, Ofinno, Futurewei, AT&T, |
| Macro+Micro | Around 4GHz + Around 30GHz | Huawei, vivo, OPPO, ZTE, CMCC, DCM, Intel, Ofinno, Nokia, AT&T, |
| Around 7GHz + Around 30GHz | Huawei, vivo, OPPO, ZTE, CMCC, DCM, Intel, Ofinno, AT&T, |
| Around 4/7GHz + Around 4/7GHz | DCM |

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| **Frequency** | **Aggregated system bandwidth** | **Mentioned by** |
| Around 700MHz | Up to 60MHz (DL+UL) | Huawei, OPPO, Ericsson, Qualcomm, CMCC, DCM, Sony, Intel, Ofinno, Nokia, AT&T |
| Around 2GHz | Up to 200MHz (DL+UL) | Huawei, OPPO, Ericsson, Qualcomm, CMCC, DCM, Sony, Intel, Ofinno, AT&T |
| Up to 120MHz (DL+UL) | ZTE, Nokia, |
| Up to 60MHz (DL+UL) | Futurewei, |
| Around 4GHz | Up to 300MHz (DL+UL) | Huawei, vivo, OPPO, Ericsson, CMCC, DCM, Sony, Intel, Ofinno, AT&T, ETRI |
| Up to 200MHz (DL+UL) | ZTE, Qualcomm, MTK, Nokia, Futurewei, |
| Around 7GHz | Up to 400MHz (DL+UL) | Huawei, vivo, OPPO, Ericsson, ZTE, Qualcomm, CMCC, DCM, Sony, Intel, Ofinno, Nokia, Futurewei, AT&T, ETRI |
| Up to 200MHz (DL+UL) | MTK, |
| Around 15GHz | Up to 400MHz (DL+UL) | Huawei, OPPO, Ericsson, DCM, Sony, Intel, Ofinno, Futurewei, AT&T |
| Around 30GHz | Up to 1GHz (DL+UL) | Huawei, vivo, OPPO, Ericsson, ZTE, CMCC, DCM, Sony, Intel, Ofinno, Nokia, AT&T |
| Up to 400MHz (DL+UL) | Futurewei |

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| **Frequency** | **Simulation bandwidth** | **Mentioned by** |
| Around 700MHz | 60MHz per CC | Huawei, CMCC, Ofinno, |
| 20MHz per CC | OPPO, Ericsson, Interdigital, ZTE, Qualcomm, DCM, Samsung, |
| 10 MHz per CC | Samsung, |
| Around 2GHz | 200MHz per CC | Huawei, DCM, Sony, Ofinno, |
| 100MHz per CC | CMCC, Intel, Nokia, |
| 60 MHz per CC | Futurewei, |
| 40 MHz per CC | Samsung, |
| 20MHz per CC | OPPO, Ericsson, Interdigital, ZTE, Qualcomm, |
| 10MHz per CC | Samsung, |
| Around 4GHz | 300MHz per CC | Huawei, Sony, Ofinno, |
| 200MHz per CC | DCM, Intel, Futurewei |
| 100MHz per CC | vivo, Ericsson, Interdigital, CMCC, Samsung, Nokia, |
| 20MHz per CC | OPPO, CATT, ZTE, Qualcomm, Samsung, MTK, Apple, ETRI |
| 10MHz per CC | Samsung, |
| Around 7GHz | 400MHz per CC | Huawei, vivo, Ericsson, Interdigital, CMCC, Sony, Ofinno, Futurewei |
| 200MHz per CC | vivo, CMCC, DCM, Samsung, Intel, Nokia, |
| 100MHz per CC | Qualcomm, Samsung, |
| 80MHz per CC | ZTE, |
| 20MHz per CC | OPPO, CATT, Samsung, MTK, Apple, ETRI |
| Around 15GHz | 400MHz per CC | Huawei, Samsung, Intel, Ofinno, Futurewei, |
| 200MHz per CC | DCM, Samsung, |
| 100MHz per CC | Samsung, |
| 80MHz per CC | OPPO, |
| 20MHz per CC | Samsung, |
| Around 30GHz | 1GHz per CC | Ofinno, |
| 800MHz per CC | Samsung, |
| 400MHz per CC | CMCC, DCM, Samsung, Intel, Futurewei, |
| 200MHz per CC | Samsung, Nokia, |
| 100MHz per CC | Samsung, |
| 80MHz per CC | OPPO, ZTE, |

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| **Frequency** | **Total transmit power per BS** | **Mentioned by** |
| Around 700MHz | 44dBm/20MHz | Huawei, vivo, OPPO, CATT, Interdigital, ZTE, DCM, Samsung, Intel, Ofinno, Futurewei, ETRI |
| 33dBm/20MHz (micro layer) | Huawei, OPPO, Interdigital, ZTE, DCM, Intel, Ofinno, Nokia, Futurewei, |
| 46dBm/20MHz | Apple |
| 49dBm/20MHz | Qualcomm, |
| 52dBm/20MHz | Ericsson, Nokia, |
| Around 2GHz | 44dBm/20MHz | Huawei, vivo, OPPO, CATT, Interdigital, ZTE, DCM, Samsung, Sony, Intel, Ofinno, Futurewei, ETRI |
| 33dBm/20MHz (micro layer) | Huawei, OPPO, Interdigital, ZTE, DCM, Sony, Intel, Ofinno, Nokia, Futurewei, |
| 46dBm/20MHz | Apple |
| 49dBm/20MHz | Ericsson, Qualcomm, Nokia, |
| 52dBm/20MHz | Ericsson, |
| Around 4GHz | 44dBm/20MHz | Huawei, vivo, OPPO, CATT, Interdigital, ZTE, DCM, Samsung, MTK, Sony, Intel, Ofinno, Futurewei, ETRI |
| 33dBm/20MHz (micro layer) | Huawei, OPPO, Interdigital, ZTE, DCM, Sony, Intel, Ofinno, Nokia, Futurewei, |
| 46dBm/20MHz | Qualcomm, Apple, |
| 49dBm/20MHz | Ericsson, |
| 52 dBm/20MHz | Nokia, |
| Around 7GHz | 44dBm/20MHz | Huawei, vivo, OPPO, CATT, Interdigital, DCM, Samsung, MTK, Sony, Intel, Ofinno, Futurewei, ETRI |
| 33dBm/20MHz (micro layer) | Huawei, OPPO, Interdigital, ZTE, DCM, Sony, Intel, Ofinno, Nokia, Futurewei, |
| 46dBm/20MHz | Qualcomm, Apple |
| 46.2dBm/20MHz | Nokia, |
| 49dBm/20MHz | Ericsson, |
| 56dBm | ZTE |
| Around 15GHz | 40dBm/20MHz, EIRP not exceed 73dBm | Huawei, OPPO, Futurewei, |
| 33dBm/20MHz, EIRP not exceed 68dBm (micro layer) | Huawei, OPPO, Nokia, Futurewei, |
| 23dBm/20MHz, EIRP not exceed 58dBm | Intel, |
| 44dBm/20MHz | Samsung, |
| 46.2dBm/20MHz | Nokia, |
| Around 30GHz | 40dBm/20MHz, EIRP not exceed 73dBm | Huawei, OPPO, ZTE, Futurewei, |
| 33dBm/20MHz, EIRP not exceed 68dBm (micro layer) | Huawei, OPPO, ZTE, Nokia, Futurewei, |
| 34dBm/20MHz | vivo, Ericsson, |
| 26.6dBm/100MHz | Samsung, |
| 32.6dBm/800MHz | Samsung, |
| 23dBm/20MHz, EIRP not exceed 58dBm | Intel, |
| 35dBm/20MHz | Nokia, |

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| **Frequency** | **UE power class** | **Mentioned by** |
| Around 7GHz and below | 23dBm (FDD and TDD) | Huawei, vivo, OPPO, Ericsson, Interdigital, ZTE, Qualcomm, DCM, Samsung, MTK, Sony, Intel, Nokia, Futurewei, Apple, ETRI |
| 26dBm (TDD) | Huawei, vivo, OPPO, CATT, Ericsson, ZTE, Qualcomm, Samsung, MTK, Intel, Ofinno, Nokia, Futurewei, Apple |
| 29dBm (TDD) | Huawei, Qualcomm, Nokia, Futurewei |
| 31dBm (CPE/FWA) | ZTE, Nokia |
| Around 15GHz and above | 23dBm, EIRP not exceed 43dBm | Huawei, vivo, OPPO, Ericsson, DCM, Samsung, Intel, Futurewei |
| 29dBm | Nokia, |
| 26dBm | Samsung, Nokia, |
| 12dBm | Qualcomm, |
| 35dBm (CPE/FWA) | Samsung |

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| **Frequency** | **UE noise figure** | **Mentioned by** |
| Around 7GHz and below | 7dB | Interdigital, Samsung, Apple |
| 8dB | Huawei, |
| 9dB | Huawei, vivo, OPPO, Ericsson, ZTE, Qualcomm, DCM, MTK, Sony, Intel, Ofinno, Nokia, Futurewei, Apple, ETRI |
| Around 15GHz | 10dB | Huawei, OPPO, Ericsson, ZTE, DCM, Samsung, |
| 13dB | Huawei, OPPO, Ericsson, ZTE, Intel, |
| Around 30GHz | 10dB | Huawei, OPPO, Ericsson, ZTE, DCM, Samsung, |
| 13dB | Huawei, vivo, OPPO, Ericsson, ZTE, Qualcomm, Samsung, Intel, Nokia, |

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| **Traffic model** | **Mentioned by** |
| Full buffer | Huawei, CATT, Qualcomm, CMCC, DCM, Xiaomi, MTK, Ofinno, Nokia, |
| FTP1 | CATT, ZTE, Qualcomm, Samsung, |
| FTP2 |  |
| FTP3 | Huawei, vivo, CATT, ZTE, Qualcomm, CMCC, DCM, Samsung, MTK, Sony, Ofinno, Nokia, Futurewei, AT&T, ETRI |
| XR | vivo, ZTE, Ericsson, CMCC, DCM, Sony, Nokia, Futurewei, AT&T, |
| VoIP | Ericsson, Samsung, |
| IM | Samsung, |
| FTP3 variant with packet delay budget requirement | Huawei, |
| a mixed/variable packet size and the associated time domain behaviors | Ericsson, Ofinno, |
| AI/ML services | Huawei, Ofinno, |
| Immersive communication services | Huawei, Ericsson, Sony, Futurewei |
| Other/Feature-dependent | OPPO, ZTE, Intel, Interdigital, AT&T, |

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| **UE distribution and speed** | | **Mentioned by** |
| UE number per TRxP | 10 | Huawei, vivo, OPPO, CATT, Ericsson, Interdigital (10/20), CMCC, DCM, MTK, Intel, Ofinno, Nokia, Futurewei, AT&T, ETRI |
| 30 | Huawei, Sony, Nokia (10/30/50), Futurewei, |
| UE location & speed | 20% outdoor incar 30km/h  80% indoor 3km/h | vivo (outdoor 30,60,120km/h), OPPO, CATT, Ericsson, ZTE, Qualcomm, CMCC, DCM, MTK, Intel, Ofinno, Futurewei, Apple, AT&T, ETRI |
|  | 20% outdoor incar 30km/h  60% outdoor 3km/h  20% indoor 3km/h | Ericsson, |
| O2I penetration loss | 20% high-loss  80% low-loss | Huawei, vivo, OPPO, CATT, Ericsson, Interdigital, ZTE, CMCC, DCM, Samsung, MTK, Sony, Ofinno, Nokia, Futurewei, Apple, ETRI |
| 50% high-loss  50% low-loss | Huawei, vivo, OPPO, ZTE, DCM, Nokia, |

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| **BS array downtilt** | | **Mentioned by** |
| BS mechanic tilt | 90° | Huawei, vivo, OPPO, CATT, Interdigital, Qualcomm, CMCC, MTK, Sony, Intel, Ofinno, Nokia, Futurewei |
| According to scenario/ Need optimization | Ericsson, Apple |
| BS electronic tilt | 105° | Huawei, vivo, MTK, Sony, Futurewei, |
| 102° | CATT, Interdigital, ZTE, Intel, Futurewei, |
| 90° | Nokia |
| According to scenario/ Need optimization | Ericsson, Qualcomm, Apple |

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| **Network layer** | **Carrier frequency** | **Mentioned by** |
| Macro layer | Around 700MHz (for ISD 1 or ISD 2) | Huawei, vivo, OPPO, CATT, Ericsson, ZTE, Qualcomm, CMCC, DCM, MTK, Sony, Intel, Ofinno, Nokia, Futurewei |
| Around 4GHz (for ISD 1) | Huawei, vivo, OPPO, CATT, Ericsson, ZTE, Qualcomm, CMCC, DCM, {Tejas Networks, CEWiT, IIT Madras}, MTK, Sony, Intel, Ofinno, Nokia, Futurewei |
| Around 7GHz (ISD 1) | Huawei, vivo, OPPO, Ericsson, ZTE, Qualcomm, CMCC, DCM, {Tejas Networks, CEWiT, IIT Madras}, MTK, Intel, Ofinno, Nokia, |
| Around 700MHz + Around 2GHz (for ISD 2) | Huawei, OPPO, Ericsson, ZTE, CMCC, DCM, Intel, Ofinno, Nokia, |
| Around 700MHz + Around 7GHz (for ISD 1) | Huawei, OPPO, Ericsson, ZTE, CMCC, DCM, Intel, Ofinno, Nokia, |
| Around 2GHz | Sony, Futurewei |
| Around 600/700MHz (ISD2) | {Tejas Networks, CEWiT, IIT Madras} |

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| **Frequency** | **Aggregated system bandwidth** | **Mentioned by** |
| Around 700MHz | Up to 60MHz (DL+UL) | Huawei, vivo, OPPO, Ericsson, ZTE, Qualcomm, CMCC, DCM, MTK, Sony, Intel, Ofinno, Nokia, Futurewei |
| Around 2GHz | Up to 200MHz (DL+UL) | Huawei, OPPO, Ericsson, CMCC, DCM, Sony, Intel, Ofinno, Futurewei |
| Up to 120MHz (DL+UL) | ZTE, Nokia, |
| Around 4GHz | Up to 300MHz (DL+UL) | Huawei, vivo, OPPO, Ericsson, CMCC, DCM, {Tejas Networks, CEWiT, IIT Madras}, MTK, Sony, Intel, Ofinno, |
| Up to 200MHz (DL+UL) | ZTE, Qualcomm, Nokia, |
| Up to 400MHz (DL+UL) | Futurewei |
| Around 7GHz | Up to 400MHz (DL+UL) | Huawei, vivo, OPPO, Ericsson, ZTE, Qualcomm, CMCC, DCM, {Tejas Networks, CEWiT, IIT Madras}, MTK, Sony, Intel, Ofinno, Nokia, |
| Around 600/700MHz | Up to 40MHz (DL+UL) | {Tejas Networks, CEWiT, IIT Madras} |

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| **Frequency** | **Simulation bandwidth** | **Mentioned by** |
| Around 700MHz | 60MHz per CC | Huawei, vivo, CMCC, {Tejas Networks, CEWiT, IIT Madras}, Sony, Ofinno, Nokia, |
| 20MHz per CC | OPPO, CATT, Ericsson, Interdigital, ZTE, Qualcomm, DCM, Samsung, MTK, Futurewei |
| 10MHz per CC | Samsung, |
| 100MHz per CC | Intel |
| Around 2GHz | 200MHz per CC | Huawei, DCM, {Tejas Networks, CEWiT, IIT Madras}, Sony, Ofinno, Futurewei |
| 100MHz per CC | CMCC, Samsung, Intel, Nokia, |
| 60MHz per CC |  |
| 40 MHz per CC | Samsung, |
| 20MHz per CC | OPPO, Ericsson, Interdigital, ZTE, Samsung, |
| 10MHz per CC | Samsung, |
| Around 4GHz | 300MHz per CC | Huawei, {Tejas Networks, CEWiT, IIT Madras}, Sony, Ofinno, |
| 200MHz per CC | DCM, Intel, Futurewei |
| 100MHz per CC | vivo, Ericsson, Interdigital, CMCC, Samsung, Nokia, |
| 20MHz per CC | OPPO, CATT, ZTE, Qualcomm, Samsung, MTK, |
| 10MHz per CC | Samsung, |
| Around 7GHz | 400MHz per CC | Huawei, vivo, Ericsson, Interdigital, CMCC, {Tejas Networks, CEWiT, IIT Madras}, Ofinno, |
| 200MHz per CC | vivo, CMCC, DCM, Samsung, Intel, Nokia, |
| 100MHz per CC | Qualcomm, Samsung, |
| 80MHz per CC | ZTE, |
| 20MHz per CC | OPPO, Samsung, MTK, |

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| **Frequency** | **Total transmit power per BS** | **Mentioned by** |
| Around 700MHz | 49dBm/20MHz | Huawei, vivo, OPPO, CATT, Interdigital, ZTE, Qualcomm, DCM, Samsung, {Tejas Networks, CEWiT, IIT Madras}, MTK, Sony, Intel, Ofinno, Nokia, Futurewei |
| 52dBm/20MHz | Ericsson, |
| Around 2GHz | 49dBm/20MHz | Huawei, OPPO, Ericsson, Interdigital, ZTE, DCM, Samsung, MTK, Sony, Intel, Ofinno, Nokia, Futurewei |
| 52dBm/20MHz | Ericsson, |
| Around 4GHz | 49dBm/20MHz | Huawei, vivo, OPPO, CATT, Ericsson, Interdigital, ZTE, DCM, Samsung, {Tejas Networks, CEWiT, IIT Madras}, MTK, Sony, Intel, Ofinno, Nokia, Futurewei |
| 46dBm/20MHz | Qualcomm, |
| Around 7GHz | 49dBm/20MHz | Huawei, vivo, OPPO, Ericsson, Interdigital, ZTE, DCM, Samsung, {Tejas Networks, CEWiT, IIT Madras}, MTK, Sony, Intel, Ofinno, Nokia, Futurewei |
| 56dBm/20MHz | ZTE, |
| 53dBm/100MHz | Qualcomm, |

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| **Frequency** | **UE power class** | **Mentioned by** |
| Around 7GHz and below | 23dBm (FDD and TDD) | Huawei, vivo, OPPO, Ericsson, Interdigital, ZTE, Qualcomm, DCM, Samsung, {Tejas Networks, CEWiT, IIT Madras}, MTK, Sony, Intel, Nokia, Futurewei |
| 26dBm (TDD) | Huawei, vivo, OPPO, CATT, Ericsson, ZTE, Qualcomm, Samsung, {Tejas Networks, CEWiT, IIT Madras}, MTK, Intel, Ofinno, Nokia, Futurewei |
| 29dBm (TDD) | Huawei, Qualcomm, Nokia, Futurewei |
| 31dBm (CPE/FWA) | ZTE, Nokia |

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| **Frequency** | **UE noise figure** | **Mentioned by** |
| Around 7GHz and below | 7dB | Interdigital, Samsung, {Tejas Networks, CEWiT, IIT Madras} |
| 8dB | Huawei, |
| 9dB | Huawei, vivo, OPPO, Ericsson, ZTE, Qualcomm, DCM, MTK, Sony, Intel, Ofinno, Nokia, Futurewei |

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| **Traffic model** | **Mentioned by** |
| Full buffer | Huawei, CATT, Qualcomm, CMCC, DCM, Ofinno, Nokia, |
| FTP1 | CATT, ZTE, Qualcomm, Samsung, |
| FTP2 |  |
| FTP3 | Huawei, vivo, CATT, ZTE, Qualcomm, CMCC, DCM, Samsung, MTK, Sony, Ofinno, Nokia, Futurewei |
| XR | vivo, ZTE, Ericsson, DCM, MTK, Sony |
| VoIP | Ericsson, Samsung, |
| IM | Samsung, |
| FTP3 variant with packet delay budget requirement | Huawei, |
| a mixed/variable packet size and the associated time domain behaviors | Ericsson, Ofinno, |
| AI/ML services | Huawei, Ofinno, |
| Immersive communication services | Huawei, Ericsson |
| Other/Feature-dependent | OPPO, ZTE, Intel, Interdigital, {Tejas Networks, CEWiT, IIT Madras} |

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| **UE distribution and speed** | | **Mentioned by** |
| UE number per TRxP | 10 | Huawei, vivo, OPPO, CATT, Ericsson, Interdigital, CMCC, DCM, {Tejas Networks, CEWiT, IIT Madras}, MTK, Sony, Intel, Ofinno, Nokia, Futurewei |
| 30 | Huawei, Nokia (optional 10/30/50), |
| UE location & speed | 50% outdoor incar 120km/h  50% indoor 3km/h | Huawei, vivo, OPPO, CATT, Ericsson, Interdigital, ZTE, Qualcomm, CMCC, DCM, MTK, Sony, Intel, Ofinno, Nokia, Futurewei |
| 15% outdoor incar 120km/h  15% outdoor 3km/h  70% indoor 3km/h | Ericsson, DCM, Ofinno, Nokia, |
| 40% Outdoor pedestrian 3km/h  20% Outdoor incar 30km/h or 60km/h  40% Indoor 0-3km/h | {Tejas Networks, CEWiT, IIT Madras} |
| 100% outdoor 0km/h | {Tejas Networks, CEWiT, IIT Madras} |
| O2I penetration loss | 100% low-loss | vivo, Ericsson, Interdigital, CMCC, DCM, {Tejas Networks, CEWiT, IIT Madras}, MTK, Sony, Ofinno, Nokia |
| 20% high-loss  80% low-loss | Futurewei, ZTE |
| 50% high-loss  50% low-loss | ZTE, |

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| **BS array downtilt** | | **Mentioned by** |
| BS mechanic tilt | 90° | Huawei, vivo, OPPO, CATT, Qualcomm, CMCC, MTK, Sony, Intel, Ofinno, Nokia, Futurewei |
| 91.5° | Samsung, |
| 92° | ZTE, |
| 95° | Interdigital, |
| 100° | {Tejas Networks, CEWiT, IIT Madras} |
| According to scenario/ Need optimization | Ericsson, |
| BS electronic tilt | 92° | Nokia |
| 94° | Intel, |
| 96°for ISD=1732m  100°otherwise | Huawei, vivo, OPPO, MTK, Sony, Futurewei |
| 100°for ISD=1732m | CATT |
| According to scenario/ Need optimization | Ericsson, |

#### UMa

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| **Network layer** | **Carrier frequency** | **Mentioned by** |
| Macro or micro layer | Around 700MHz | Huawei, OPPO, Ericsson, Qualcomm, DCM, Sony, Intel, Ofinno, AT&T |
| Around 2GHz | Huawei, OPPO, Ericsson, ZTE, Qualcomm, DCM, Sony, Intel, Ofinno, Nokia, Futurewei, AT&T |
| Around 4GHz | Huawei, vivo, OPPO, CATT, Ericsson, ZTE, Qualcomm, DCM, MTK, Sony, Intel, Ofinno, Nokia, Futurewei, Apple, AT&T |
| Around 7GHz | Huawei, vivo, OPPO, CATT, Ericsson, ZTE, Qualcomm, DCM, Xiaomi, Sony, Intel, Ofinno, Nokia, Futurewei, Apple, AT&T |
| Around 15GHz | Huawei, OPPO, Ericsson, DCM, Intel, Ofinno, Futurewei, AT&T |
| Around 2GHz + Around 4GHz | Huawei, OPPO, Ericsson, DCM, Intel, Ofinno, AT&T |
| Around 2GHz + Around 7GHz | Huawei, OPPO, Ericsson, DCM, Intel, Ofinno, AT&T |
| Around 4GHz + Around 7GHz | Huawei, OPPO, Ericsson, ZTE, DCM, Intel, Ofinno, Nokia, AT&T |
| Around 2GHz + Around 4GHz + Around 7GHz | Huawei, OPPO, Ericsson, DCM, Intel, Ofinno, AT&T |
| Around 7GHz + Around 4GHz + Around 2GHz + Around 700MHz | Huawei, OPPO, Ericsson, DCM, Intel, Ofinno, AT&T |
| Micro layer | Around 7GHz | Huawei, OPPO, Ericsson, DCM, Intel, Ofinno, Futurewei, Apple, AT&T |
| Around 15GHz | Huawei, OPPO, Ericsson, DCM, Intel, Ofinno, Futurewei, AT&T |
| Around 30GHz | Huawei, OPPO, Ericsson, DCM, Intel, Ofinno, Futurewei, AT&T |
| Macro+Micro | Around 2GHz + Around 30GHz | Huawei, OPPO, Ericsson, DCM, Intel, Ofinno, AT&T |
| Around 4GHz + Around 30GHz | Huawei, vivo, OPPO, Ericsson, ZTE, DCM, Intel, Ofinno, Nokia, AT&T |
| Around 7GHz + Around 30GHz | Huawei, vivo, OPPO, Ericsson, ZTE, DCM, Intel, Ofinno, AT&T |
| Around 4/7GHz + Around 4/7GHz | DCM |

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| **Frequency** | **Aggregated system bandwidth** | **Mentioned by** |
| Around 700MHz | Up to 60MHz (DL+UL) | Huawei, OPPO, Ericsson, Qualcomm, CMCC, DCM, Sony, Intel, Ofinno, Nokia, AT&T |
| Around 2GHz | Up to 200MHz (DL+UL) | Huawei, OPPO, Ericsson, Qualcomm, CMCC, DCM, Sony, Intel, Ofinno, AT&T |
| Up to 120MHz (DL+UL) | ZTE, Nokia, |
| Up to 60MHz (DL+UL) | Futurewei |
| Around 4GHz | Up to 300MHz (DL+UL) | Huawei, vivo, OPPO, Ericsson, CMCC, DCM, Sony, Intel, Ofinno, AT&T |
| Up to 200MHz (DL+UL) | ZTE, Qualcomm, MTK, Nokia, Futurewei |
| Around 7GHz | Up to 400MHz (DL+UL) | Huawei, vivo, OPPO, Ericsson, ZTE, Qualcomm, CMCC, DCM, Xiaomi, Sony, Intel, Ofinno, Nokia, Futurewei, AT&T |
| Around 15GHz | Up to 400MHz (DL+UL) | Huawei, OPPO, Ericsson, DCM, Sony, Intel, Ofinno, Futurewei, AT&T |
| Around 30GHz | Up to 1GHz (DL+UL) | Huawei, vivo, OPPO, Ericsson, ZTE, CMCC, DCM, Sony, Intel, Ofinno, AT&T |
| Up to 400MHz (DL+UL) | Futurewei, |

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| **Frequency** | **Simulation bandwidth** | **Mentioned by** |
| Around 700MHz | 60MHz per CC | Huawei, CMCC, Sony, Ofinno, |
| 20MHz per CC | OPPO, Ericsson, Interdigital, ZTE, Qualcomm, DCM, |
| 10 MHz per CC |  |
| Around 2GHz | 200MHz per CC | Huawei, DCM, Sony, Intel, Ofinno, Futurewei |
| 100MHz per CC | CMCC, Samsung, Nokia, |
| 60 MHz per CC |  |
| 40 MHz per CC | Samsung, |
| 20MHz per CC | OPPO, Ericsson, Interdigital, ZTE, Qualcomm, Samsung, |
| 10MHz per CC | Samsung, |
| Around 4GHz | 300MHz per CC | Huawei, Sony, Ofinno, |
| 200MHz per CC | DCM, Intel, Futurewei |
| 100MHz per CC | vivo, Ericsson, Interdigital, CMCC, Samsung, Nokia, |
| 20MHz per CC | OPPO, CATT, ZTE, Qualcomm, Samsung, MTK, Apple, |
| 10MHz per CC | Samsung, |
| Around 7GHz | 400MHz per CC | Huawei, vivo, Ericsson, Interdigital, CMCC, Sony, Ofinno, Futurewei |
| 200MHz per CC | vivo, CMCC, DCM, Xiaomi, Samsung, Intel, Nokia, |
| 100MHz per CC | Qualcomm, Samsung, |
| 80MHz per CC | ZTE, |
| 20MHz per CC | OPPO, CATT, Samsung, Apple |
| Around 15GHz | 400MHz per CC | Huawei, Samsung, Intel, Ofinno, Futurewei |
| 200MHz per CC | DCM, Samsung, |
| 100MHz per CC | Samsung, |
| 80MHz per CC | OPPO, |
| 20MHz per CC | Samsung, |
| Around 30GHz | 1GHz per CC | Ofinno, |
| 800MHz per CC | Samsung, |
| 400MHz per CC | vivo, CMCC, DCM, Samsung, Futurewei |
| 200MHz per CC | Samsung, Nokia, |
| 100MHz per CC | Samsung, |
| 80MHz per CC | OPPO, ZTE, |

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| **Frequency** | **Total transmit power per BS** | **Mentioned by** |
| Around 7GHz and below | 56dBm | ZTE |
| 52dBm/20MHz | Ericsson, Nokia, |
| 49dBm/20MHz | Huawei, vivo, OPPO, CATT, Ericsson, ZTE, Qualcomm, DCM, Xiaomi, MTK, Sony, Ofinno, Nokia, Futurewei, |
| 46dBm/20MHz | Huawei, Qualcomm, Nokia, Apple |
| 44dBm/20MHz | Interdigital, Samsung, Intel, |
| 33dBm/20MHz (micro layer) | Huawei, Sony, Ofinno, Nokia, |
| Around 15GHz and above | 43dBm/20MHz, EIRP not exceed 78dBm | Huawei, vivo, OPPO, ZTE, DCM, Futurewei, |
| 33dBm/20MHz, EIRP not exceed 68dBm (micro layer) | Huawei, |
| 34dBm/20MHz | Ericsson, |
| 44dBm/20MHz | Samsung |
| 23dBm/20MHz | Intel |
| Around 30GHz | 26.6dBm/100MHz | Samsung |
| 32.6dBm/800MHz | Samsung |

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| **Frequency** | **UE power class** | **Mentioned by** |
| Around 7GHz and below | 23dBm (FDD and TDD) | Huawei, vivo, OPPO, Ericsson, Interdigital, ZTE, Qualcomm, DCM, Xiaomi, Samsung, MTK, Sony, Intel, Nokia, Futurewei, Apple |
| 26dBm (TDD) | Huawei, vivo, OPPO, CATT, Ericsson, ZTE, Qualcomm, Samsung, MTK, Intel, Ofinno, Nokia, Futurewei, Apple |
| 29dBm (TDD) | Huawei, Qualcomm, Nokia, Futurewei, |
| 31dBm (CPE/FWA) | ZTE, Nokia, |
| Around 15GHz and above | 23dBm, EIRP not exceed 43dBm | Huawei, vivo, OPPO, Ericsson, DCM, Samsung, Intel, Futurewei, |
| 26dBm | Samsung, Nokia, |
| 29dBm | Nokia, |
| 35dBm (CPE/FWA) | Samsung, |

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| **Frequency** | **UE noise figure** | **Mentioned by** |
| Around 7GHz and below | 7dB | Interdigital, Xiaomi, Apple |
| 8dB | Huawei, |
| 9dB | Huawei, vivo, OPPO, Ericsson, ZTE, Qualcomm, DCM, MTK, Sony, Intel, Ofinno, Nokia, Futurewei, Apple |
| Around 15GHz | 10dB | Huawei, OPPO, Ericsson, DCM, |
| 13dB | Huawei, OPPO, Ericsson, Intel, Nokia, |
| Around 30GHz | 10dB | OPPO, Ericsson, ZTE, DCM, |
| 13dB | vivo, OPPO, Ericsson, ZTE, Qualcomm, Intel, Nokia, |

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| **Traffic model** | **Mentioned by** |
| Full buffer | Huawei, CATT, Qualcomm, CMCC, DCM, Xiaomi, MTK, Ofinno, Nokia, |
| FTP1 | CATT, ZTE, Qualcomm, Xiaomi, Samsung, |
| FTP2 |  |
| FTP3 | Huawei, vivo, CATT, ZTE, Qualcomm, CMCC, DCM, Xiaomi, Samsung, MTK, Sony, Ofinno, Nokia, Futurewei, AT&T |
| XR | vivo, ZTE, Ericsson, DCM, Sony, Nokia, Futurewei, AT&T, |
| VoIP | Ericsson, Samsung, |
| IM | Samsung, |
| FTP3 variant with packet delay budget requirement | Huawei, |
| a mixed/variable packet size and the associated time domain behaviors | Ericsson, Ofinno, |
| AI/ML services | Huawei, Ofinno, |
| Immersive communication services | Huawei, Ericsson, Sony |
| Other/Feature-dependent | OPPO, ZTE, Intel, Interdigital, AT&T, |

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| **UE distribution and speed** | | **Mentioned by** |
| UE number per TRxP | 10 | Huawei, vivo, OPPO, Interdigital, CMCC, DCM, Xiaomi, MTK, Sony, Intel, Ofinno, Nokia, Futurewei, AT&T |
| 30 | Huawei, Nokia (10/30/50 per TRxP), |
| UE location & speed | 20% outdoor incar 30km/h  80% indoor 3km/h | Huawei, vivo (incar 30,60,120km/h), OPPO, Ericsson, Interdigital, ZTE, Qualcomm, CMCC, Xiaomi, MTK, Sony, Intel, Nokia, Futurewei, Apple |
| O2I penetration loss | 20% high-loss  80% low-loss | Huawei, vivo, CATT, Ericsson, Interdigital, ZTE, CMCC, DCM, Xiaomi, MTK, Sony, Ofinno, Nokia, Futurewei, Apple |
| 50% high-loss  50% low-loss | Huawei, vivo, CATT, ZTE, DCM, Intel, Ofinno, Nokia, Futurewei |

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| **BS array downtilt** | | **Mentioned by** |
| BS mechanic tilt | 90° | Huawei, vivo, OPPO, CATT, Interdigital, Qualcomm, CMCC, DCM, Xiaomi, MTK, Sony, Ofinno, Nokia, Futurewei, |
| 102° | Samsung, |
| According to scenario/ Need optimization | Ericsson, Apple |
| BS electronic tilt | 96° | Nokia |
| 98° | Huawei, Sony, |
| 102° | vivo, OPPO, CATT, Interdigital, ZTE, Xiaomi, MTK, Intel, Futurewei |
| According to scenario/ Need optimization | Ericsson, Apple, Qualcomm, |

#### SMa

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| **Network layer** | **Carrier frequency** | **Mentioned by** |
| Macro layer | Around 700MHz | Huawei, OPPO, Ericsson, ZTE, Qualcomm, CMCC, DCM, MTK, Intel, Ofinno, Nokia, AT&T |
| Around 2GHz | Huawei, OPPO, Ericsson, ZTE, Qualcomm, CMCC, DCM, Intel, Ofinno, Nokia, Futurewei, AT&T |
| Around 4GHz | Huawei, OPPO, Ericsson, ZTE, Qualcomm, CMCC, DCM, MTK, Intel, Ofinno, Nokia, Futurewei, Apple, AT&T |
| Around 7GHz | Huawei, vivo, OPPO, Ericsson, ZTE, Qualcomm, DCM, MTK, Intel, Ofinno, Nokia, Futurewei, Apple, AT&T |
| Around 15GHz | Huawei, OPPO, Ericsson, DCM, Intel, Ofinno, AT&T |
| Around 700MHz + Around 7GHz | Huawei, OPPO, Ericsson, CMCC, DCM, Intel, Ofinno, AT&T |
| Around 4GHz + Around 7GHz | Huawei, OPPO, Ericsson, ZTE, CMCC, DCM, Intel, Ofinno, Nokia, AT&T |
| Around 2GHz + Around 7GHz + Around 30GHz | Huawei, OPPO, Ericsson, CMCC, DCM, Intel, Ofinno, AT&T |
| Around 2GHz + Around 700MHz | Huawei, OPPO, Ericsson, ZTE, CMCC, DCM, Intel, Ofinno, Nokia, AT&T |
| Around 7GHz + Around 4GHz + Around 2GHz + Around 700MHz | Huawei, OPPO, Ericsson, CMCC, DCM, Intel, Ofinno, AT&T |

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| **Frequency** | **Aggregated system bandwidth** | **Mentioned by** |
| Around 700MHz | Up to 60MHz (DL+UL) | Huawei, OPPO, Ericsson, ZTE, Qualcomm, CMCC, DCM, Intel, Ofinno, Nokia, AT&T |
| Up to 40MHz (DL+UL) | MTK, |
| Around 2GHz | Up to 200MHz (DL+UL) | Huawei, OPPO, Ericsson, Qualcomm, CMCC, DCM, Intel, Ofinno, AT&T |
| Up to 120MHz (DL+UL) | ZTE, Nokia, |
| Up to 60MHz (DL+UL) | Futurewei |
| Around 4GHz | Up to 300MHz (DL+UL) | Huawei, OPPO, Ericsson, Qualcomm, CMCC, DCM, Intel, Ofinno, AT&T |
| Up to 200MHz (DL+UL) | ZTE, MTK, Nokia, Futurewei |
| Up to 400MHz (DL+UL) |  |
| Around 7GHz | Up to 400MHz (DL+UL) | Huawei, vivo, OPPO, Ericsson, ZTE, Qualcomm, CMCC, DCM, Intel, Ofinno, Nokia, Futurewei, AT&T |
| Up to 200MHz (DL+UL) | MTK, |
| Around 15GHz | Up to 400MHz (DL+UL) | Huawei, OPPO, Ericsson, DCM, Intel, Ofinno, AT&T |
| Around 30GHz | Up to 1GHz (DL+UL) | Huawei, OPPO, Ericsson, CMCC, DCM, Intel, Ofinno, AT&T |

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| **Frequency** | **Simulation bandwidth** | **Mentioned by** |
| Around 700MHz | 60MHz per CC | Huawei, CMCC, Intel, Ofinno, Nokia, |
| 20MHz per CC | OPPO, Ericsson, Interdigital, ZTE, Qualcomm, DCM, Samsung, MTK, |
| 10MHz per CC | Samsung, |
| Around 2GHz | 200MHz per CC | Huawei, DCM, Intel, Ofinno, Futurewei |
| 100MHz per CC | CMCC, Samsung, Nokia, |
| 60MHz per CC |  |
| 40 MHz per CC | Samsung, |
| 20MHz per CC | OPPO, Ericsson, Interdigital, ZTE, Qualcomm, Samsung, |
| 10MHz per CC | Samsung, |
| Around 4GHz | 300MHz per CC | Huawei, Ofinno, |
| 200MHz per CC | DCM, Intel, Futurewei |
| 100MHz per CC | Ericsson, Interdigital, CMCC, Samsung, Nokia, |
| 20MHz per CC | OPPO, ZTE, Qualcomm, Samsung, MTK, Apple |
| 10MHz per CC | Samsung, |
| Around 7GHz | 400MHz per CC | Huawei, vivo, Ericsson, Interdigital, CMCC, Ofinno, Futurewei |
| 200MHz per CC | vivo, CMCC, DCM, Samsung, Intel, Nokia, |
| 100MHz per CC | Qualcomm, Samsung, |
| 80MHz per CC | ZTE, |
| 20MHz per CC | OPPO, Samsung, MTK, Apple |
| Around 15GHz | 400MHz per CC | Huawei, Samsung, Intel, Ofinno, |
| 200MHz per CC | DCM, Samsung, |
| 100MHz per CC | Samsung, |
| 80MHz per CC | OPPO, |
| 20MHz per CC | Samsung, |
| Around 30GHz | 1GHz per CC | Huawei, |
| 400MHz per CC | CMCC, DCM |
| 80MHz per CC | OPPO, ZTE, |

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| **Frequency** | **Total transmit power per BS** | **Mentioned by** |
| Around 7GHz and below | 56dBm | ZTE |
| 52dBm/20MHz | Ericsson, Nokia, |
| 49dBm/20MHz | Huawei, vivo, OPPO, Ericsson, Interdigital, ZTE, Qualcomm, DCM, MTK, Ofinno, Nokia, Futurewei, Apple |
| 46dBm/20MHz | Qualcomm, Nokia, |
| 44dBm/20MHz | Samsung, Intel, |
| Around 15GHz and above | 49dBm/20MHz | DCM, |
| 44dBm/20MHz | Samsung, |
| 23dBm/20MHz | Intel, |
| Around 30GHz | 34dBm/20MHz | Ericsson, |

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| **Frequency** | **UE power class** | **Mentioned by** |
| Around 7GHz and below | 23dBm (FDD and TDD) | Huawei, vivo, OPPO, Ericsson, Interdigital, ZTE, Qualcomm, DCM, Samsung, MTK, Intel, Nokia, Futurewei, Apple |
| 26dBm (TDD) | Huawei, vivo, OPPO, Ericsson, ZTE, Qualcomm, Samsung, MTK, Intel, Ofinno, Nokia, Futurewei, Apple |
| 29dBm (TDD) | Huawei, Qualcomm, Nokia, Futurewei, |
| 31dBm (CPE/FWA) | ZTE, Nokia |
| Around 15GHz and above | 23dBm, EIRP not exceed 43dBm | Huawei, OPPO, Ericsson, DCM, Nokia, |
| 26dBm (TDD) | Samsung, Nokia, |

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| **Frequency** | **UE noise figure** | **Mentioned by** |
| Around 7GHz and below | 7dB | Interdigital, Samsung, Apple |
| 8dB | Huawei, |
| 9dB | Huawei, vivo, OPPO, Ericsson, ZTE, Qualcomm, DCM, MTK, Intel, Ofinno, Nokia, Futurewei, Apple |
| Around 15GHz and above | 10dB | Huawei, OPPO, Ericsson, ZTE, DCM, Samsung, |
| 13dB | Huawei, OPPO, Ericsson, ZTE, Qualcomm, |

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| **Traffic model** | **Mentioned by** |
| Full buffer | Huawei, CATT, Qualcomm, CMCC, DCM, MTK, Ofinno, Nokia, |
| FTP1 | CATT, ZTE, Qualcomm, Samsung, MTK, |
| FTP2 |  |
| FTP3 | Huawei, vivo, CATT, ZTE, Qualcomm, CMCC, DCM, Xiaomi, Samsung, MTK, Sony, Ofinno, Nokia, Futurewei, AT&T |
| XR | vivo, ZTE, Ericsson, DCM, Sony, Nokia, Futurewei, AT&T, |
| VoIP | Ericsson, Samsung, |
| IM | Samsung, |
| FTP3 variant with packet delay budget requirement | Huawei, |
| a mixed/variable packet size and the associated time domain behaviors | Ericsson, Ofinno, |
| AI/ML services | Huawei, Ofinno, |
| Immersive communication services | Huawei, Ericsson, Sony |
| Other/Feature-dependent | OPPO, ZTE, Intel, Interdigital, AT&T, |

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| **UE distribution and speed** | | **Mentioned by** |
| UE number per TRxP | 10 | Huawei, vivo, OPPO, Ericsson, Interdigital, CMCC, DCM, MTK, Ofinno, Nokia, Futurewei, Apple, AT&T |
| 30 | Huawei, Nokia (optional 30/50), Futurewei, |
| UE location & speed | 10% outdoor pedestrian 3km/h  10% outdoor incar 40km/h  80% indoor 3km/h | Huawei, vivo (incar 40,60,120km/h), Ericsson, ZTE, Qualcomm, DCM, MTK, AT&T |
| 20% outdoor 40km/h  80% indoor 3km/h | OPPO, Interdigital, Intel, Ofinno, Nokia, Apple, |
| O2I penetration loss | 100% low-loss | Huawei, vivo, CMCC, DCM, Ofinno, |
| 20% low-loss  80% low-loss A | Ericsson, |
| 100% low-loss A | Interdigital, Intel, Nokia |
| 5% high-loss  20% low-loss  75% low-loss A | Ericsson, |
| 20% high-loss  80% low-loss | ZTE, MTK, Futurewei, Apple |
| 50% high-loss  50% low-loss | ZTE, Futurewei, |

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| **BS array downtilt** | | **Mentioned by** |
| BS mechanic tilt | ISD=1299m: 95°  ISD=1732m: 92° | Huawei, OPPO, ZTE, Intel, Ofinno, Nokia, Futurewei, |
| 90° | vivo, Qualcomm, CMCC, MTK, |
| 95° | Interdigital |
| According to scenario/ Need optimization | Ericsson, Apple |
| BS electronic tilt | 90° | Huawei, Interdigital, Intel, |
| 102° | OPPO, Futurewei |
| ISD=1299m: 99°  ISD=1732m: 96° | vivo, |
| ISD=1299m: 95°  ISD=1732m: 92° | MTK, |
| According to scenario/ Need optimization | Qualcomm, |

#### (FL1) Proposal in Attachment2

**Please check the ‘moderator’s proposal’ as attached for the SLS assumptions for TN for the first 5 scenarios based on the majority inputs.**

*Any comments/suggestions, please leave them here.*

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| **Company** | **Comments** |
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## Other views in TDoc

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| **Company** | **Views/proposals** |
| *Futurewei* | *Proposed to study multi-cell / multi-TRP deployments with nonideal backhaul or imperfect network synchronization.* |
| *vivo* | *Discussed in details and proposed to support the urban grid scenarios for 6GR evaluations.* |
| *ZTE* | *Discussed the co-frequency networking for two-layer deployment and multi-layer heterogenous network with assisting node.*  *Proposed to consider multi-TRP operation with CJT (targeting for FR1/around-7GHz) and NCJT transmission (targeting FR2/around 30GHz under ideal/non-ideal backhaul and ideal/non-ideal sync (in terms of frequency-domain and time-domain)*  *Proposed sensing related scenarios, e.g., indoor-factory, highway.* |
| *Huawei* | *Discussed and proposed to add the urban grid scenario for sensing and communication.* |
| *LGE* | *Discussed and proposed urban grid and highway should be studied so need to remove the brackets.* |
| *Sony* | *Proposed that High-density of cells in indoor hotspot (e.g. 12/36 TRPs) and dense urban (e.g. 6 or 9 micro TRPs per macro TRP) should be considered for the evaluation of spectrum efficiency and user-experienced data rates.* |
| *Tejas* | *Proposed to study Isolated Macro cell with cluster UE drop as one of the deployment scenarios for Rural in 6G. Proposed to add indoor-factor as one of scenarios.* |

# Traffic models

## Existing models

### Companies’ views

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| **Company** | **Views/proposals** |
| *Futurewei* | *It should be sufficient to* ***prioritize*** ***FTP Model 3 and XR traffic models*** *as they enable the study of user experience and generally cover other models and can be easily extended for new traffic types.* |
| *Nokia* | *Proposal 9: RAN1 to* ***adopt full buffer traffic model*** *for some 6G evaluation simulations,* ***at least for calibration purposes.***  *Proposal 11: RAN1 to* ***adopt FTP-3 as the default model for time-variant best effort traffic*** *in 6G evaluation simulations.*  *Proposal 12: RAN1 to consider the parametrization of the FTP-3 traffic model with a default file size of 0.5 MB, while varying the file arrival rate to result in Low, Medium, Large offered loads per cell that corresponds to average PRB utilization of approximately 10%, 30% and 60%.*  *Proposal 14: RAN1 to* ***adopt the single-stream packet-based XR traffic model for real-time video*** *from TR 38.838* ***with default settings of 45 Mbps for DL and 10 Mbps for UL, assuming 60 fps****.*  *Proposal 15: RAN1 to* ***adopt for the 6GR study the model of XR UL control information feedback from 38.838*** *that needs to be transmitted together with DL traffic.* |
| *vivo* | *Throughout the entire NR phase, the full buffer traffic model was* ***rarely used*** *for system level simulation, except for the IMT spectrum efficiency submissions.*  *Proposal 2:* ***Do not support using the full buffer traffic model*** *for 6G technology evaluation.* |
| *xiaomi* | *Proposal 9:* ***Support both full buffer and non-full buffer traffic models*** *in 6GR.* |
| *CMCC* | *Proposal 3: For the basic traffic models for 6GR evaluation, RAN1 at least consider the following:*  ***• Full buffer***  ***• FTP Model 3 (in TR 36.872)***  ***• XR Traffic models (in TR 38.838)*** |
| *ZTE* | *Proposal 4-1-1: 6GR evaluation should* ***consider utilizing full-buffer traffic model****, particularly for*   * ***assessing system capacity limits and scheduling algorithm performance****.* * ***enabling comparison with IMT-Advanced baseline values***   *Proposal 4-1-2: 6GR evaluation should* ***prioritize the use of FTP model 1/3 and deprioritize FTP model 2****. Model parameters should be determined based on actual service characteristics.*  *Proposal 4-1-3: 6GR evaluation should* ***consider using XR traffic model****, particularly for periodic arrival and delay-sensitive services.*  *Proposal 4-1-4: 6GR evaluation should* ***deprioritize the VoIP model*** *and address potential evaluation requirements through an extended FTP model.* |
| *Huawei* | *Proposal 7:* ***Full buffer and FTP3 model could be considered*** *for 6GR evaluation.* |
| *CATT* | *Proposal 7:* ***Support the full buffer model, the FTP model 1 and the FTP model 3*** *for 6G evaluations.*  *Proposal 8: For the metric for evaluation,* ***at least average spectral efficiency and the 5th percentile user spectral efficiency should be considered for full buffer traffic****. Average user perceived throughput and the 5th percentile user perceived throughput are suggested for FTP models in 6GR.*  *Proposal 9:* ***Whether to support FTP2 model or other existing models depends on the evaluation methodology adopted for each KPI****.*  *Proposal 10: The discussion on new traffic models should be postponed until the discussion of the common evaluation assumptions is completed.* |
| *OPPO* | *Proposal 7: The selection of traffic models for different topics/evaluations can be decided under each individual agenda.* |
| *Samsung* | *Proposal #5:*   * ***Use conventional traffic models (FTP1, FTP3,*** [***FTP3-IM***](ftp://FTP3-IM)***, and VOIP) as baseline*** *for 6GR evaluations* |
| *Ofinno* | *Proposal 12:* ***The full buffer traffic model is used for RAN1 evaluations*** *(e.g., related to system capacity evaluations).*  *Proposal 13:* ***FTP Model 3 defined in TR 36.814 is used*** *for RAN1 evaluations of UE power saving and network energy saving related use cases.* |
| *Sony* | *Proposal 1: RAN1 should define at least the following traffic model for 6G system level simulation assumption:*   * ***FTP model 3*** *for mobile broadband and IoT, with scale of data rate* * ***Periodic traffic with 60/120 fps for XR devices*** * *Immersive communication services such as UL-heavy* |
| *Intel* | *Proposal 8*  *•* ***Full buffer is applicable to 6GR scenarios to evaluate user experienced throughput, 5th percentile user spectral efficiency, average SE, area traffic capacity KPIs*** |
| *AT&T* | *Proposal 3:* ***Full Buffer, FTP Model 2, FTP Model 3, VoIP and XR traffic models*** *are reused for 6G evaluations*  *Proposal 4:* ***FTP Model 3 is considered as the main bursty traffic model*** *for general evaluations.* ***FTP Model 2 is only considered as a web browsing proxy*** *and for regression until a dedicated HTTP model is available.*  *Proposal 5: When applicable,* ***full buffer traffic model can be used*** *in addition to a bursty traffic model for performance evaluations.*  *Note: Full buffer traffic model is not exclusively used to make observations/decisions on performance evaluations*  *Proposal 6:* ***The XR traffic model is used as a baseline for latency/jitter sensitive workloads in general evaluations****, including evaluation of HARQ timing and K1 selection.* |
| *DOCOMO* | *Proposal 2*   * *Support to base following traffic models for 6GR evaluation:*   + ***Full buffer***   + ***FTP1***   + ***FTP2***   + ***FTP3***   + ***FTP3-IM***   + ***XR***   + ***VoIP*** * *Whether to replace/update the existing traffic model should be decided including how to model/update.* |

### Discussions

The definitions of the exiting traffic models are copy-pasted in the appendix.

Companies all agree to keep FTP-3 and XR traffic models. Some specific parameters setting is suggested for XR model.

*Whether to use full buffer traffic model:*

- Most companies mentioned full buffer can be reused to evaluate user experienced throughput, 5th percentile user spectral efficiency, average SE, area traffic capacity KPIs, etc, though one company proposed not to consider it.

*Proposed being deprioritized by a couple of companies: FTP-2, VOIP.*

- However, a couple of companies also proposed to have them as ones of baseline traffic models or the usage of them may depend on the evaluation methodology.

It seems no consensus to preclude any one of the existing traffic models for 6GR evaluation at this moment.

#### (FL1) Proposal 4.1.2

The following existing traffic models could be used for 6GR performance evaluations, e.g.,

* Full buffer
* FTP Model 1 (in TR 36.814)
* FTP Model 2 (in TR 36.814)
* FTP Model 3 (in TR 36.872)
* XR Traffic models (in TR 38.838)
* VoIP model (as in TR 36.814)
* Instant message (as in TR 38.840)
* Note that which model(s) will be used can be further decided when performing simulations.

*Any comments/suggestions, please leave them here:*

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| **Company** | **Comments** |
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## New model 1- AI/ML services

### Companies’ views

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| **Company** | **Views/proposals** |
| *Futurewei* | *For AI/ML services,* ***it can be further discussed after relevant decisions are made in AI/ML agenda items****.* |
| *Nokia* | *Proposal 17: RAN1* ***to send an LS to SA4 to trigger the study of traffic modeling for AI/ML applications, e.g. tokenized traffic,*** *before agreeing on its use for performance evaluation.* |
| *CMCC* | *Proposal 5: For traffic model for new use cases or services,* ***RAN1 can consider token communication as the new AI service and further discuss the detailed characteristics of token transmission.*** |
| *ZTE* | ***Proposal 4-2-3:*** *Adopt the traffic model in Table 4-2-3 for* ***generative AI application (NW for AI)*** *in 6GR evaluation.*  **Table 4-2-3** Traffic model **for generative AI application**   |  |  |  |  | | --- | --- | --- | --- | | Parameter | **Image based GenAI app** | **Video based GenAI app** | **Chatbot** | | Packet size | [~400] KB | [~20] MB | [~0.5] KB | | Arrival time | Poisson process with [~2 - 20] packets per second | Poisson process with [~0.1 - 1] packets per second | Poisson process with [~1000] packets per second | | Latency requirement | < [~400] ms | < [~2] s | < [~10] ms | | Reliability requirement | > [99%] | > [99%] | > [99%] |   ***Proposal 4-2-4****: Study* ***traffic models for AI/ML model training/inference in 6GR evaluation (AI for NW):***   * *Consider the traffic characteristics of the following processes separately:*   + ***Training data collection***   + ***Inference result transmission***   + ***Model download*** * ***Adopt traffic model in Table 4-2-4 for AI/ML model training/inference****.*   **Table 4-2-4** Traffic model for **model training/inference**   |  |  |  |  | | --- | --- | --- | --- | | Parameter | Model download | Training data collection | Inference result transmission | | Packet size | [~100] MB | [~500] KB | [~10] KB | | Arrival time | Poisson process with [~0.01 - 0.1] packets per second | Poisson process with [~2 - 20] packets per second | Poisson process with [~100 - 1000] packets per second | | Latency requirement | < [~5] s | < [~500] ms | < [~10] ms | | Reliability requirement | > [99%] | > [99%] | > [99%] | |
| *Huawei* | *Proposal 9: The traffic model of token communications includes the parameters with regards to* ***token arrival rate, token size, token success rate requirement, and token delay budget****.*  Table 8: Examples for the traffic model of token communications.   |  |  |  |  |  | | --- | --- | --- | --- | --- | |  | **Token arrival rate (Note 0)** | **Token size** | **Token success rate (Note 1)** | **Token Delay budget** | | Human-agent communication with text/visual tokens [26] | 30K~100K tokens/second (Note 2) | [small: 10~20, large: ~400] bits/token (Note 5) | [80~99] % for image/video/audio (Note 3) | 0.1~1 s (Note 4) | | Robot-agent communication with visual tokens [27] | 30K~60K tokens/second (Note 10) | [small: 10~20, large: ~400] bits/token (Note 5) | [80~99] % | 10~15 ms (Note 6) | | Agent-agent communication [28] | up to 30K tokens/second (Note 7) | ~20 bits/token (Note 8) | [90~99] % for image/video/audio | [1~15] ms (Note 9) | |
| *OPPO* | *Proposal 8：****A new traffic model for AI service (e.g., Token communication) should be introduced in 6G****, at least including following aspects:*   * + ***Introduce Token transmission as a new traffic type*** *for RAN1 evaluation*   + ***Introduce Token size, Token packet size, Token packet arrival, Assumptions on Token Importance***   + ***Introduce success rate requirement for token transmission***   + ***Service requirement for token transmission***   *Proposal 9：Regarding* ***the successful ratio requirement*** *for token transmission, at least following aspects should be introduced:*   * + ***Requirements for Tokens Transmission*** *(e.g., for Token Error Rate)*   + ***Methodology for Token error identification***   *Proposal 10：Regarding the service requirement for token transmission, at least following aspects should be introduced:*   * *Assumptions on downstream service* * *Downstream service requirement* * *Transmission requirement to guarantee the service requirement*   *Proposal 11: A* ***typical Token communication traffic model*** *for RAN1 evaluation should be considered and introduced, shown as Table 1:*  ***Table 1: A typical Token communication traffic model for RAN1 evaluation.***   |  |  |  | | --- | --- | --- | | ***New traffic type*** | | ***Token communication, e.g., tokenized image*** | | *Token based Packet (Tokenized image)* | *Original source data size (image)* | *256\*256\*3\*8 bit* | | *Tokenized source data size (tokenized image)* | *256\*12 bit* | | *Number of Token per image* | *256* | | *Number of bits per token* | *12* | | *Tokenizer and Detokenizer model* | *Up to implementation, [e.g., by AI models like One-D-Piece]* | | *Packet size*  *Tokens to be transmitted in one packet* | *N image, N\*256 tokens to be transmitted,*  *i.e., N\*256\*12/8 Bytes*  *FFS the value of N* | | *Packet arrival* | *Case1: Packet arrival in Poisson distribution*  *Case2: Packet arrival in Periodic distribution* | | *Packet delay budget* | *The value of Packet delay budget may vary for different services.* | | *Assumptions on Token Importance* | *Case 1: tokens are treated without different importance*  *Case 2: tokens are treated with different importance,*  *e.g., with assumptions as below:*   * *256 Tokens can be numbered from 0 to 255 in descending order of importance;* * *a lower number indicates higher criticality for information expression, while a higher number corresponds to detail information.* | | *Success rate requirement for token transmission* | *Requirements for Token Transmission* | *Consider the error tolerance characteristics for token communication, follow token transmission requirement should be evaluated:*  *Case1: All tokens are transmitted with different token error rate (TER) requirements,*  *e.g., TER=10%,20%,50%*  *Case2: Partial tokens with high importance are transmitted, TER=0 for the selected and transmitted high importance tokens, e.g., 10%,20%,50% tokens with high importance are selected and transmitted*  *Case3: Partial tokens with high importance are transmitted, TER=0 for the selected and transmitted high importance tokens, 10%,20%,50% tokens with high importance are selected and transmitted; and the rest tokens are transmitted with different token error rate requirements, e.g., TER=10%,20%,50%*  *Note: The value of Success rate requirement for token transmission (based on TER) may vary for different services.*  *Note: Error tolerance characteristics are discussed in [3].* | | *Methodology for Token error identification* | *Methods for Token level error identification are needed*  *Note: error tolerance characteristics are discussed in [3]* | | *Service requirement for token transmission* | *Assumptions on downstream service* | *Case 1: a classification task, [ e.g., ImageNet dataset, with N images, belonging to M categories, FFS N, M, e.g., N=3000, M=1000]*   * *FFS whether/how to define an aligned source data set* * *FFS whether/how to define an aligned classification algorithm/model*   *Case 2: FFS others* | | *Downstream service requirement* | *Top-5 accuracy > 90%* | | *Transmission requirement to guarantee the service requirement* | *X TER (token error rate) / BER (bit error rate) / BLER (block error rate) that could guarantee corresponded service requirement. FFS the value of X, e.g., 20% TER, or 5% BER.*  *Y important tokens are selected for transmission that guarantee corresponded service requirement. FFS the value of Y, e.g., 25% tokens are selected based on their importance.* | |
| *NEC* | *Proposal 5: For AI services,* ***adopt a flexible traffic model that differentiates between bursty and streaming uplink prompts****, defined by the following parameters:*   * *Uplink Traffic Profile, configured as either:*   + *For bursty inputs (e.g., text, images): An Uplink Prompt Size.*   + *For streaming inputs (e.g., real-time video): An Uplink Service Data Rate with periodic packet generation.* * ***Token Generation Rate (downlink).*** * ***Token Size****.* * ***Token Success Rate****.* * ***E2E Delay Budget****.* |
| *NVIDIA* | *Proposal 2:* ***Study traffic models for performance evaluation during 6GR study taking into consideration the unique characteristics of UL-heavy immersive and AI applications related traffic****.* |
| *Ofinno* | *Proposal 16:* ***New traffic model to evaluate AI/ML related use cases is needed****.*  *Proposal 17: New traffic model for AI/ML related use cases is studied under agenda item 11.6.* |
| *Google* | *Proposal 1:* ***Adopt the token-streamlined traffic model as the baseline for evaluating AI-specific use cases****.*  *Proposal 2:* ***GenAI traffic properties as agreed in SA1/TR 22.870 can be used as baseline for token-streamlined traffic model in RAN1****.*  *Proposal 3: Support 1% target BLER for CQI reporting in evaluations for AI traffic.*  *Proposal 4:* ***Support a max allowed latency for a burst (e.g., 20 ms) as key target metric for AI traffic****.* |
| *Qualcomm* | *Proposal 8:* ***For 6GR evaluation of the new use cases or services, e.g., AI/ML services, immersive communication services, study whether it can be based on extending the existing FTP or XR traffic models****.* |
| *Intel* | *- We are* ***open to consideration*** *of new traffic models to cover new use cases.* |
| *AT&T* | *Proposal 7: For 6G evaluations,* ***introduce a new traffic model for AI/ML traffic****.*  *Note: Thrive to minimize modeling complexity for the new traffic model.* |

### Discussions

13 companies discussed the traffic model for AI/ML services. With the reference to the SA1 study report in TR22.870 for 6G use cases and service requirements for AI/ML and based on the contributions for this meeting, it seems consensus that the existing traffic models do not reflect the traffic characteristics of the AI/ML services and new traffic model is needed.

**The different views among the companies lie in**:

- *What AL/ML services are concerned about*: 7 companies (Nokia, CMCC, Huawei, OPPO, NEC, Google, AT&T) explicitly mentioned the traffic model for token communication; 2 companies (ZTE, NEC) discussed the traffic models for non-tokenized generative AI application and for model training/inference or mentioned uplink prompts. 5 companies (Futurewei, NVIDIA, Ofinno, Qualcomm, Intel) just mentioned the model for AI/ML generally.

- *What level of details on the token traffic model*: 5 companies (CMCC, Huawei, OPPO, NEC, Google) are generally supportive for defining a token traffic model. 4 companies (Huawei, OPPO, NEC, Google) mentioned the token traffic model are characterized by some parameters (e.g., token size, token arrival rate, token success rate, delay budget, etc). 2 companies (Huawei, OPPO) elaborated the detailed values for the parameterized token traffic model. 1 company (ZTE) provided detailed parameterized traffic model for non-tokenized generative AI application and for model training/inference.

- *Whether other WG should be involved/consulted for defining the traffic model*: 1 company (Nokia) mentioned SA4 should be triggered for the study of the traffic model before agreeing on its use for evaluation.

- *Which agenda (11.2 or 11.6) the traffic model for AI/ML should be discussed:* 2 companies (Futurewei, Ofinno) mentioned the model can be further discussed after relevant decision is made in AI 11.6 or the model is studied under AI 11.6.

**Other suggestions from companies:**

- Some company proposed to make the token-streamlined traffic model the baseline for evaluating AI-specific use cases.

- Some companies mentioned TR22.870 documented the use cases and the requirements so can be used to derive the traffic model.

- Some companies considered to extend the existing FTP-3 or XR traffic model for simplicity regarding how to model.

- Some company argued that there are no standardized ways for compression and transport of tokens, especially considering that different tokenized traffic behaviors heavily depend on the application-level coding, encapsulation, formats etc. In addition, SA4 has studied AI/ML for media applications (AI4Media) in Rel-19 and concluded that further study is needed for traffic characteristics of AI/ML data (conclusions in TR 26.927) so SA4 should be consulted before defining the traffic model in RAN1. *[Moderator’s note: SA4’s further study is on the data defined in the TR which comprise of AI/ML model data, Intermediate data, Inference input/output data, training input/out data, etc, nothing to do with token?]*

With that and assuming agenda 11.2 will continue discussing the model, RAN1 discussions can start from the following aspects:

- *Whether the new traffic model is needed for AI/ML services:* The answer should be positive based on the above summary*.*

- *How many traffic models are needed for AI/ML services*, *e.g., one for tokenized and the other for non-tokenized for GenAI services? One traffic model for AI/ML model training/inference?*

*- Whether RAN1 can define the traffic model(s)? For instance, start from deriving the necessary parameters based on the services requirements in TR22.870?*

The new traffic model(s) for AI/ML will be needed. The questions are how many models are needed and how to set the models.

#### (FL1) Question 1:

*How many traffic models are needed for AI/ML services*, *e.g., one for tokenized and the other for non-tokenized for GenAI services? One traffic model for AI/ML model training/inference? For example, study to define traffic model(s) that could be used for 6GR AI/ML services performance evaluations,*

* *For GenAI services:*
  + *Model-1: Token traffic model*
  + *Model-2: FTP-3 variant type1 (i.e., non-tokenized model)*
* *For AI/ML model training/inference*
  + *Model-3: FTP-3 variant type2*

#### (FL1) Question 2:

*Start from deriving the necessary parameters based on the services requirements in TR22.870? For example,* *study to define traffic model(s) that could be used for 6GR AI/ML services performance evaluations,*

*- For GenAI services:*

* + *Model-1: Token traffic model*
    - ***Parameterized by: Token size, Token arrival, Token success rate, Token delay budget.*** 
      * ***FFS on values.***
      * ***FFS on whether defining other parameters.***
  + *Model-2: FTP-3 variant type1 (i.e., non-tokenized model)*
    - ***Parameterized by: Same as FTP-3 with different values.*** 
      * ***FFS on values***
* *For AI/ML model training/inference*
  + *Model-3: FTP-3 variant type2*
    - ***Parameterized by: Same as FTP-3 with different values.*** 
      * ***FFS on values***

*Moderator’s proposals will be based on the collected views to the above two questions.*

*Please share your views to the above questions here:*

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| **Company** | **Comments** |
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## New model 2-Immersive comm.

### Companies’ views

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| **Company** | **Views/proposals** |
| *Futurewei* | *For* *immersive communication services, it is likely that they can be viewed as further* ***extensions of XR services****, and generalizations of XR traffic models can be discussed and adopted.* |
| *vivo* | *Proposal 3: Support to introduce* ***haptic traffic model for immersive communication service evaluation****, and further study,*  *- The distribution of packet size*  *- The distribution of packet arrival time*  *- Packet delay budget*  *- Packet error rate*  *- Jitter*  *- The number of channels*  *- The density*  *Proposal 4: Support to* ***evaluate hybrid traffic flows (e.g., audio, video, haptics) for immersive communication service****, taking into account synchronization requirements among different flows.* |
| *Huawei* | *Proposal 10: The traffic model of immersive communications should* ***take the XR traffic model as the baseline but with the modifications on packet size******related*** *as in Table 9.*  *Table 9: Modifications of traffic model based on XR for emerging immersive services*   |  |  |  |  | | --- | --- | --- | --- | | *Parameter* | *unit* | *XR traffic model (TR38.838)* | *6GR immersive communication traffic model* | | *Mean: M* | *Byte* | *R×1e6 / F / 8* | *R×1e6 / F / 8* | | *Data rate: R* | *Mbps* | *DL: 30/45/60*  *UL: 10/20* | *DL: 100/300/500*  *UL: 20/60/100* | | *Frame generation rate: F* | *fps or Hz* | *DL: 60*  *UL: 60* | *DL: 90/120*  *UL: 15/30* | | *STD* | *Byte* | *10.5% of M* | *25% of M* | | *Max* | *Byte* | *150% of M* | *300% of M* | | *Min* | *Byte* | *50% of M* | *25% of M* | |
| *NVIDIA* | *Proposal 2: Study traffic models for performance evaluation during 6GR study taking into consideration the unique characteristics of* ***UL-heavy immersiv****e and AI applications related traffic.* |
| *Ofinno* | *Proposal 15:* ***The XR related traffic models defined in TR 38.838 are used for RAN1 evaluations related to immersive communications including XR****.* |
| *Sony* | *Proposal: RAN1 should define at least the following traffic model for 6G system level simulation assumption:*   * *FTP model 3 for mobile broadband and IoT, with scale of data rate* * *Periodic traffic with 60/120 fps for XR devices* * ***Immersive communication services such as UL-heavy*** |
| *Intel* | *We are open to consideration of new traffic models to cover new use cases.* |
| *Qualcomm* | *Proposal 8: For 6GR evaluation of the new use cases or services, e.g., AI/ML services, immersive communication services, study whether it can be based on extending the existing FTP or XR traffic models.* |

### Discussions

First off, immersive Communication has been described as follows by ITU-R: "This usage scenario extends the enhanced Mobile Broadband (eMBB) of IMT-2020 and covers use cases which provide a rich and interactive video (immersive) experience to users, including the interactions with machine interfaces.".

In addition, what immersive communication services are discussed in 3GPP can refer to SA1 study report in TR22.870 for 6G use cases and service requirements, where such use cases are documented, e.g., immersive gaming, wearable devices with immersive applications which require much computing capability for processing application data, holographic telepresence in healthcare, personalized interactive immersive guided tour service of a city, etc.

**In particular, companies discussed the traffic model for immersive comm. are referring to the use cases:**

- cloud gaming with higher display resolution such as 8K/12K predicts a larger downlink data rate. In addition, with variable bit rate (VBR) coding emerging, a larger fluctuation range on packet size compared with the traditional constant bit rate coding is implied. *(Discussed by Huawei).*

- AI wearable and intelligent eldercare on embodied AI robots implies an UL-heavy traffic packet data rate. *(Discussed by Huawei, NVDIA, Sony)*

- haptics service with traffic characteristics studied by SA4 in Rel-19 and documented in TR26.854. Haptics refers to the sense of touch, and encompasses the generation, manipulation, and perception of tactile sensations, forces, and motions. Three parameters, namely the number of channels, the media format, and the density, affect the traffic data rate. When researching immersive service, hybrid video, audio and haptics flows, along with their synchronization requirements of the arrival sequence, should be considered. *(Discussed by vivo)*

**Ideas on how to model from companies**

- Some other companies mentioned to use/extend XR traffic model to cover the use cases for immersive comm. *(Mentioned by Futurewei, Huawei, Ofinno, Qualcomm)*

- Same parameters (packet size, arrival time, delay budget and error rate, jitter) as XR traffic model will be used for haptic traffic model. In addition, consider the number of channels and the density. *(Mentioned by vivo)*

With these summarized, it can be concluded that a traffic model is needed for performance evaluations with regards to immersive communication services and the traffic model could be based on the XR traffic model with modification. The discussion points can start from:

*- How many traffic models will be defined for this purpose, e.g., haptic traffic model and others with the same parameters with different values?*

#### (FL1) Proposal 4.3.2

Study to define a traffic model that will be used for performance evaluations with regards to immersive communication services, the XR traffic model with modifications will be the starting point.

* FFS how many models need to be defined and the corresponding representative use cases.
* FFS the detailed modifications to the XR traffic model.

*Any comments/suggestions, please leave them here:*

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| **Company** | **Comments** |
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## New model 3 – FTP-3+PDB

### Companies’ views

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| **Company** | **Views/proposals** |
| *Futurewei* | *we suggest* ***introducing packet delay budget for FTP-3 Model****.* |
| *Nokia* | *Proposal 13: We propose* ***not to introduce a new FTP-3 traffic model with a with packet delay budget (PDB) requirement****. Instead, we suggest* ***using the existing FTP-3 model and defining a Capacity measure/KPI as the maximum offered cell load*** *that can be supported while UEs meet a minimum PDB threshold allowing for 5%-ile outage.* |
| *ZTE* | *Proposal 4-2-2:* ***Adopt the extended FTP traffic model in Table 4-2-2 for 6GR evaluation****.*  *FFS:* ***Using single FTP file download to simulate burst transmission and how to configure PDB values*** |
| *Huawei* | *Proposal 8:* ***FTP model 3 with different packet sizes, mean inter-arrival time and packet delay budget can be used to model some typical traffic****, and the Table 7 can be the starting point for this kind of traffic model.*  *Table 7: Example for parameters about the traffic model of FPT3 plus packet delay budget*   |  |  | | --- | --- | | *Items* | *Notes/Values* | | *FTP Model* | *FTP model 3* | | *Packet size* | *e.g. 0.05Mbytes, 0.25Mbytes, 0.5Mbytes, 1 Mbytes or other value, which is used to achieve different RUs, assuming fixed UE number per cell* | | *Mean inter-arrival time* | *e.g. 200 ms, 30ms or other value, which is also used to achieve different RUs* | | *Packet delay budget (PDB) within RAN* | *e.g. 50ms, 200ms or other value, which is used for modelling*  *different PDBs, where 98% of the packets shall not experience a delay exceeding the PDB in section 5.7.3.4 in TS 23.501* | |
| *NEC* | *Proposal 4: For MBB evaluations,* ***adopt FTP Model 3 with an added PDB requirement****. The model is defined as follows:*   * *Packets are generated according to the FTP Model 3 process (e.g., 0.5 Mbytes packet size, 200 ms mean inter-arrival time).* * *Each packet is assigned a PDB (e.g., 50 ms or 200 ms) to reflect QoS requirements.* * *The evaluation metric shall be the QoS satisfaction rate (the percentage of packets successfully delivered within their PDB) in addition to average UPT.* |
| *Ofinno* | *Proposal 14: S****tudy new traffic model generating mixed/variable packet size*** *for RAN1 evaluations related to* ***UE/network power saving and new/other use cases****.* |
| *Intel* | *Proposal 9*  *•* ***FTP Model 3 is updated to always have an associated PDB***  *•* ***A packet exceeding PDB during the transfer is dropped***  *• The number / ratio of dropped packets is reported*  *• UE packet throughput accounts all three types of packets,*  *o Successfully transferred during the simulation time,*  *o Dropped during the simulation time,*  *o Unfinished during the simulation time.* |

### Discussions

It is the fact that the FTP traffic models do not allow for the required latency for the delivery, which essentially only reflect the traffic with random packet arrival and fixed packet size for all the UEs.

*Whether the FTP-3 with packet delay budget (PDB) considered is needed:*

- With increasing number of 6G services have latency requirement, the existing FTP traffic models are not appropriate, especially considering when the RU is high, some packets stuck in the queue will have to be discarded and flagged as failure to deliver. *(mentioned by ZTE, Futurewei, NEC, Huawei, Intel)*

- There are many services (based on the standardized 5QI to QoS characteristics mapping from Table 5.7.4-1 in TS 23.501) that need both data rate and latency at the same time, such as real time gaming, video (Live Streaming), interactive gaming and etc. However, it is worth noting also that such model is not the same as XR traffic, because its each packet size keeps the same and its latency budget is around 50-280ms. *(mentioned by Huawei)*

*How to reflect PDB for the FTP-3:*

*-* Most companies view to add PDB parameter into the FTP-3 model, with some values suggested or TBD. *(Mentioned by Futurewei, ZTE, Huawei, NEC, Intel)*

*-* One company views that PDB does not need to be considered as a part of the traffic model. Instead, we can define **a capacity KPI for FTP-3 that factors in experienced packet delays** We define Capacity as maximum offered load per cell that the system can tolerate while the 5%-ile outage UE experienced PDB is above a certain threshold. This threshold may e.g. be set to equal 100 ms correct reception of a file. So essentially defining the Capacity subject to a certain minimum cell-edge UE outage performance**.**  *(Mentioned by Nokia)*

With that, companies discussed the model seem to converge that the FTP-3 model with PDB considered for the evaluations is needed. Moreover, except one company all other companies view that just adding PDB into the FTP-3 model will suffice.

#### (FL1) Proposal 4.4.2

Study to define a traffic model that could be used for 6GR evaluations, a.k.a. FTP-3a, by adding the parameter of packet delay budget (PDB) into the existing FTP-3 traffic model.

* A packet exceeding PDB during the transfer is dropped.
* FFS exact values for the PDB to be added.
* FFS other values for packet size, mean inter-arrival time will be added.

*Any comments/suggestions, please leave them here:*

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| **Company** | **Comments** |
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## New model 4- mixed/variable packet size

### Companies’ views

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| **Company** | **Views/proposals** |
| *Futurewei* | *we* ***suggest introducing a FTP-3 variant (i.e., extending the current FTP-3*** ***Model) with mixed/variable packet sizes****, or* ***even with mixed packet size distributions****, and the associated time domain behaviors, which can be used to model mixed traffic profiles, e.g., mixed delivery of large files and voice packets.* |
| *CMCC* | *Proposal 4: For enhancement on FTP3-wise traffic model, RAN1* ***take the traffic model in ETSI TS 103 786 as the starting point*** *and* ***further discuss whether there is modification/enhancement*** *on top of it.* |
| *Huawei* | *Proposal 11: The* ***services*** *corresponding to the traffic of mixed/variable packet size and the associated time domain behaviours* ***should be identified and justified before discussing how to model it****.* |
| *OPPO* | *Proposal 6:* ***A new traffic model with a mixed/variable packet size or a mix of multiple traffic models can be supported*** *in 6G without significant increase on evaluation complexity.* |
| *Samsung* | *Observation:*   * ***Packets with variable sizes are observed from real traffic logs****, with small and medium packets occurring much more frequently than larger ones*   *Proposal #6:*   * *In addition to conventional traffic models,* ***consider optional*** *6GR evaluation with non-full buffer traffic models* ***supporting variable packet sizes using FTP modeling framework***   *Proposal #7:*   * *For traffic model supporting variable packet sizes,* ***define three reference packet sizes*** *corresponding to small, medium and large packet sizes along with associated packet arrival rates*    + ***The proportion of the packet arrival rates*** *should be maintained to ensure that smaller packets are occurring much more frequently than larger ones*   *Proposal #8:*   * *For traffic model supporting variable packet sizes, consider scheduling aspects to determine reference packet sizes*   *Proposal #9:*   * *For traffic model supporting variable packet sizes, consider the following options of packet assignment to the UE for joint SLS evaluation with different packet sizes:* * *Each UE can receive the packet of only one size from the reference packet sizes* * *Each UE can receive packet of different sizes from reference packet sizes* |
| *Apple* | *For more realistic traffic modeling and suiting the need for new service/new use cases,* ***consider traffic flows with different packet size distribution/inter-arrival time/latency bound****.*  *- Consider packet size variation and inter-arrival time variation in traffic flow modeling*  *- Consider latency & reliability requirements for specific evaluations*  *-* ***Traffic flow mixture can be per UE or across UEs considering simulation time span and simulation goal****.*  *- For KPI, consider*  *- 5th percentile user spectral efficiency & average spectral efficiency*  *- UE satisfaction for new traffic model(s)* |
| *Qualcomm* | *Regarding the new traffic model considering a mixed or variable packet size, we think* ***it has been already supported by the existing XR traffic model used in 5G NR evaluation.*** *XR models inherently involve mixed traffic characteristics. Therefore, introducing a new mixed traffic model for 6G would be redundant. Instead,* ***XR model parameters can be tuned or extended*** *to match the specific traffic profiles with mixed or variable packet size.* |
| *Intel* | *- The mix of traffic types may be used to evaluate efficiency of supporting a mix of services in the system with diverse QoS requirements. In 5G, such mixed scenarios were evaluated as part of eMBB and URLLC multiplexing studies. It is expected that study on 6GR may* ***also introduce mixed traffic scenarios based on 6G use cases****, such as Immersive Communication and HRLLC.* |
| *AT&T* | *Proposal 8: For 6G evaluations,* ***introduce a new traffic model considering mixed traffic****.*  *Proposal 9: Consider enhancements on the mixed traffic model in TR36.899 to include representations of traffic characteristics of AI/ML, video streaming, web browsing, VoIP and XR traffic.* |
| *Ericsson* | *Observations*   * *Without accurate traffic models, the behavior of many mechanisms such as frequency domain scheduling, MU-MIMO, hybrid beamforming, can be misunderstood and incorrect conclusions drawn on the merit of design alternatives.* * *Existing bursty traffic models in RAN1 may not adequately reflect aspects such as mixed/variable packet size and time domain behaviors (e.g., time between packets and packet arrivals in a burst).*   *Proposal 4-1*   * *Support following traffic models for 6GR Evaluations* * *Extension of FTP Model 1 to enable multiple packet sizes*   + *UEs arrive according to Poisson process. Arrival rate of UEs is λ*     - *Each UE has one burst. A UE of class c has Sc bits per burst*       * *There are Nc packets per burst (UE). Each packet contains Sc/Nc bits*       * *Each subsequent packet is separated by time Tc from its previous packet*         + *FFS: if Tc is random or is a fixed value*   + *Each UE class c consumes a fraction αc of the total traffic, where*   + *At least two UE classes are defined*   + *FFS: the number of UE classes ‘c’ to define and corresponding values of , Tc, and Sc.* * *Extension of FTP Model 3 to enable multiple packet sizes*   + *Packets of a UE arrive according to Poisson process.*      - *Arrival rate of packets for UE of class c is λc (mean inter-arrival time between packets is 1/ λc)*   + *UEs of class c have Sc bits per packet*   + *Each UE class c consumes a fraction of the total traffic, where*   + *At least two UE classes are defined*   + *FFS: the number of UE classes ‘c’ to define and corresponding values of , Sc and λc* |

### Discussions

*Companies’ observations from the live networks:*

- Some companies mentioned packets (e.g., smartphone traffic) with variable sizes are observed from real traffic logs, with small and medium packets occurring much more frequently than larger ones. *(mentioned by Samsung, Ericsson)*

*Whether a new traffic model with mixed/variable packet size with time domain:*

- Several companies mentioned the new traffic model can be defined, given FTP1 and FTP3 assume perfectly homogenous traffic: only a single packet size is supported. *(mentioned by Futurewei, CMCC, OPPO, Apple, Intel, AT&T)*

- However, one company (*Qualcomm*) mentioned that XR inherently involves mixed traffic characteristics and extending XR model can also be considered if necessary. One company (*Huawei*) suggests clarifying the targeting service first before discussing how to model it.

*How to define the model considering the mixed/variable packet sizes and the associated time-domain behaviour, consider*

- Take the traffic model in ETSI TS 103 786 as the starting point. *(CMCC)*

- Define three reference packet sizes corresponding to small, medium and large packet sizes along with associated packet arrival rates .Two sub-options can be considered: per-UE fixed packet size: Each UE is assigned packets of a single size, but different UEs may have different packet sizes; or per-UE variable packet size: Each UE may receive packets of varying sizes over time: *(Samsung)*

- Traffic flow mixture can be per UE or across UEs considering simulation time span and simulation goal. *(Apple)*

- Extension of FTP Model 1 to enable multiple packet sizes and extension of FTP Model 3 to enable multiple packet sizes. *(Ericsson). [Moderator’s note: whether either one suffices.]*

With that, among companies discussed the model, most of them view that a new model is needed because the targeting services (i.e., smartphone traffic as mentioned by Ericsson) may have quite different traffic characteristics from XR services, so modifying the XR traffic model might be more complex than defining a new traffic model. However, how to define the model companies’ views are quite divergent.

#### (FL1) Proposal 4.5.2

Study to define a traffic model that could be used for 6GR evaluations, considering mixed/variable packet size and associated time-domain behaviors, FFS which of following approach will be pursued:

* Take the traffic model in ETSI TS 103 786 as the starting point.
* Define three reference packet sizes corresponding to small, medium and large packet sizes along with associated packet arrival rates .
* Extension of FTP Model 1 to enable multiple packet sizes and/or extension of FTP Model 3 to enable multiple packet sizes.

*Any comments/suggestions, please leave them here:*

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| **Company** | **Comments** |
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## New model 5-bidirectional traffic

### Companies’ views

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| **Company** | **Views/proposals** |
| *Futurewei* | *In our view, with the above models and enhancements to model variable packet arrival rates, packet sizes, and time-domain behaviors, the general impact of bidirectional traffic flows is already taken into account. To avoid further complicating the system-level simulators and simulation result comparison,* ***we suggest that the impact of*** ***bidirectional traffic flows being incorporated into enhanced FTP-3/XR models as much as possible****, rather than* ***introducing new/additional approaches for this purpose****. In any case, bidirectional traffic flows can be further discussed if justified.* |
| *Nokia* | *Observation 6: Closed-loop (bi-directional) traffic model* ***facilitates realistic studies of RAN recovery loops*** *at different layers such as HARQ, RLC, PDCP and inter-play with TCP CUBIC, where the dependency between the DL and UL is explicitly modelled.*  *Proposal 16: RAN1 to* ***add at least one closed-loop (bi-directional) traffic model into the 6GR study****, e.g.,* ***can be based on the existing XR model with TCP ACK feedback****.* |
| *CMCC* | *Proposal 6: For traffic model on bidirectional traffic flow,* ***RAN1 first discuss and clarify how to embed such procedure within the existing traffic model*** *(e.g. how to consider the latency on RAN MAC/RRC/core network layer/etc., and how to model the impact on ACK/NAK for TCP layer).* |
| *ZTE* | *Proposal 4-2-5: Whether to model the TCP slow start mechanism in traffic models still* ***requires sufficient justification****.* |
| *Huawei* | *Proposal 12: The* ***transport layer traffic should not be modelled*** *before 3GPP well studied the up-to-date transport layer models.* |
| *Apple* | *-* ***Be prudent in making assumptions regarding high layer protocols****, and assess evaluation complexity carefully.*  *- DL and UL traffic is separately evaluated.* |
| *DOCOMO* | *Proposal 3*   * *New/additional approaches that can reflect the impact of bidirectional traffic flows on performance metrics (e.g., impact of UL TCP ACK latency on DL throughput/latency) should be deprioritized.* |
| *Ericsson* | *Proposal 4-2*   * *6G system simulation methodology should include realistic modelling of bidirectional traffic flows by considering impact of TCP slow start and TCP ACK latency on throughput.* * *In DL system simulations the UL TCP ACK delay can be modeled by combining the two components below*   + *Component 1: Fixed delay (e.g., 5-10ms) to reflect Core/transport/internet network delays*   + *Component 2: SR+ UL grant+UL transmission delay.*      - *Suitable values can be chosen based on HARQ RTT, SR availability and TTI length for the corresponding evaluation*     - *Ideal transmission of UL TCP ACK can be assumed instead of explicitly simulating UL.* |

### Discussions

*What’s the bidirectional traffic to be considered:*

The bidirectional traffic discussed the last meeting was mainly talking about the TCP protocol from transport layer and its impact on the wireless network performance. The TCP protocol has a slow start mechanism and is used to prevent network congestion.

Specifically, as explained in a couple of companies’ contributions *(ZTE, Ericsson)* as well, when the TCP connection starts, the congestion window (cwnd) is set to a small initial value, typically measured in units of maximum segment size (MSS). For each ACK received, the congestion window increases by one MSS, which implies cwnd size increases exponentially. During the slow start process, the performance is latency limited. Only when the cwnd size stabilizes can the UE's data rate reach its maximum. This means that a packet transported using TCP consists of a sequence of data chunks, where the separation between packets is determined by the latency of the acknowledgment in the opposite link direction.

Since DL throughput depends on packet size divided by the total transmission time, the DL throughput will be affected by the UL latency. With the high data rates to be supported, the intervals between data chunks will be comparable to the time it takes to transmit the bits. This is the motivation from the proponent to consider the bidirectional traffic flow impact on wireless network performance.

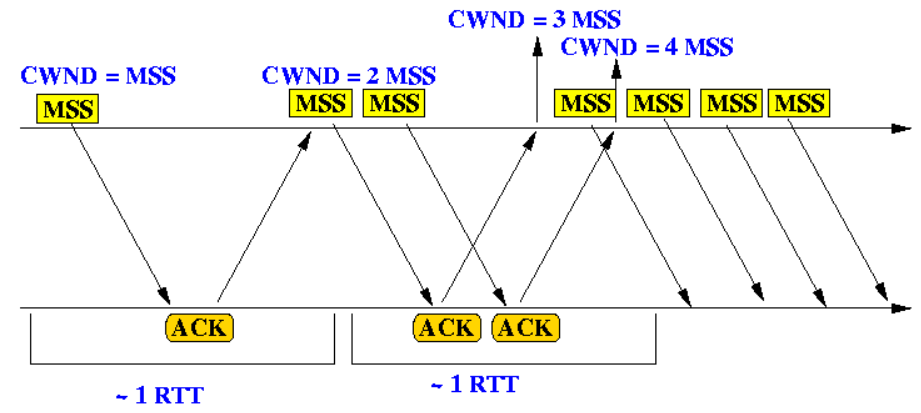


Illustration of slow start mechanism of TCP protocol

*Companies’ view on* ***whether*** *to consider this bidirectional traffic flow impact:*

- Most companies *(Futurewei, CMCC, ZTE, Huawei, Apple, DOCOMO)* view that it should be well justified or clarified first and be **prudent** in assuming a higher layer protocol to be considered for evaluating wireless network performance.

- Specific concerns mentioned in companies’ contributions:

* Transport layer protocol is out of 3GPP and has been evolving as well in another standard origination. For instance, as mentioned that the TCP protocol nowadays allows a larger initial congestion window size, which can mitigate significantly the performance bottleneck caused by latency-limited slow start phases. *(ZTE, Huawei)*
* It is unclear and should be clarified how to consider the latency on RAN MAC/RRC/core network layer/etc., and how to model the impact on ACK/NAK for TCP layer. *(CMCC)*

*Companies’ view on* ***how*** *to consider this bidirectional traffic flow impact:*

- A couple of companies (Futurewei, Nokia) mentioned it can be based on the existing XR model or FTP-3 with modification, if the necessity is well justified.

- The proponent (Ericsson) also considered the implementation complexity and suggested a simplified approach. Also mentioned that the DL system simulations with the TCP modelling methodology has been discussed/considered for LTE Rel-14 latency reduction evaluations (see Table A2-1 of TR 36.881). In the simulations, the delay caused due to TCP ACKs (i.e., for the TCP segments in the other direction) can be reflected without explicitly modelling the TCP ACK transmissions. This approach was used by several companies in previous evaluations (see Annex B of TR 36.881for some example contributions).

With proponent’s concretely simplified approach suggested, RAN1 can discuss whether this approach can be agreeable.

- The delay due to TCP ACKs can be modeled as Component 1: Core/transport/internet network delay which could be a fixed number (e.g., 5-10ms) and Component 2: SR+ UL grant+UL transmission delay. Suitable values for Component 2 can be chosen based on HARQ RTT, SR availability and TTI length for the corresponding evaluation (ideal TCP ACK transmission can be assumed instead of explicitly simulating the ACKs).

#### (FL1) Question

Whether to define a bidirectional traffic flow modelling with simplified modelling as follows:

* *In DL system simulations the UL TCP ACK delay can be modeled by combining the two components below*
  + *Component 1: Fixed delay (e.g., 5-10ms) to reflect Core/transport/internet network delays*
  + *Component 2: SR+ UL grant+UL transmission delay.* 
    - *Suitable values can be chosen based on HARQ RTT, SR availability and TTI length for the corresponding evaluation*
    - *Ideal transmission of UL TCP ACK can be assumed instead of explicitly simulating UL.*

*Any comments/suggestions, please leave them here:*

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| **Company** | **Comments** |
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## Other traffic model

### Companies’ views

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| **Company** | **Views/proposals** |
| *Ericsson* | *Proposal 4-3*   * *Based on RAN#109 agreement to support massive communication in 6G, include traffic model(s) suitable for massive communications for 6G evaluations.* * *Include the following massive communication (IoT) traffic types for 6G evaluations:*   + *Triggered/polled reporting*   + *Autonomous reporting (event-driven or periodic)*   + *Remote actuation*   + *Firmware/software update*   + *FFS the values for traffic characteristics (e.g., packet size, inter-arrival time, number of users, mobility pattern) considering 6G massive communication use cases* |

### Discussions

One company *(Ericsson)* proposed a new traffic model is needed for IOT traffic types.

*What traffic models were used in the past*

- In TR 37.910 (“Study on self-evaluation towards IMT-2020 submission”), mMTC uses a traffic model with layer 2 PDU (Protocol Data Unit) message size of 32 bytes and 1 message/day/device or 1 message/2 hours/device, where the packet arrival follows Poisson arrival process for non-full buffer system-level simulation.

- In TR 36.888 (“Machine-Type Communications (MTC) User Equipments (UEs) based on LTE”), the following traffic types have been considered for mMTC (Annex A and Annex A.1):

* Triggered reporting (command-response traffic)
* Autonomous reporting (exception/event-driven reports or periodic reports)

- In TR 45.820 (“Cellular system support for ultra-low complexity and low throughput Internet of Things”), the following traffic types have been considered (Annex E.2):

* Autonomous reporting (exception reports or periodic reports)
* Network command
* Software update

*Why a new model is needed?*

- Although the traffic types described in the above TRs may still be relevant for 6G massive communication, the traffic characteristics (e.g., packet size, inter-arrival time) may not be representative of what is expected for 6G massive communication or what has been observed in real deployments of legacy massive IoT solutions.

*What the new aspect needs to be considered for the new traffic model for IOT*

The following traffic models can be considered as representative of the applications expected for 6G massive communications for evaluation purposes:

* Network triggered/polled reporting
  + Application layer in the network triggering an UL application payload from the device, e.g., for sensor reading.
* Device autonomous reporting (event-driven or periodic)
  + Event-driven: An UL application payload triggered by an event in the device delivered (within a certain latency target) and a DL application ACK, e.g., for outage notifications from sensors.
  + Periodic: Periodic UL reporting from a device and a DL application ACK, e.g., for regular sensor reading.
* Remote actuation
  + An application server generates an application layer command to the device to perform an action (in the physical world) with an UL application ACK received (within a certain latency target), e.g., for disconnecting devices or triggering an emergency shutoff.
* Firmware/software update
  + All 6G massive communication devices are expected to require occasional firmware and/or software updates (e.g., every few months). Although updates are expected rather occasionally, file sizes are expected to be relatively large (e.g., for new version release) and certain updates (e.g., security patches) may need to be delivered to selected UE groups withing a certain update campaign timeframe (e.g. within a few days or weeks). Based on the above discussion, we have the following proposals.

#### (FL1) Question

Whether need to study a new traffic model for 6GR IoT performance evaluation, considering the following factors:

* *Triggered/polled reporting*
* *Autonomous reporting (event-driven or periodic)*
* *Remote actuation*
* *Firmware/software update*
* *FFS the values for traffic characteristics (e.g., packet size, inter-arrival time, number of users, mobility pattern) considering 6G massive communication use cases*

*Any comments/suggestions, please leave them here:*

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| **Company** | **Comments** |
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# Link budget

## General consideration for 6GR coverage

### Companies’ views

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| **Company** | **Views/proposals** |
| *Futurewei* | *Proposal 12: Evaluate coverage for 6GR upper mid-band in* ***at least around 7 GHz based on existing 5G mid-band site grid, based on link budget analysis.***   * *At least maximum path loss (MPL) is used as a metric for coverage performance.* |
| *Nokia* | *Proposal 18: RAN1 needs to agree first on the default system-level evaluation parameters in various deployment scenarios before starting link-budget evaluation.*  *Observation 7: Link budget calculation can be initially based on modified Shannon Bound (MSB) but should be refined based on the results of LLS and SLS. Besides PUSCH and PDSCH the link budgets would need to account for PDCCH and PUCCH, PRACH, CQI and ACK/NACK formats for different UE form factors and other multiple propagation factors.*  *Proposal 19:* ***Link budget evaluations should consider not only data channels but also PDCCH, PUCCH, PRACH****.*  *Proposal 20: For the data channels (PDSCH, PUSCH), the link budget evaluation should provide supported data rate for a given gNB-UE distance as one of the metrics.* |
| *CMCC* | *Proposal 7:* ***Compared with 5G, similar or better coverage performance can be considered for 6G design****.*  *Proposal 8: Both urban macro and rural scenarios can be considered for coverage performance evaluation. And urban macro scenario has higher priority.*  *Proposal 9：Both requirements of wideband traffic with high data rate and VoIP, LPWA traffic should be considered for the coverage performance evaluations.*  *Proposal 10: 7GHz can be considered as main operation frequency for the coverage evaluations.*  *Proposal 11: Both uplink and downlink channels in the idle mode and connected mode should be considered for the coverage evaluations.* |
| *CATT* | *Proposal 12: Separate LLS simulation assumptions should be adopted for MBB UE and IoT devices respectively, and at least data rate, number of UE Rx chains and system bandwidth should be studied.*  *Proposal 13: gNB antenna gain from RF chains in LLS to actual TxRUs can be reflected in link budget template similar as NR.* |
| *Apple* | *Deployment scenarios*  *- Site sharing for 7 GHz and 4GHz/(2.6 GHz?)*  *- Target data rates for eMBB performance evaluation for FR3*  *- Urban scenario: DL 10Mbps, UL 1Mbps*  *- Rural scenario (?): DL 1Mbps, UL 100kbps*  *- LPWA (10dB extension compared with eMBB)*  *Evaluated channels*  *- PUSCH for eMBB (same or different UL/DL pattern with NR), PUSCH for VoIP, PUCCH, SSB, PDCCH (broadcast and unicast), PDSCH for eMBB*  *- Random access channels (Msg1 to Msg5, PUCCH with HARQ-ACK for Msg.4 )* |
| *Qualcomm* | *Proposal 4: Study how 7GHz co-site deployment with 4GHz can be effectively supported.*  *This may involve modeling of channel estimation error in system-level simulations.* |
| *DOCOMO* | *Proposal 1*  *• Support to evaluate 5%-tile UPT for evaluation of coverage, in addition to link budget.* |

### Discussions

One of the study objectives is to target the comparable coverage to 5G mid-band for reusing 5G mid-band (~3.5GHz) site grid for 6G deployments in at least around 7 GHz. Moreover, 6GR physical layer structure study will evaluate coverage compared to 5G NR.

Last RAN1 and plenary meetings discussed coverage aspect and it was clarified that the coverage target is to be decided by the RAN plenary meeting.

For this RAN1 meeting, companies discussed some points such as

- The different requirements of data rate regarding different traffic types, e.g., wideband traffic, LPWA traffic, or for different scenarios, e.g., Uma or Rural, should be considered;

- Coverage analysis should consider data channel and other channels, e.g., control channels, PRACH;

- Coverage analysis should consider both uplink and downlink channels;

- Diverse device types should be considered;

- The concerned scenarios and carrier frequency for coverage evaluations, i.e., Uma and rural, 7GHz carrier frequency

- 5%-tile UPT should also be evaluated for coverage in addition to link budget.

As RAN plenary decided to make the decision for the coverage target, it seems premature for RAN1 WG to move further step than discussing the evaluation methodology first. Whether further aspects need to be discussed in this agenda can be TBD.

#### (FL1) Moderator’s suggestion:

Evaluation methodology for coverage analysis can be discussed first. Whether further aspects need to be discussed in this agenda can be TBD.

*Any comments/suggestions, please leave them here:*

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| **Company** | **Comments** |
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## Metric for 6GR coverage analysis

### Companies’ views

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| --- | --- |
| **Company** | **Views/proposals** |
| *Futurewei* | *Proposal 12: Evaluate coverage for 6GR upper midband in at least around 7 GHz based on existing 5G mid-band site grid, based on link budget analysis.*   * ***At least maximum path loss (MPL)*** *is used as a metric for coverage performance.* |
| *CMCC* | *Proposal 13:*  *It is proposed that* ***considering the pathloss, penetration loss and shadow fading in total as propagation loss for the coverage performance metric****.*  *Proposal 14:*  ***MCL with modification based on Rel-16 definition can be considered as the coverage performance metric****.*  *Proposal 15:*  *The definition of MCL is proposed,*  ***Definition of MCL:***  ***- MCL = Total transmit power – Receiver sensitivity + gNB antenna gain (considering all elements in one polarization).*** |
| *ZTE* | *Proposal 3-1:* ***Adopt MCL as the standardized link budget metric*** *for 6GR evaluation as 5G NR.* |
| *Huawei* | *Proposal 13: Table 11 (Link budget template in TR38.830) as the starting point is used for 6G Link budget template,* ***where the MPL should be used as the basic performance metric for coverage analysis****.* |
| *Apple* | *-* ***Coverage bottleneck channel(s) identification is performed using MIL or MCL or MPL*** |
| *Ericsson* | *Proposal 5*   * ***MCL as defined by Table 7.10.1-1 of TR 38.913 is used by RAN1 to quantify the RAN coverage targets for 6G****.* * *Methodologies for evaluating the coverage of each physical channel/signal are further discussed.* |

### Discussions

The evaluation methodology for coverage analysis, based on Rel-17 coverage enhancement study report in TR 38.380, includes the performance metrics and link budget template.

It was documented in TR 38.830 that for LLS based methodology, coverage bottleneck(s) identification is performed using at least MIL or MCL (assuming the set of simulation assumptions). Even when SLS is used to obtain some components of MIL or MCL, it is categorized as LLS based methodology. MCL values can also be used to identify the coverage bottleneck(s). MPL can be used as supplemental information for coverage bottleneck(s) identification.

The correlations among MCL, MIL, and MPL are

- MCL = Total transmit power – Receiver sensitivity + gNB antenna gain (component 2).

- MIL = Total transmit power – Receiver sensitivity – Tx loss – Rx loss + gNB antenna gain (component 2 + 3 + 4) + UE antenna gain.

- MPL = MIL – Shadow fading margin + BS selection/macro-diversity gain – Penetration margin + Other gains.

The gNB antenna gain with components 2, 3, and 4 are defined in TR 38.830:

|  |
| --- |
| *For link level simulation, two options for TDL channel model are considered:*  *- TDL channel model option 1: 2 or 4 gNB RF chains in LLS*  *- TDL channel model option 2 (optional): number of gNB RF chains in LLS = number of TXRUs*  *For TDL channel model option 1, the complexity of link level simulation can be simplified, while the practical gNB architecture can be reflected in TDL channel model option 2.*  *Figure 4.1-1 and Figure 4.1-2 depict gNB antenna gain modelling for TDL channel model option 1, and TDL channel model option 2 and CDL channel model respectively. M is the number of antenna elements, N is the number of TXRUs, k is the number of RF chains considered in LLS. For TDL channel model option 1, gNB antenna gains include 4 components, i.e., antenna gain component 1/2/3/4. For TDL channel model option 2 and CDL channel model, gNB antenna gains include 3 components, i.e., antenna gain component 1/3/4. The antenna gain component 1 is included in LLS, while the antenna gain component 2/3/4 are included in link budget template.*    Figure 4.1-1: gNB antenna gain modelling for TDL channel model option 1    Figure 4.1-2: gNB antenna gain modelling for TDL channel model option 2 and CDL channel model |

**However, it was noted by companies in contributions that**

- Cons of MCL: MCL does not consider some important factors that should be considered for a more realistic coverage footprint identification for 6GR and comparison between 5G NR coverage and 6GR coverage when co-site deployed, though it is simpler and straightforward.

- Cons of MPL: The shadow fading and the penetration loss vary in different deployment scenarios. It is not fair that RAN1 or RAN assume a fixed shadow fading and penetration loss and only provide the pathloss for the deployments.

- **Challenging for MIL/MPL**: when determining MIL and MPL, a value of antenna array gain must be determined, and this depends on a wide variety of factors, such as the tilt in a fixed antenna system, the beamwidth in an adaptive antenna system for a particular physical channel, and the angle spread of the channel relative to the beamwidth. These effects were discussed at length in the Rel-17 NR coverage enhancement item, which concluded with companies proposing widely different values for effective beamforming gain.

- MCL counts gNB antenna gain (component 2) should be updated to contain all the component 2+3+4.

**Suggestions from companies:**

- If companies are interested in the MIL/MPL, they can further study based on their appropriate hardware implementation assumption, on the top of 3GPP outcome of MCL evaluation.

- MIL and MPL are suited to specific tasks. MIL may be motivated where antenna gains differ among physical channels and may provide insight on ‘bottleneck’ channels that result from these differences. MPL can be used as a rough check of supported cell size.

- It is most important to first have a simple link budget approach like the MCL calculation above that can be consistently used across companies for discussions on coverage targets (e.g., in RAN). More detailed methodologies for evaluating the coverage of each physical channel/signal, including any additional link budget metrics can be considered later according to the feature being designed. To be clear, link budget metrics like MCL/MIL/MPL etc. will not on their own accurately determine the physical size of a cell. The evaluation methodology should reflect basic link design aspects like power, modulation, coding, diversity, etc. which are used by most or all 6G services.

#### (FL1) Proposal 5.2.2

To target the comparable coverage to 5G mid-band for reusing 5G mid-band (~3.5GHz) site grid for 6G deployments in at least around 7 GHz, the performance metrics of MCL/MIL/MPL could be used with definitions referring to TR38.830:

* MCL can be used for carrier frequency independent coverage comparison.
* MIL can be used for comparing different channels where antenna gains differ among physical channels
* MPL can be used as for the supported cell size (i.e., ISD) conversion.
* FFS: For MCL definition, whether the gNB antenna gain comprising component 2 should be updated to include components 2+3+4.

*Any comments/suggestions, please leave them here:*

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| **Company** | **Comments** |
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## Link budget template for 6GR

### Companies’ views

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| --- | --- |
| **Company** | **Views/proposals** |
| *CMCC* | *Proposal 12: Link level simulation can be carried out to evaluate the SINR requirements for the specific channel and traffic. Link budget template from Rel-16 CE and IMT-2020 self-evaluations can be considered as a starting point.*  *Proposal 16:*  ***The link budget template from TR 38.830 (as in section A.3)*** *is proposed as a starting point for the coverage evaluations.* |
| *ZTE* | *Proposal 3-2:* ***Adopt method in TR 38.830 as the starting point*** *for link budget analysis in 6GR evaluation.*   * *When determining target SINR values, advanced hardware capabilities and algorithmic improvements should be taken into consideration.* |
| *Huawei* | *Proposal 13:* ***Table 11 (Link budget template in TR38.830) as the starting point*** *is used for 6G Link budget template, where the MPL should be used as the basic performance metric for coverage analysis.* |
| *CATT* | *Proposal 11:* ***Link budget template in TR38.830*** *can be a starting point for 6G coverage evaluation.*  *Proposal 14: Penetration margin in the link budget template can be separately determined for O2I scenarios at around 4GHz and around 7GHz based on the latest O2I penetration model in TR 38.901.* |
| *OPPO* | *Proposal 5****: Link budget template and performance metrics from Rel-17 NR coverage enhancement in TR 38.830*** *can be used as a starting point.* |
| *Apple* | *The basic evaluation methodology is based on link-level simulation*  *- Obtain the required SINR for the physical channels under target scenarios and service/reliability requirements*  *- Obtain the baseline performance based on required SINR and the link budget template* |

### Discussions

With reference of TR38.830, companies all suggested the link budget template from this TR can be used as a starting point.

#### (FL1) Proposal 5.3.2

Reusing the link budget template from TR38.830 (with the deletion highlighted) for 6GR coverage evaluation, i.e., the following table with notes as follows:

* The values of the parameters are TBD.
* The row (22bis) of MCL may be updated based on the performance metric discussion.

|  |  |
| --- | --- |
| System configuration | |
| Channel for evaluation |  |
| Scenarios and Carrier frequency (GHz) |  |
| BS antenna heights (m) |  |
| UT antenna heights (m) |  |
| Cell area reliability (%) |  |
| Lognormal shadow fading std deviation (dB) |  |
| Tx Diversity |  |
| Number of SSB |  |
| Transmitter | |
| (1) Number of transmit antenna elements |  |
| (2) Number of transmit TxRUsNote: this row is void (left empty) for uplink |  |
| (2a) Number of transmit chains modelled in LLS |  |
| (3) Total transmit power (dBm) Note: total transmit power for system bandwidth |  |
| (3a) System bandwidth for downlink, or occupied bandwidth for uplink (Hz) |  |
| (3b) Power Spectrum Density = (3) - 10 log( (3a) / 1000000 ) (dBm/MHz)  ~~Note: For FR1 downlink, (3b) should satisfy the following:   For 4GHz frequency, 24 and 33  For 2.6 GHz frequency, 33  For 700MH and 2GHz frequency, 36 Note: For FR2 downlink, the following should be satisfied:  40 dBm for 100 MHz Urban scenario,  23 dBm for 100 MHz Indoor scenario.~~ Note: no PSD constraint for uplink |  |
| (3c) Bandwidth used for the evaluated channel (Hz) Note: (3c) is identical to the number of PRBs assigned to the channel evaluated. For uplink, (3a) = (3c) |  |
| (3bis) Total transmit power for occupied bandwidth = (3b) + 10 log ((3c) /1000000) (dBm) |  |
| (4) Total antenna gain at antenna gain component 3 & antenna gain component 4 of transmitter = (4a) – (4b) (dB) |  |
| (4a) Antenna gain at antenna gain component 3 & antenna gain component 4 of transmitter = (4c) + 10 log ((1) / (2)) (dB) for downlink, and = (4c) + 10 log ((1) / (2a)) (dB) for uplink |  |
| (4b) Antenna gain correction factor at antenna gain component 3 & antenna gain component 4 of transmitter (dB) |  |
| (4c) Gain of antenna element (dBi) |  |
| (5) Total antenna gain at antenna gain component 2 of transmitter = (5a) - (5b) (dB) Note: zero for uplink |  |
| (5a) Antenna gain at antenna gain component 2 of transmitter = 10 log((2)/(2a)) (dB) Note: zero for uplink |  |
| (5b) Antenna gain correction factor at antenna gain component 2 of transmitter (dB) Note: zero for uplink |  |
| (8) Cable, connector, combiner, body losses, etc. (enumerate sources) (dB) (feeder loss must be included for and only for downlink) |  |
| (9) EIRP = (3bis) + (4) + (5) – (8) dBm |  |
| Receiver | |
| (10) Number of receive antenna elements |  |
| (10a) Number of receive TxRUs Note: this row is void (empty) for downlink |  |
| (10b) Number of receive chains modelled in LLS |  |
| (11) Total antenna gain at antenna gain component 3 & antenna gain component 4 of receiver = (11a) - (11b) (dB) |  |
| (11a) Antenna gain at antenna gain component 3 & antenna gain component 4 of receiver  = (11c) + 10 log ((10)/(10a)) (dB) for uplink  = (11c) + 10 log ((10)/(10b)) (dB) for downlink |  |
| (11b) Antenna gain correction factor at antenna gain component 3 & antenna gain component 4 of receiver (dB) |  |
| (11c) Gain of antenna element (dBi) |  |
| (11bis) Total antenna gain at antenna gain component 2 of receiver = (11bis-a) - (11bis-b) (dB) Note: zero for downlink |  |
| (11bis-a) Antenna gain at antenna gain component 2 of receiver = 10 log((10a)/(10b)) (dB) Note: zero for downlink |  |
| (11bis-b) Antenna gain correction factor at antenna gain component 2 of receiver (dB) Note: zero for downlink |  |
| (12) Cable, connector, combiner, body losses, etc. (enumerate sources) (dB) (feeder loss must be included for and only for uplink) |  |
| (13) Receiver noise figure (dB) |  |
| (14) Thermal noise density (dBm/Hz) |  |
| (15) Receiver interference density (dBm/Hz) |  |
| (16) Total noise plus interference density = 10 log (10^(( (13) + (14))/10) + 10^((15)/10)) (dBm/Hz) |  |
| (18) Effective noise power = (16) + 10 log ((3c)) (dBm) |  |
| (19) Required SNR (dB) |  |
| (20) Receiver implementation margin (dB) |  |
| (21) H-ARQ gain (dB) Note: Only applicable if HARQ is not considered in LLS |  |
| (22) Receiver sensitivity = (18) + (19) + (20) – (21) (dBm) |  |
| (22bis) MCL = (3bis) – (22) + (5) + (11bis) (dB) |  |
| (23) Hardware link budget, a.k.a. MIL = (9) + (11) + (11bis) − (12) − (22) (dB) Note: MIL can also be derived by (22bis) + (4) – (8) + (11) − (12) |  |
| Calculation of available pathloss | |
| (25) Shadow fading margin (function of the cell area reliability and lognormal shadow fading std deviation) (dB) |  |
| (26) BS selection/macro-diversity gain (dB) |  |
| (27) Penetration margin (dB) |  |
| (28) Other gains (dB) (if any please specify) |  |
| (29) Available path loss = (23) – (25) + (26) – (27) + (28) (dB) |  |
| Range/coverage efficiency calculation | |
| (30) Maximum range (based on (29) and according to the system configuration section of the link budget) (m) |  |

*Any comments/suggestions, please leave them here:*

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| **Company** | **Comments** |
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# Additional assumptions for NTN

## Carrier frequency for NTN

### Companies’ views

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| --- | --- |
| **Company** | **Views/proposals** |
| *Nokia* | *Proposal 8: Frequency band assumptions for 6GR system evaluations should be based on existing FR1-NTN and FR2-NTN. That is, FDD operation, and 2 GHz for FR1-NTN and 20 GHz (DL) and 30 GHz (UL) for FR2-NTN.* |
| *vivo* | *Around 2 GHz (S band)*  *Around 12/14 GHz (Ku band)*  *Around 20/30 GHz (Ka band)* |
| *xiaomi* | *S-band / Ka-band* |
| *ZTE* | *Around 1.5 or 2 GHz for both DL and UL*  *Around 20 GHz for DL Around 30 GHz for UL*  *Around 10 GHz for both DL and UL* |
| *Huawei* | *S/L band: Around 2 GHz for both DL and UL*  *Ka-band: Around 20 GHz for DL Around 30 GHz for UL* |
| *CATT* | *S-band (i.e. 2 GHz)*  *Ka-band (i.e. 30 GHz for UL, 20GHz for DL)* |
| *LGE* | *Proposal 5: For NTN evaluation assumption, following frequency ranges are considered as the starting points:*   * *Around 1.5 GHz* * *Around 2 GHz* * *Around 4 GHz* * *Around 11 GHz + Around 13 GHz* * *Around 20 GHz + Around 30 GHz* * *Around 40 GHz + Around 50 GHz*   *FFS: Satellite parameters for system level evaluation for each frequency range.* |
| *ETRI* | *S-band (2GHz)*  *Ka-band (20GHz for DL, 30GHz for UL)* |
| *ESA, Thales, Viasat, Eutelsat* | *L-, S-, C-, Ku-, Ka-, and Q/V bands* |
| *MediaTek* | *Ku-band (i.e. [12-14] GHz), S-band (i.e. 2 GHz)* |
| *Sharp* | *Ka/Ku* |
| *CSCN* | *S-band (i.e. 2 GHz)*  *Ka-band (i.e. 30 GHz for UL, 20GHz for DL)* |

### Discussions

*Background for this discussion*

- When discussing the common assumptions (i.e., antenna modelling and general system-level simulation assumptions) in the last meeting, it was clarified in the end that last meeting and the subsequent post-122 email discussion started with TN. The reason was that many assumptions rely on the carrier frequency, e.g., antenna modelling and bandwidth, etc., and the carrier frequency for TN has been decided from the RAN plenary meeting. Assumptions to NTN were pending and subject to plenary meeting decision on the carrier frequency first.

- During post-122 email discussion, some companies expressed the concerns of pending NTN assumptions and suggested starting the discussion as soon as possible. It was clarified then that RAN1 could start the discussion on the carrier frequency from RAN1#122bis based on companies’ inputs.

*Situations for this RAN1#122bis meeting on the carrier frequency*

- 12 companies discussed the evaluation assumptions for 6GR NTN, including carrier frequency/band and/or the associated system-level/link-level assumptions.

- The 12 companies all mentioned the carrier frequency for NTN can be considered includes S-band (i.e., 2GHz) and Ka-band (*i.e. 30 GHz for UL, 20GHz for DL*).

- 5 contributions *(vivo, LGE, ESA (with co-sourced), MediaTek, Sharp)* mentioned Ku-band (i.e. [12-14] GHz)

- A co-sourced *(by ESA, Thales, Viasat, Eutelsat)* contribution mentioned other bands as well, i.e., L-band, C-band

- 2 contributions *(ESA (with co-sourced), LGE)* mentioned Q/V bands.

*Plan for this meeting*

- Discussing/agreeing on the carrier frequency that could be used for 6GR NTN evaluations.

- Discussing/ agreeing on the assumption template for NTN, including the template on antenna modelling and general system-level simulations as what has done for TN.

- Post-122bis email discussion on collecting assumptions for NTN based on the templates can also be considered as what has don’t for NTN.

#### (FL1) Proposal 6.1.2

At least the following carrier frequencies could be considered (from RAN1 perspective) for 6GR NTN evaluations:

* S-band (i.e. 2 GHz)
* Ka-band (i.e. 30 GHz for UL, 20GHz for DL)

*Any comments/suggestions, please leave them here:*

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| **Company** | **Comments** |
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## Assumption template for NTN

### Companies’ views

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| **Company** | **Views/proposals** |
| *CSCN* | *Along with the contribution, attached with a spreadsheet which suggested being the template for NTN.* |
| *Other 11 companies* | *Included in the contribution a table for system-level simulation assumptions.*  *The tables from different proponents have different numbers of rows or categorize the parameters from different angles/aspects.* |

### Discussions

*Plan for this meeting*

- Discussing/ agreeing on the assumption template for NTN, including the template on antenna modelling and general system-level simulations as what has done for TN.

- Post-122bis email discussion on collecting assumptions for NTN based on the templates can also be considered as what has don’t for NTN.

Likewise, the templates for NTN will be provided in an attached spreadsheet.

#### (FL1) Proposal in Attachment3

Attached spreadsheet (labeled with ATMT3) includes

* the template for antenna modelling for 6GR NTN evaluations.
* the general system-level simulation assumption template for 6GR NTN evaluations.

*Please check the templates and share your comments/views here if any:*

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| **Company** | **Comments** |
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# Other common assumptions?

Last meeting clarified that the common evaluation assumptions, traffic models, and link budget will be discussed in this agenda. Other topic specific assumptions will be discussed in other individual agendas including those have opened for discussions including waveform, coding and modulation, frame structure, AI/ML, energy efficiency and those will be discussed from RAN1#124/124bis including initial access, sensing, etc.

It was also noted that additional assumptions can also be discussed in this agenda if the necessity is being identified.

Companies’ views are briefly summarized in the next subsection and the discussion is supposed to identify whether additional common evaluation assumptions will be further discussed in this agenda.

### Companies’ views

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| **Company** | **Views/proposals** |
| *Nokia* | *Discussed and proposed that RAN1 to define the scope of Link Level Simulations (LLS), e.g., LLS covers the evaluation of the PHY features, and shall include Hybrid ARQ, Dynamic link adaptation, and presence of interference for a single UE-gNB link.*  *Also proposed the detailed LLS simulation parameters RAN1 to consider, e.g., subcarrier spacing, channel model to be used, reference signals, performance metrics.* |
| *vivo* | *Discussed evaluation methodology in details for sensing, e.g., use case, metrics, channel model, etc.* |
| *ZTE* | *Discussed sensing related use cases and scenarios.* |
| *Huawei* | *Discussed sensing related use case, evaluation methodology.* |
| *OPPO* | *Discussed evaluation methodology for energy efficiency, including power model for BS and UE.* |
| *BUPT* | *Discussed channel model on advanced mobility and micro-doppler for ISAC evaluations.* |
| *Samsung* | *Discussed specific assumptions for MIMO, e.g., sTRP/mTRP, MIMO layers, channel and interference estimation error, etc.*  *Discussed specific assumptions for sensing, e.g., sensing modes, performance metrics, interference modelling, waveform, etc.*  *Discussed RF model with nonlinearity which in particular from PA and proposed to consider a PA model (e.g., GMP) in TR38.803 and an I/Q imbalance model for the evaluation.*  *Discussed a specific interference estimation modelling and proposed to use a realistic modelling* *e.g., Wishart distribution-based model according to TR 36.829 (Note: the parameters of the model should be reported by company).* |
| *LGE* | *Discussed MIMO related assumptions, e.g., antenna ports, rank numbers, MIMO layers, etc.*  *Discussed sensing related scenarios.* |
| *NEC* | *Discussed power model for energy efficiency.*  *Discussed AI/MI modeling, considering performance, overhead, complexity and also discussed the need to enhance the power model for AI/ML.* |
| *NVIDIA* | *Discussed power consumption model and proposed to study the model based on AI-driven NW energy optimization and energy cost of running AI models.*  *Discussed channel model and proposed Ray-tracing should be considered.*  *Discussed and proposed the performance metrics for 6GR evaluations.* |
| *InterDigital* | *Proposed that inter-RAT interference modelling should be considered to evaluate the co-existence impact in MRSS scenario.*  *View that it might be useful to align some link level evaluation parameters as much as possible so a common set of link level evaluation parameters that each topic can leverage needs to be defined.*  *Proposed a set of parameters for link-level evaluations.* |
| *Lenovo* | *Discussed power consumption model that needs to allow for the upper mid band spectrum operation, large antenna array, and larger bandwidth.*  *Discussed MIMO related evaluations aspects, including larger number of antennas for both base station and UEs and other related optimization.*  *Discussed and proposed the evaluation assumption for sensing related including use case, waveform, performance metrics.* |
| *ETRI* | *Proposed to study cost-efficient network architectures leveraging NCR and/or RIS technologies from the early stage of 6GR.*  *Discussed link-level evaluation assumptions for both TN and NTN.* |
| *Sony* | *Discussed power consumption models for BS and UE, performance metrics for 6GR evaluations, ISAC related performance metrics, link-level simulation assumptions.* |
| *Apple* | *Discussed and proposed evaluation assumptions for initial access, ISAC related assumptions, NTN related, MIMO related.* |
| *Qualcomm* | *Discussed evaluation assumptions for modulation coding, waveform, MIMO related, initial access, sensing and positioning related.* |
| *Ericsson* | *Discussed channel model enhancement for e.g., sensing, accurate Doppler modelling for high speed scenario.*  *Discussed evaluation assumptions for support of diverse device types.*  *Discussed UE RF and PA modelling. Proposed RAN4 should be involved early in high level aspect of RF performance and makes final conclusion on relative RF performance of schemes studied by RAN1.* |
| *BOOST* | *Discussed key principles for designing energy-efficient 6G Radio (6GR) by focusing on improvements at both the device and network levels. The strategy is three-fold: leveraging existing 5G energy efficiency techniques, employing AI/ML to optimize relevant algorithms, and utilizing Multi-Radio Signaling and Sharing (MRSS) to allow 6G and 5G to share signals and channels where they coexist. Ultimately, these principles guide 6GR development toward reducing overall power consumption while sustaining high performance and diverse service capabilities.* |

### Discussions

Except those have been clarified in the last meeting agreement, nothing else that can be decided that should be discussed in this agenda at this meeting per moderator’s assessment.

#### (FL1) Moderator’s suggestion

Continue discussing the issues as agreed to be discussed in this agenda first. TBD on any other issues that needs to be discussed in this agenda.

*Any comments/suggestions, please leave them here:*

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| **Company** | **Comments** |
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# Proposals for offline/online

TBD

# References

1. R1-2507292 Post-122 email discussion on 6GR common evaluation assumptions Moderator (Huawei)
2. R1-2506739 Evaluation assumptions for 6GR air interface FUTUREWEI
3. R1-2506751 On Evaluation Assumptions for Study of 6G Radio Air Interface Nokia
4. R1-2506814 Discussion on evaluation assumption for 6GR Spreadtrum, UNISOC
5. R1-2506898 Evaluation methodology and assumptions for 6GR air interface vivo
6. R1-2506989 Discussion on evaluation assumptions for 6GR air interface Xiaomi
7. R1-2507014 Discussion on evaluation assumptions for 6GR air interface CMCC
8. R1-2507022 Evaluation assumptions for 6GR Tejas Network Limited (Withdrawn)
9. R1-2507042 Discussion on evaluation assumptions for 6GR air interface ZTE Corporation, Sanechips
10. R1-2507058 Evaluation assumptions for 6GR air interface Huawei, HiSilicon
11. R1-2507105 On evaluation assumptions for 6GR air interface CATT
12. R1-2507176 Evaluation assumption for 6GR air interface OPPO
13. R1-2507215 Considerations on channel modeling and evaluation assumptions for 6GR air interface BUPT, CMCC, vivo, X-Net
14. R1-2507253 Evaluation assumptions for 6GR Samsung
15. R1-2507361 Discussion on evaluation assumptions for 6GR air interface LG Electronics
16. R1-2507411 Discussion on 6G Evaluation Requirements NEC
17. R1-2507434 Evaluation assumptions for 6GR air interface NVIDIA
18. R1-2507467 Discussion on Evaluation assumptions for 6GR air interface Ofinno
19. R1-2507479 Evaluation assumptions for 6GR air interface InterDigital, Inc.
20. R1-2507481 Evaluation assumptions for 6GR air interface Lenovo
21. R1-2507506 Discussion on evaluation assumptions for 6GR air interface ETRI
22. R1-2507571 Satellite Access Node Characteristics for the Evaluation Assumptions for 6GR air interface ESA, Thales, Viasat
23. R1-2507596 Evaluation assumptions for 6GR air interface Sony
24. R1-2507607 Evaluation assumptions for 6GR air interface MediaTek Inc.
25. R1-2507635 On Evaluation Assumptions for the 6GR air interface Google
26. R1-2507677 Evaluation assumptions for 6GR air interface Apple
27. R1-2507721 Evaluation assumptions for 6GR air interface Qualcomm Incorporated
28. R1-2507731 Views on evaluation assumptions for 6GR Intel
29. R1-2507746 Evaluation Assumptions for 6GR Air Interface AT&T
30. R1-2507766 Evaluation assumptions for 6GR air interface for NTN Ka/Ku band Sharp
31. R1-2507815 Discussion on Evaluation assumptions for 6GR air interface NTT DOCOMO, INC.
32. R1-2507825 Evaluation assumptions for 6GR Ericsson AB.
33. R1-2507853 Views on evaluation assumptions for 6GR air interface CSCN
34. R1-2507895 Evaluation assumptions for 6GR Tejas Network Limited
35. R1-2507939 BOOST Mobile Network Boost Mobile Network

# Appendix – Existing traffic models

* **FTP Model 1, FTP Model 2, and VOIP (in TR 36.814)**

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| *A.2.1.3 Traffic models*  *Traffic models for system performance evaluations are given in Table A.2.1.3-1. System throughput studies shall be assessed using full-buffer traffic model capturing continuous traffic and non-varying interference. Additionally, evaluations with time-varying interference shall be carried out using bursty traffic models. Table A.2.1.3-1 proposes FTP traffic models to exercise system performance studies in bursty traffic.*  ***Table A.2.1.3-1. Traffic Models***   |  |  | | --- | --- | | ***Traffic Models*** | ***Model Applies to*** | | *Full buffer* | *DL and UL.  Continuous traffic.* | | *Non-full buffer*  *FTP models* | *DL and UL.  Bursty traffic.* | | *VoIP* | *DL and UL Real time services* |   *A.2.1.3.1 FTP traffic models*  *Two FTP traffic models are considered as non-full buffer traffic models. Tables A.2.1.3-2 and A.2.1.3-3 show the parameters for FTP traffic model 1 and model 2, respectively. Figure A.2.1.3.1-1 and A.2.1.3.1-2 illustrate the user arrival of traffic model 1 and 2, respectively. Baseline model is Model 1 with file size of 2 Mbytes, however Model 1 with file size of 0.5 Mbytes and Model 2 with file size of 0.5 Mbytes can be also evaluated.*  ***Table A.2.1.3.1-1. FTP Traffic Model 1***   |  |  | | --- | --- | | ***Parameter*** | ***Statistical Characterization*** | | *File size, S* | *2 Mbytes (0.5 Mbytes optional)*  *(one user downloads a single file)* | | *User arrival rate λ* | *Poisson distributed with arrival rate λ* |   *- Small file size of 0.5 Mbytes can be chosen to speed-up the simulation.*  *- Simulations are run for various λ to find performance metrics covering at least the range of HM-NCT (See A.2.1.3.2) that leads to [10%, 50%] of RU (See A.2.1.3.2) in non-CoMP SU-MIMO.*  *- Possible range of λ: [0.5, 1, 1.5, 2, 2.5] for 0.5 Mbytes, [0.12, 0.25, 0.37, 0.5, 0.625] for 2 Mbytes (See A.2.1.3.4 for more details). Range of λ can further be adjusted.*  *- The same traffic should be simulated for CoMP and non-CoMP schemes. The above range of λ will cover RU from 10% to 50% for non-CoMP SU-MIMO*    ***Figure A.2.1.3.1-1: Traffic generation of FTP Model 1***  ***Table A.2.1.3.1-2. FTP Traffic Model 2***   |  |  | | --- | --- | | ***Parameter*** | ***Statistical Characterization*** | | *File Size, S* | *0.5 Mbytes* | | *Reading Time, D* | *Exponential Distribution, Mean= 5 seconds*  *PDF: λ = 0.2* | | *Number of users, K* | *Fixed* |   *- Simulations are run for various K to find performance metrics covering at least the range of HM-NCT that leads to [10%, 50%] of RU in non-CoMP SU-MIMO.*  *- Possible range of K: [2, 5, 8, 10, 14] (See A.2.1.3.4 for more details). Range of K can further be adjusted.*  *- The reading time D is the time interval between end of download of previous file and the user request for the next file.*  *- The same traffic should be simulated for evaluating CoMP and non-CoMP schemes. The above range of K will cover RU from 10% to 50% for non-CoMP SU-MIMO.*    ***Figure A.2.1.3.1-2: Traffic generation of FTP Model 2*** |

* **FTP Model 3 (in TR 36.872)**

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| *FTP Model 3: based on FTP model 2 with the exception that packets for the same UE arrive according to a Poisson process and the transmission time of a packet is counted from the time instance it arrives in the queue  0.5Mbytes file size. The offered traffic is generated per macro cell geographical area when FTP model 1 is used.* |

* **XR Traffic models (in TR 38.838)**

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| *5 Traffic models*  *In this clause, we provide the DL and UL traffic models for VR, CG, and AR applications. Since DL/UL traffic models for these applications share similar characteristics, we first define a generic and parameterized DL / UL traffic model, which could be later used in defining VR, CG, AR applications.*  *The traffic model defined in this clause is statistical traffic model, where packet size and packet arrival process are characterized by certain random variables. The described model is based on the input XR traffic study from SA4 [7][3][4].*  *5.1 Generic DL traffic model*  *5.1.1 Single stream DL traffic model*  *This clause provides a parameterized generic single stream DL traffic model. In this model, as shown in Figure 5.1-1, the XR DL traffic is modelled as a sequence of video frames arriving at gNB according to the considered video frame rates and random jitter. The size of each frame is also random according to a certain distribution.*    ***Figure 5.1.1-1: Single stream DL traffic model***  *5.1.1.1 Packet Size*  *In this model, a packet models the set of IP packets belong to the same video frame. The video frame includes both left and right eye frame sharing the same buffer, which is referred to as 'single stream for dual eye buffer' or 'single eye buffer' throughout this document.*  *The size of a packet is determined by the given data rates and frame rates, which is modelled as a random variable following truncated Gaussian distribution with following statistical parameters.*  ***Table 5.1.1.1-1: Statistical parameters for packet size following truncated Gaussian distribution***   |  |  |  |  | | --- | --- | --- | --- | | ***Parameter*** | ***unit*** | ***Baseline values for evaluation*** | ***Optional values for evaluation for single eye buffer*** | | *Mean: M* | *byte* | *R×1e6 / F / 8* | *R×1e6 / F / 8* | | *STD* | *byte* | *10.5% of M* | *3 % of M* | | *Max* | *byte* | *150% of M* | *109% of M* | | *Min* | *byte* | *50% of M* | *91% of M* | | *R: data rate of the flow in Mbps.*  *F: frame generation rate of the flow in fps.*  *Note that the mean and STD apply before truncation applies.*  *Note that the value of R, F depend on application.* | | | |   *Exploration to other distributions for packet size are left up to each company and could be reported with the modelling details.*  *5.1.1.2 Packet arrival*  *In this model, the packet arrival rate is determined by the frame generation rate, e.g., 60fps. Accordingly, the average packet arrival periodicity is given by the inverse of the frame rate, e.g., 16.6667ms = 1/60fps. The periodic arrival without jitter gives the arrival time at gNB for packet with index k (=1,2,3….) as*  *k/F\*1000 [ms],*  *where F is the given frame generation rates (per second).*  *Note that this periodic packet arrival implicitly assumes fixed delay contributed from network side including fixed video encoding time, fixed network transfer delay, etc.*  *However, in a real system, the varying frame encoding delay and network transfer time introduces* ***jitter*** *in packet arrival time at gNB which. In this model, the jitter is modelled as a random variable added on top of periodic arrivals. The jitter follows truncated Gaussian distribution with following statistical parameters shown in Table 5.1-2.*  ***Table 5.1.1.2-1: Statistical parameters for jitter***   |  |  |  |  | | --- | --- | --- | --- | | ***Parameter*** | ***unit*** | ***Baseline value for evaluation*** | ***Optional value for evaluation*** | | *Mean* | *ms* | *0* |  | | *STD* | *ms* | *2* |  | | *Truncation range* | *ms* | *[-4, 4]* | *[-5, 5]* |   *Note that the given parameter values and considered frame generation rates (60 or 120 in this model) ensure that packet arrivals are in order (i.e., arrival time of a next packet is always larger than that of the previous packet).*  *Thus, the periodic arrival with jitter gives the arrival time for packet with index k (=1,2,3….) as*  *offset + k/F\*1000 + J [ms],*  *where F is the given frame generation rates (per second) and J is a random variable capturing jitter. Note that actual traffic arrival timing of traffic for each UE could be shifted by the UE specific arbitrary offset.*  *5.1.1.3 Packet delay budget*  *The latency requirement of XR traffic in RAN side (i.e., air interface) is modelled as packet delay budget (PDB). The PDB is a limited time budget for a packet to be transmitted over the air from a gNB to a UE.*  *For a given packet, the delay of the packet incurred in air interface is measured from the time that the packet arrives at the gNB to the time that it is successfully transferred to the UE. If the delay is larger than a given PDB for the packet, then, the packet is said to violate PDB, otherwise the packet is said to be successfully delivered.*  *The value of PDB may vary for different applications and traffic types.*  *5.1.1.4 Packet success rate requirement*  *The performance requirement in terms of packet success rate is given as X (%). If packet delivery delay exceed a given PDB, then, the packet is counted as failure. Following values for packet success rate X are considered.*  ***Table 5.1.1.4-1: Packet Success Rate Requirement***   |  |  |  |  | | --- | --- | --- | --- | | ***Parameter*** | ***unit*** | ***Baseline values for evaluation*** | ***Optional values for evaluation*** | | *Packet success rate requirement X for DL single stream* | *%* | *99* | *95, 99.99, etc.* |   *Note that the Packet error rate (PER) in percentage is given as PER = 100 – X.*  *5.1.1.5 Dual eye buffer model*  *This clause describes optional modification of packet size and frame rates for separate packet arrival for dual-eye buffer.*  *In single eye buffer model, the frame for both eyes arrive at the same time as a single packet. Thus, mean packet size M is given as R×1e6 / F, where R is frame generation rate in Mbps and F is frame generation rate.*  *Whereas, in dual eye buffer model of data rate R, the left and right eye frame arrive separately with a time offset, which makes the arrival process effectively equivalent to have two times of frame rates and half mean packet size of that of single eye buffer model. Accordingly, we have mean packet size M of dual eye buffer model is given as R×1e6 / (2×F) for dual eye buffer model.*  ***Table 5.1.1.5-1: Statistical parameter values for dual eye buffer packet size***   |  |  |  |  | | --- | --- | --- | --- | | ***Parameter*** | ***unit*** | ***values for evaluation*** | ***Optional values for evaluation*** | | *Mean: M* | *byte* | *R×1e6 / (2×F) /8* | *R×1e6 / (2×F) / 8* | | *STD* | *byte* | *10.5% of M* | *4% of M* | | *Max* | *byte* | *150% of M* | *112% of M* | | *Min* | *byte* | *50% of M* | *88% of M* | | *R: data rate of the flow in Mbps*  *F: frame generation rate of the flow in fps* | | | |   *5.1.2 Multi-streams DL traffic model*  *This clause provides optional multi-streams model for XR DL traffic.*  *- Option 1: I-frame + P-frame*  *- Option 1A: slice-based traffic model*  *- Option 1B: Group-Of-Picture (GOP) based traffic model*  *- Option 2: video + audio/data*  *- Option 3: FOV + omnidirectional stream*  *5.1.2.1 Option 1 (I+P)*  *For Option 1, two streams (I-stream and P-stream) are modelled according to Table 5.1-5.*  *- Stream 1: I stream*  *- Stream 2: P stream*  *Depending on the video encoding scheme, two additional sub models – slice based, and Group of Picture (GOP)-based models are defined.*  *- Slice-based: In this encoding scheme, a single video frame is divided into N slices. Out of N, one slice is I slice and remaining N-1 slices are P slices. N packets (one I and N-1 P) packets corresponds to one video frame arriving at the same time.*  *- GOP-based: In this encoding scheme, a single video frame is either I frame or P frame. I frame is transmitted every K frames, where K is the GOP size, i.e., every group of picture. One video frame arrives at a time as a packet.*  ***Table 5.1.2.1-1: Statistical parameters for Option 1 multi streams DL traffic model***   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | *Two data streams* | *Option 1A: slice-based* | | *Option 1B: GOP-based* | | | | *I-stream* | *P-stream* | *I-stream* | | *P-stream* | | *Packet modelling* | *Slice-level* | | *Frame-level* | | | | *Traffic pattern* | *Both streams are periodic at 60 fps with the same jitter model as for single stream.* | | *Follow the GOP structure, where GOP size K = 8 with the same jitter model as for single stream.* | | | | *Number of packets per stream at a time* | *1* | *N-1* | *I-frame: 1 or 0*  *P-frame: 0 or 1*  *At each time instant, there is either only one I-stream packet or only one P-stream packet* | | | | *N = 8: the number of slices per frame.* | | | *Average data rate per stream* |  |  |  | |  | | *- R: average data rate of a single stream video*  *- : average size ratio between one I-frame/slice and one P-frame/slice*  *- = 1.5, 2 (baseline)*  *- = 3 (optional)* | | | | | | *Packet size distribution* | *Truncated Gaussian distribution* | | | | | | *Mean =* | *Mean =* | *Mean =* | *Mean =* | | | *- [STD, Max, Min]: [10.5, 150, 50]% of Mean packet size*  *- FPS is the frame rate of the single stream video* | | | | | |  | *Depends on application, see 6.3.1, 6.4.1, 6.5.1 for VR, CG, AR respectively.* | | | | | | *PDB* | *Depends on application, see 6.3.1, 6.4.1, 6.5.1 for VR, CG, AR respectively.* | | | | |   *5.1.2.2 Option 2 (video + audio/data)*  *For Option 2, two streams (video + audio/data) are modelled.*  *- Stream 1: video*  *- Stream 2: audio/data*  *The stream 1 - video stream follows the generic single stream model given in clause 5.1.1. The stream 2 - audio/data a periodic traffic with following parameters.*  ***Table 5.1.2.2-1: Statistical parameter values for Option 2 multi streams model***   |  |  |  |  | | --- | --- | --- | --- | | ***Parameters*** | ***unit*** | ***Baseline values for evaluation*** | ***Optional values for evaluation*** | | *Periodicity P* | *ms* | *10* |  | | *Data rate: R* | *Mbps* | *0.756, 1.12* |  | | *Packet size* | *byte* | *R×1e6 × P /1000 / 8* |  | | *PDB* | *ms* | *30* | *Other values can be optionally evaluated* | | *Packet Success Rate* | *%* | *99* | *99.9* |   *5.1.2.3 Option 3 (FOV + omnidirectional view)*  *For Option 3, following two streams are modelled.*  *- Stream 1: FOV*  *- Stream 2: omnidirectional view stream*  *The detailed modelling of the two streams is left to company with the report of evaluation results.*  *5.2 Generic UL pose/control traffic*  *In this clause, we provide the generic UL pose/control stream traffic model. A packet for UL pose/control arrives at UE periodically with following parameters.*  ***Table 5.2-1: Statistical parameters for the UL pose/control traffic***   |  |  |  |  | | --- | --- | --- | --- | | ***Parameters*** | ***unit*** | ***Baseline values for evaluation*** | ***Optional value for evaluation*** | | *Periodicity* | *ms* | *4* | *Other values can be optionally evaluated.* | | *Jitter* | *ms* | *No jitter* |  | | *Packet size* | *byte* | *100* |  | | *PDB* | *ms* | *10* |  | | *Packet Success Rate X* | *%* | *99* | *90, 95* | |

* **Instant message (as in TR 38.840)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Traffic model used for the UE power saving scheme evaluation***  *- Applications with the traffic model for the evaluation of the UE power saving scheme*  *- FTP - FTP model 3*  *- Other bursty traffic arrival models can be considered*  *- Web-browsing*  *- Video streaming*  *- Instant messaging*  *- VoIP*  *- Gaming*  *- Background app sync*  *For FTP, instant messaging, and VoIP application, the following traffic models and DRX configuration should be included for evaluation:*   |  |  |  |  | | --- | --- | --- | --- | |  | ***FTP traffic*** | ***Instant messaging*** | ***VoIP*** | | *Model* | *FTP model 3* | *FTP model 3* | *As defined in R1-070674.*  *Assume max two packets bundled.* | | *Packet size* | *0.5 Mbytes* | *0.1 Mbytes* | | *Mean inter-arrival time* | *200 ms* | *2 sec* | | *DRX setting* | *Period = 160 ms*  *Inactivity timer = 100 ms* | *Period = 320 ms*  *Inactivity timer = 80 ms* | *Period = 40 ms*  *Inactivity timer = 10 ms* |   *Note: For ON duration setting, following reference DRX configurations as previously agreed.*  *- For web-browsing, video streaming, and gaming applications, the traffic models and the delay requirements defined in R1-070674 can be used in the evaluation. The parameters (e.g. packet size) may be updated to be in line with EMBB traffic requirements.*  *- For background app sync application, for power consumption evaluation purpose, it can be assumed that idle mode operations (inclusive of page detection, RRM, deep sleep and transition overhead) contributes to X% of the use case power. The remaining portion is contributed by intermittent RRC connections due to background activities (FFS: value of X)*  *- Companies should report the assumptions made in the evaluation* |

# Appendix - Agreements

# Agreements from RAN1#122

Agreement

* The deployment scenarios in TR38.914 should be considered for evaluation assumption
* The common evaluation assumptions including the antenna modelling, general system-level simulation assumptions (including the carrier frequency, bandwidth and subcarrier spacing used for link-level simulation) for the deployment scenarios in TR38.914, link budget and traffic models will be discussed in AI 11.2
  + Other assumptions including for link-level simulation specific to each technical topic will be separately discussed under each individual agenda.
  + Note: Subcarrier spacing decision is up to AI 11.3.2.

Conclusion

* Template in R1-2506582 is to be used for collecting inputs from companies.
  + Additional NTN or TN assumptions, if any, or any necessary change of the parameters, are to be incorporated into the updated one of R1-2506582.

Agreement

* Study which of the following traffic models are to be used for 6G evaluations, e.g.,
  + Full buffer
  + FTP Model 1 (in TR 36.814)
  + FTP Model 2 (in TR 36.814)
  + FTP Model 3 (in TR 36.872)
  + XR Traffic models (in TR 38.838)
  + VoIP model (as in TR 36.814)
  + Instant message (as in TR 38.840)
* Study whether to introduce the following traffic models for 6G evaluations considering, e.g.,
  + FTP-3 variant with packet delay budget requirement
    - Details FFS
  + New traffic model considering a mixed/variable packet size and the associated time domain behaviors (e.g., time between adjacent packet arrivals, packet delay budget)
    - Details FFS
  + New traffic model(s) considering the new use cases or services, e.g., AI/ML services, immersive communication services, etc.
    - Details FFS
* Study whether to introduce new/additional approaches that can reflect the impact of bidirectional traffic flows on performance metrics (e.g., impact of UL TCP ACK latency on DL throughput/latency)

Note: Whether/how to consider the combination of traffic model and loading level will be studied under individual agendas.