|  |  |
| --- | --- |
| 3GPP TR 38.808 V0.2.0 (2020-11) | |
| Technical Report | |
| 3rd Generation Partnership Project;  Technical Specification Group Radio Access Network;  Study on supporting NR from 52.6 GHz to 71 GHz  (Release 17) | |
|  | |
|  |  |
|  | |
| The present document has been developed within the 3rd Generation Partnership Project (3GPP TM) and may be further elaborated for the purposes of 3GPP. The present document has not been subject to any approval process by the 3GPPOrganizational Partners and shall not be implemented. This Specification is provided for future development work within 3GPPonly. The Organizational Partners accept no liability for any use of this Specification. Specifications and Reports for implementation of the 3GPP TM system should be obtained via the 3GPP Organizational Partners' Publications Offices. | |

|  |
| --- |
|  |
| ***3GPP***  Postal address  3GPP support office address  650 Route des Lucioles - Sophia Antipolis  Valbonne - FRANCE  Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16  Internet  http://www.3gpp.org |
| ***Copyright Notification***  No part may be reproduced except as authorized by written permission. The copyright and the foregoing restriction extend to reproduction in all media.  © 2020, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).  All rights reserved.  UMTS™ is a Trade Mark of ETSI registered for the benefit of its members  3GPP™ is a Trade Mark of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners LTE™ is a Trade Mark of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners  GSM® and the GSM logo are registered and owned by the GSM Association |

Contents

Foreword 6

1 Scope 8

2 References 8

3 Definitions of terms, symbols and abbreviations 12

3.1 Terms 12

3.2 Symbols 12

3.3 Abbreviations 12

4 Study of required changes to NR 13

4.1 RAN1 Aspects 13

4.1.1 General description of study in RAN1 13

4.1.2 Candidate numerology and bandwidth 14

4.1.2.1 Subcarrier spacing and CP length 14

4.1.2.2 Bandwidth and Channelization 15

4.1.3 Investigation of physical layer impact from candidate numerology and bandwidths 16

4.1.3.1 General physical layer impacts 16

4.1.3.2 Physical layer impacts to synchronization and random access 18

4.1.3.3 Physical layer impacts to PDSCH and PUSCH 19

4.1.3.4 Physical layer impacts to PDCCH 20

4.1.3.5 Physical layer impacts to PUCCH 20

4.1.3.6 Physical layer impacts to reference signals 20

4.1.3.7 Physical layer impacts to beam management and CSI 21

4.2 RAN4 aspects 22

4.2.1 General description of study in RAN4 22

4.2.2 Timing considerations 22

4.2.3 Phase noise characteristics 22

4.2.4 Power amplifiers trends 23

4.2.5 BS aspects 25

4.2.5.1 BS antenna arrays 25

4.2.5.2 Noise figure 26

4.2.6 UE aspects 27

4.2.7 RAN4 conclusions on numerologies and channel bandwidths 27

5 Study of channel access mechanism for 60 GHz 27

5.1 Identification of regulatory aspects for consideration 27

5.2 Channel access and interference mitigation techniques 27

5.2.1 Interference mitigation techniques 27

5.2.2 Listen before talk (LBT) design 28

5.2.3 Receiver assisted channel access and interference management 29

6 Summary of evaluation study 30

6.1 Summary of link level evaluations 30

6.1.1 Observations on PDSCH/PUSCH 30

6.1.2 Observations on PSS/SSS and PBCH 36

6.1.3 Observations on PRACH 37

6.2 Summary of system level evaluations 37

6.2.1 Description of channel access schemes modelled in evaluations 37

6.2.2 Detailed observations for indoor scenario A 39

6.2.3 Detailed observations for indoor scenario B 42

6.2.4 Detailed observations for indoor scenario C 42

6.2.5 Detailed observations for outdoor scenario B 43

6.2.6 Summary of observations 44

6.3 Summary of delay spread evaluations 44

7 Conclusions 45

Annex A: Evaluations methodology 46

A.1 Link level evaluation assumptions 46

A.2 System level evaluation assumptions 49

A.3 LBT procedure for system level evaluation 54

Annex B: Evaluations results 56

B.1 Link level evaluation results 56

B.1.1 Evaluation results for PDSCH/PUSCH 56

B.1.1.1 Source 1 [65] 56

B.1.1.2 Source 2 [72] 60

B.1.1.3 Source 3 [30] 63

B.1.1.4 Source 4 [60] 66

B.1.1.5 Source 5 [64] 69

B.1.1.6 Source 6 [68] 70

B.1.1.7 Source 7 [62] 72

B.1.1.8 Source 8 [59] 74

B.1.1.9 Source 9 [25] 75

B.1.1.10 Source 10 [67] 76

B.1.1.11 Source 11 [27] 77

B.1.1.12 Source 12 [5] 78

B.1.1.13 Source 13 [29] 78

B.1.1.14 Source 14 [16] 80

B.1.1.15 Source 15 [71] 83

B.1.1.16 Source 16 [61] 84

B.1.1.17 Source 17 [19] 84

B.1.2 Evaluation results for PSS/SSS 86

B.1.2.1 Source 1 [65] 86

B.1.2.2 Source 3 [30] 88

B.1.2.3 Source 4 [60] 89

B.1.2.4 Source 6 [68] 90

B.1.2.5 Source 9 [25] 90

B.1.2.6 Source 13 [29] 91

B.1.2.7 Source 14 [16] 91

B.1.3 Evaluation results for PRACH 92

B.1.3.1 Source 1 [65] 92

B.1.3.2 Source 2 [72] 94

B.1.3.3 Source 3 [30] 95

B.1.3.4 Source 4 [60] 95

B.1.3.5 Source 5 [64] 96

B.1.3.6 Source 6 [68] 96

B.1.3.7 Source 7 [62] 97

B.1.3.8 Source 13 [29] 97

B.1.3.9 Source 14 [16] 98

B.2 System level evaluation results 99

B.2.1 RSRP distribution 99

B.2.1.1 Source 1 [65] 99

B.2.1.2 Source 2 [72] 100

B.2.1.3 Source 3 [56] 102

B.2.1.4 Source 4 [37] 103

B.2.1.5 Source 5 [64] 103

B.2.1.6 Source 6 [68] 104

B.2.1.7 Source 10 [67] 104

B.2.1.8 Source 14 [43] 105

B.2.2 Indoor scenario A 111

B.2.2.1 Source 1 [65] 111

B.2.2.2 Source 2 [72] 116

B.2.2.3 Source 3 [56] 120

B.2.2.4 Source 4 [37] 128

B.2.2.5 Source 5 [64] 130

B.2.2.6 Source 7 [62] 134

B.2.2.7 Source 10 [67] 135

B.2.2.8 Source 14 [43] 136

B.2.3 Indoor scenario B 139

B.2.3.1 Source 1 [65] 139

B.2.4 Indoor scenario C 145

B.2.4.1 Source 1 [65] 145

B.2.4.2 Source 2 [72] 149

B.2.4.3 Source 5 [64] 150

B.2.4.4 Source 6 [68] 150

B.2.4.5 Source 13 [29] 151

B.2.4.6 Source 15 [71] 151

B.2.5 Outdoor scenario B 152

B.2.5.1 Source 1 [65] 152

B.2.5.2 Source 2 [72] 153

Annex C: Change history 155

# Foreword

This Technical Report has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

In the present document, modal verbs have the following meanings:

**shall** indicates a mandatory requirement to do something

**shall not** indicates an interdiction (prohibition) to do something

The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

The constructions "must" and "must not" are not used as substitutes for "shall" and "shall not". Their use is avoided insofar as possible, and they are not used in a normative context except in a direct citation from an external, referenced, non-3GPP document, or so as to maintain continuity of style when extending or modifying the provisions of such a referenced document.

**should** indicates a recommendation to do something

**should not** indicates a recommendation not to do something

**may** indicates permission to do something

**need not** indicates permission not to do something

The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

**can** indicates that something is possible

**cannot** indicates that something is impossible

The constructions "can" and "cannot" are not substitutes for "may" and "need not".

**will** indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**will not** indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**might** indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

**might not** indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

**is** (or any other verb in the indicative mood) indicates a statement of fact

**is not** (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

# 1 Scope

In order to support wide range of services, 5G NR system aims to be flexible enough to meet the connectivity requirements of a range of existing and future (yet unknown) services to be deployable in an efficient manner. NR considers supporting potential use of frequency range up to 100 GHz [1].

NR specifications that have been developed in Rel-15 and Rel-16 define operation for frequencies up to 52.6 GHz, where all physical layer channels, signals, procedures, and protocols are designed to be optimized for uses under 52.6 GHz.

However, frequencies above 52.6 GHz are faced with more difficult challenges, such as higher phase noise, larger propagation loss due to high atmospheric absorption, lower power amplifier efficiency, and strong power spectral density regulatory requirements in unlicensed bands, compared to lower frequency bands. Additionally, the frequency ranges above 52.6 GHz potentially contain larger spectrum allocations and larger bandwidths that are not available for bands lower than 52.6 GHz.

As an initial effort to enable and optimize 3GPP NR system for operation in above 52.6 GHz, 3GPP RAN has studied requirements for NR beyond 52.6GHz up to 114.25GHz including global spectrum availability and regulatory requirements (including channelization and licensing regimes), potential use cases and deployment scenarios, and NR system design requirements and considerations on top of regulatory requirements [2]. The potential use cases identified in the study include high data rate eMBB, mobile data offloading, short range high-data rate D2D communications, broadband distribution networks, integrated access backhaul (IAB), factory automation, industrial IoT (IIoT), wireless display transfer, augmented reality (AR)/virtual reality (VR) wearables, intelligent transport systems (ITS) and V2X, data center inter-rack connectivity, smart grid automation, private networks, and support of high positioning accuracy. The use cases span over several deployment scenarios identified in the study. The deployment scenarios include, but not limited to, indoor hotspot, dense urban, urban micro, urban macro, rural, factor hall, and indoor D2D scenarios. The study also identified several system design requirements around waveform, MIMO operation, device power consumption, channelization, bandwidth, range, availability, connectivity, spectrum regime considerations, and others.

Among the frequencies of interest, frequencies between 52.6 GHz and 71 GHz are especially interesting relatively in the short term because of their proximity to sub-52.6 GHz for which the current NR system is optimized and the imminent commercial opportunities for high data rate communications, e.g., unlicensed spectrum but also licensed spectrum between 57 GHz and 71 GHz. Therefore, it would be beneficial to make a study focused on feasibility of using existing waveforms and required changes for frequencies between 52.6 GHz and 71 GHz, so as to take advantage of imminent commercial opportunities for the specific frequency regime by minimizing the specification burden and maximizing the leverage of FR2 based implementations.

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 38.913: "Study on Scenarios and Requirements for Next Generation Access Technologies"

[2] 3GPP TR 38.807: "Study on requirements for NR beyond 52.6 GHz".

[3] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[4] ETSI EN 302 567 v2.1.20: "Multiple-Gigabit/s radio equipment operating in the 60 GHz band; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU".

[5] R1-2007549 "Further discussion on B52 numerology" FUTUREWEI.

[6] R1-2007558 "Discussion on physical layer impacts for NR beyond 52.6 GHz" Lenovo, Motorola Mobility.

[7] R1-2007604 "PHY design in 52.6-71 GHz using NR waveform" Huawei, HiSilicon.

[8] R1-2007642 "Physical layer design for NR 52.6-71GHz" Beijing Xiaomi Software Tech.

[9] R1-2007652 "Discussion on required changes to NR using existing DL/UL NR waveform" vivo.

[10] R1-2007785 "Consideration on required changes to NR using existing NR waveform" Fujitsu.

[11] R1-2007790 "Consideration on supporting above 52.6GHz in NR" InterDigital, Inc.

[12] R1-2007847 "System Analysis of NR opration in 52.6 to 71 GHz" CATT.

[13] R1-2007883 "Required changes to NR using existing DL/UL NR waveform" TCL Communication Ltd.

[14] R1-2007926 "Required changes to NR using existing DL/UL NR waveform" Nokia, Nokia Shanghai Bell.

[15] R1-2007929 "On phase noise compensation for NR from 52.6GHz to 71GHz" Mitsubishi Electric RCE.

[16] R1-2009379 "Discussion on Required Changes to NR in 52.6 – 71 GHz" Intel Corporation.

[17] R1-2007965 "On the required changes to NR for above 52.6GHz" ZTE, Sanechips.

[18] R1-2007982 "On NR operations in 52.6 to 71 GHz" Ericsson.

[19] R1-2009653 "Consideration on required physical layer changes to support NR above 52.6 GH" LG Electronics.

[20] R1-2008076 "Discussion on required changes to NR using existing DL/UL NR waveform in 52.6GHz ~ 71GHz" CMCC.

[21] R1-2008082 "Study on the numerology to support 52.6 GHz to 71GHz" NEC.

[22] R1-2008872 "Design aspects for extending NR to up to 71 GHz" Samsung.

[23] R1-2008250 "Discusson on required changes to NR using DL/UL NR waveform" OPPO.

[24] R1-2008353 "Considerations on required changes to NR from 52.6 GHz to 71 GHz" Sony.

[25] R1-2008457 "A Discussion on Physical Layer Design for NR above 52.6GHz" Apple.

[26] R1-2008493 "Discussions on required changes on supporting NR from 52.6GHz to 71 GHz" CAICT.

[27] R1-2008501 "On required changes to NR using existing DL/UL NR waveform for operation in 60GHz band" MediaTek Inc.

[28] R1-2008516 "On NR operation between 52.6 GHz and 71 GHz" Convida Wireless.

[29] R1-2009062 "Evaluation Methodology and Required Changes on NR from 52.6 to 71 GHz" NTT DOCOMO, INC.

[30] R1-2008615 "NR using existing DL-UL NR waveform to support operation between 52p6 GHz and 71 GHz" Qualcomm Incorporated.

[31] R1-2008726 "Discussion on physical layer aspects for NR beyond 52.6GHz" WILUS Inc.

[32] R1-2008769 "Waveform considerations for NR above 52.6 GHz" Charter Communications.

[33] R1-2007550 "On channel access modes in 60GHz" FUTUREWEI.

[34] R1-2007559 "Discussion on channel access for NR beyond 52.6 GHz" Lenovo, Motorola Mobility.

[35] R1-2008976 "Channel access mechanism for 60 GHz unlicensed operation" Huawei, HiSilicon.

[36] R1-2007643 "Channel access mechanism for NR on 52.6-71 GHz" Beijing Xiaomi Software Tech.

[37] R1-2007653 "Discussion on channel access mechanism" vivo.

[38] R1-2007791 "On Channel access mechanisms" InterDigital, Inc.

[39] R1-2007848 "Channel Access Mechanism in support of NR operation in 52.6 to 71 GHz" CATT.

[40] R1-2007884 "Channel access mechanism" TCL Communication Ltd.

[41] R1-2007918 "Channel access mechanisms for NR from 52.6-71GHz" AT&T.

[42] R1-2009312 "Design of NR channel access mechanisms for 60 GHz unlicensed band" Nokia, Nokia Shanghai Bell.

[43] R1-2009380 "Channel Access Procedure for NR in 52.6 - 71 GHz" Intel Corporation.

[44] R1-2007966 "On the channel access mechanism for above 52.6GHz" ZTE, Sanechips.

[45] R1-2007983 "Channel Access Mechanism" Ericsson.

[46] R1-2008046 "Considerations on channel access mechanism to support NR above 52.6 GHz" LG Electronics.

[47] R1-2008091 "Discussion on channel access mechanism for above 52.6GHz" Spreadtrum Communications.

[48] R1-2008157 "Channel access mechanism for 60 GHz unlicensed spectrum" Samsung.

[49] R1-2008251 "Discussion on channel access" OPPO.

[50] R1-2008354 "Channel access mechanism for 60 GHz unlicensed spectrum" Sony.

[51] R1-2008458 "Views on Channel Access Mechanisms for Unlicensed Access above 52.6 GHz" Apple.

[52] R1-2008494 "Discussions on channel access mechanism on supporting NR from 52.6GHz to 71 GHz" CAICT.

[53] R1-2008517 "On Channel Access Mechanism and Interference Handling for Supporting NR from 52.6 GHz to 71 GHz" Convida Wireless.

[54] R1-2008548 "Channel Access Mechanism for NR in 60 GHz unlicensed spectrum" NTT DOCOMO, INC.

[55] R1-2008563 "Discussion on channel access mechanism" ITRI.

[56] R1-2009362 "Channel access mechanism for NR in 52p6 to 71GHz band" Qualcomm Incorporated.

[57] R1-2008717 "Discussion on channel access mechanism for 52.6 to 71GHz unlicensed ban" Potevio

[58] R1-2008770 "Further aspects of channel access mechanisms" Charter Communications.

[59] R1-2007560 "Additional evaluations for NR beyond 52.6GHz" Lenovo, Motorola Mobility.

[60] R1-2007654 "Evaluation on different numerologies for NR using existing DL/UL NR waveform" vivo.

[61] R1-2007792 "Evaluation results for above 52.6 GHz" InterDigital, Inc.

[62] R1-2007928 "Simulation Results for NR from 52.6 GHz to 71 GHz" Nokia, Nokia Shanghai Bell.

[63] R1-2007943 "Considerations on performance evaluation for NR in 52.6-71GHz" Intel Corporation.

[64] R1-2009450 "Simulation results for NR above 52.6GHz" ZTE, Sanechips.

[65] R1-2007984 "Evaluation results for NR in 52.6 - 71 GHz" Ericsson.

[66] R1-2008047 "Considerations on phase noise compensation to support NR above 52.6 GHz" LG Electronics.

[67] R1-2008873 "Evaluation results for extending NR to up to 71 GHz" Samsung.

[68] R1-2009615 "Discussion on other aspects" OPPO.

[69] R1-2008459 "Evaluation results for Physical Layer Design for NR above 52.6GHz" Apple.

[70] R1-2008549 "Potential Enhancements for NR on 52.6 to 71 GHz" NTT DOCOMO, INC.

[71] R1-2009157 "Performance evaluations for NR above 52.6 GHz" Charter Communications.

[72] R1-2009610 "Link level and System level evaluation for NR system operating in 52.6GHz to 71GHz" Huawei, HiSilicon.

[73] 3GPP TR 38.803: “Study on new radio access technology; Radio Frequency (RF) and co-existence aspects”.

[74] Hua Wang, Fei Wang, Sensen Li, Tzu-Yuan Huang, Amr S. Ahmed, Naga Sasikanth Mannem, Jeongseok Lee, Edgar Garay, David Munzer, Christopher Snyder, Sanghoon Lee, Huy Thong Nguyen, and Michael Edward Duffy Smith, "Power Amplifiers Performance Survey 2000-Present," [Online]. Available: <https://gems.ece.gatech.edu/PA_survey.html>

[75] ETSI TR 101 854: “Fixed Radio Systems; Point-to-point equipment; Derivation of receiver interference parameters useful for planning fixed service point-to-point systems operating different equipment classes and/or capacities”

# 3 Definitions of terms, symbols and abbreviations

## 3.1 Terms

For the purposes of the present document, the terms given in 3GPP TR 21.905 [3] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [3].

## 3.2 Symbols

For the purposes of the present document, the following symbols apply:

B transmission bandwidth

G antenna gain

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [3] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [3].

ATPC Automatic Transmit Power Control

BD Blind Decode

BFR Beam Failure Report

BLER Block Error Ratio

BO Buffer Occupancy

BS Base Station

BW Bandwidth

BWP Bandwidth Part

CAPC Channel Access Priority Class

CC Component Carrier

CCE Control Channel Element

CORESET Control Resource Set

CP Cyclic Prefix

CPE Common Phase Error

CPU Channel State Information Processing Unit

CSI Channel State Information

CW Contention Window

DFS Dynamic Frequency Selection

DMRS Demodulation Reference Signal

DS Delay Spread

ECP Extended Cyclic Prefix

ED Energy Detection

EDT Energy Detection Threshold

EIRP Equivalent Isotropic Radiated Power

FD Frequency Domain

FDD Frequency Duplex Division

IAB Integrated Access Backhaul

ICI Inter-Carrier Interference

ISD Inter-Site Distance

ISM Industrial, Scientific and Medical

ITU International Telecommunication Union

LBT Listen Before Talk

MCL Maximum Coupling Loss

MCOT Maximum Channel Occupancy Time

MCS Modulation and Coding Scheme

MIL Maximum Isotropic Loss

NCP Normal Cyclic Prefix

NR New Radio

OCB Occupied Channel Bandwidth

OCC Orthogonal Cover Code

OOBE Out-Of-Band Emission

PDCCH Physical Downlink Control Channel

PDSCH Physical Downlink Shared Channel

PN Phase Noise

PRACH Physical Random Access Channel

PSD Power Spectral Density

PTP Point to point

PTRS Phase Tracking Reference Signal

PUCCH Physical Uplink Control Channel

PUSCH Physical Uplink Shared Channel

RAT Radio Access Technology

RF Radio Frequency

RMSI Remaining Minimum System Information

SSB Synchronization Signal Block

SCS Subcarrier Spacing

SI Study Item

SID Study Item Description

SINR Signal to Interference and Noise Ratio

TA Timing Advance

TAE Timing Alignment Error

TB Transport Block

TDD Time Duplex Division

TRP Transmission Reception Point

TTI Transmission Time Interval

UE User Equipment

V2X Vehicle to Everything

WAN Wide Area Network

# 4 Study of required changes to NR

## 4.1 RAN1 Aspects

### 4.1.1 General description of study in RAN1

For supporting NR operation in both licensed and unlicensed bands in the frequency range from 52.6 GHz to 71 GHz, FR2 numerologies and additional numerologies beyond that are supported currently in NR are studied. The existing framework for numerology scaling is considered i.e. 2μ ×15 subcarrier spacing to select the candidates. For SSB transmissions, it is investigated whether or not µ > 4 (larger than 240 kHz) is needed and the corresponding impacts, if any, on aspects including at least SSB pattern, multiplexing of other signal/channels, and transmission window, if supported. For data and control channel transmissions, it is investigated if µ > 3 (larger than 120 kHz) is needed and the corresponding impacts, if any, on aspects including at least processing timelines, PDCCH monitoring capability (BD/CCE), scheduling enhancements, beam-management, and reference signal design. For investigating the need for higher numerologies, some of the key aspects that are studied are the impacts due to phase noise, delay spread, TAE, analog beam switching delay, and impact to coverage, spectral efficiency, peak data rates, and relative delay in intra-cell/inter-cell multi-TRP operations.

For the study item, it is recommended to consider the study of at least the following aspects, including the justification for the features and their potential benefits, if applicable:

- system overhead impact from TDD switching time for larger subcarrier spacing,

- coverage enhancement mechanisms for control channels and SSB, if larger SCS is supported,

- any potential modifications to HARQ processes including number of processes, if supported,

- impact from MAC buffering for larger subcarrier spacing, if any,

- NR channelization/sub-channelization and any potential impact from RAN1 perspective,

- additional RF impairments that impact evaluations,

- impact on BWP switching procedure due to new higher SCS, if supported,

- support of rank 2 transmission for DFT-s-OFDM in the uplink.

Other aspects and impacts due to introduction of higher SCS are not precluded.

### 4.1.2 Candidate numerology and bandwidth

#### 4.1.2.1 Subcarrier spacing and CP length

It was observed that amount of specification effort increases with the number of new numerologies enabled and supported for 52.6 GHz to 71 GHz frequency.

In order to minimize specification effort while maximizing supported use cases and deployment scenarios applicable for 52.6 GHz to 71 GHz frequency, it is recommended to support 120 kHz subcarrier spacing with normal CP length, and at least one more subcarrier spacing. It is recommended to consider supporting at most up to three subcarrier spacings, including 120 kHz subcarrier spacing. It is not recommended to consider support of only 240 kHz SCS for PDCCH/PDSCH/PUCCH/PUSCH in addition to 120 kHz. Applicability of the supported subcarrier spacing to particular signals and channels should be further discussed in the corresponding WI phase.

It is recommended that numerologies 240 kHz, 480 kHz, and 960 kHz are considered as candidates for additional numerologies in addition to 120 kHz, and numerologies outside this range are not supported for any signals or channels. It is also recommended that for subcarrier spacing 240 kHz or below, normal CP length is utilized for candidate subcarrier spacings.

Selection of the additional subcarrier spacing (on top of 120 kHz) should consider versatility of being able to support various applications and deployment scenarios with all the subcarrier spacings that would be supported by specification, accounting for what is already supported in Rel-15 and Rel-16 specifications.

Some companies have noted that the ability for a deployed system to operate with a single numerology for all channels and signals is beneficial, and some companies have further noted benefit remains even if SSB numerology is different. Some companies have noted mixed numerology operation is functional and is supported in Rel-15 and Rel-16 specifications (e.g. 240 kHz SSB subcarrier spacing with 120 kHz subcarrier spacing for PDCCH/PDSCH/PUSCH/PUCCH/PRACH in an initial BWP and activation of a dedicated BWP with SCS different than the initial BWP) and consideration of single numerology operation is not needed.

Overall implementation complexity for supporting a specific subcarrier spacing may need to consider the following, but not limited to:

- processing complexity for equalization including inter-carrier interference mitigation (if required to support higher modulation orders) and compensation, and FFT complexity per unit time for a given bandwidth,

- complexity associated with supporting multiple component carriers to reach a specific throughput,

- complexity associated with supporting given reduced (in absolute time) requirements on UE processing times (e.g. N1, N2, N3, Z1, Z2, Z3, etc) and UE PDCCH processing budget as a function of subcarrier spacing, if scheduling and monitoring unit is maintained to be one slot,

- supported features indicated by UE capability signalling or implemented by the gNB,

- complexity associated with supporting required timing error tolerance which may need to consider initial timing error, timing advance setting, TA granularity, MIMO TAE (TAE value will be defined by RAN4), multi-TRP timing alignment as a function of SCS, whether mixture or a single subcarrier spacing for signals is configured, and deployment scenarios,

- complexity associated with supporting higher sampling rates and with channel bandwidth larger than 2 GHz.

It is observed that for a single carrier with the same number of transmitted symbols, in general, smaller subcarrier spacing may potentially provide larger coverage due to use of smaller bandwidth and gears towards (but not limited to) coverage driven scenarios.

It is observed that for a single carrier, in general, larger subcarrier spacing may potentially provide higher peak data rates due to use of larger bandwidth and gears towards (but not limited to) peak data-rate driven scenarios.

It is observed that in Rel-15 NR, absolute time for UE processing requirements generally decrease as subcarrier spacing increases. Some companies noted that introducing smaller UE processing time than Rel-15 and Rel-16, for larger subcarrier spacing, may lead to a more complex UE implementation. Some companies noted that per slot level monitoring for transmission and reception may not likely be the only mode of operation for higher subcarrier spacing, while some companies noted that per slot level monitoring for transmission and reception may be used as a mode of operation in scenarios that require lower latency.

It is observed that, in general, larger subcarrier spacing may have benefit of short symbol/slot length to support lower latency requirements compared to what was supported for Rel-15 and Rel-16 NR, assuming slot-level monitoring subject to scheduling configurations and potentially UE processing capabilities.

It is observed that, in general, channel access with shorter symbol duration may access channel earlier when LBT is passed, assuming slot-level monitoring and potentially subject to UE processing capabilities.

It is observed that, in general, larger subcarrier spacing has higher resilience towards phase noise. Also, in general, the performance impact from phase noise may depend on various properties of the transmission, such as modulation order and coding rate, reception processing (e.g. CPE compensation), and phase noise profile of the UE and gNB.

It is observed that, in general, maximum delay spread supported by a SCS is proportional to its CP length and larger subcarrier spacing reduces the budget for timing errors and beam switching, if beam switching delay within CP cannot be avoided by gNB (e.g. by allocating a time gap), due to shorter CP. CP needs to consider at least delay spread, timing errors (including Te), and timing alignment errors applicable for a deployment scenario. Minimum requirements on timing errors for new SCS values in > 52.6 GHz should be further studied in RAN4 when specifications are developed.

Extended CP decreases the spectrum efficiency up to 14% compared to normal CP of the same subcarrier spacing.

#### 4.1.2.2 Bandwidth and Channelization

For the study item, it has been recommended to study single carrier and multi carrier operations for achieving wide bandwidth utilization, while at least considering aspects such as control signaling overhead, transceiver complexity, spectral efficiency, etc.

In order to bound implementation complexity, it is recommended to limit the maximum FFT size required to operate system in 52.6 GHz to 71 GHz frequency to 4096 and to limit the maximum number of RBs per carrier to 275 RBs. The candidate supported maximum carrier bandwidth(s) for a cell should be between 400 MHz and 2160 MHz.

Some companies have noted support of channelization that are aligned with IEEE 802.11ad and 802.11ay channelization is beneficial for coexistence. While some companies have noted alignment of channelization for coexistence is not necessary. Alignment of channelization between a NR channel and IEEE 802.11ad and 802.11ay channel in this context refers to a NR channel that is contained within one of the channels defined for IEEE 802.11ad and 802.11ay and NR channel bandwidth does not cross over channel boundaries of IEEE 802.11ad and 802.11ay.

One company has evaluated misaligned NR wideband channels with 1.6 GHz and 2 GHz without LBT and have not identified coexistence issues between NR and NR.

Some companies proposed that 2 GHz channel bandwidth should be supported and have the raster points for 2 GHz channel bandwidth to be aligned with IEEE 802.11ad and 802.11ay channelization.

Some companies proposed that 1.6 GHz should be the maximum channel bandwidth and channels do not necessarily need to be aligned with IEEE 802.11ad and 802.11ay channelizations.

Some companies observed that support of channel bandwidth such as 200 or 400 MHz may enable efficient usage of available spectrum by 3GPP technology. Some companies observed that only supporting channelization that are aligned with IEEE 802.11ad and 802.11ay channelization result in smaller number of supported channels for some regions of the world.

Some companies have observed that channelization based on granularity of minimum supported channel BW would be beneficial and could provide efficient usage of available spectrum. Other companies have observed that support of channel BW such as 1.6 GHz or 2.4GHz would enable efficient usage of 5 GHz allocation in China and 5 GHz IMT allocation in Europe. Some companies have observed that smaller bandwidth (e.g. 1.6 GHz) allows for more channels (e.g., with 1.6 GHz, 3 channels instead of two) in these regions, easing frequency planning between operators at the cost of reduction in available channel bandwidth per carrier.

Some companies proposed to support more than one channel bandwidths for a given SCS.

Some companies observed that the relationship between channel bandwidth and initial access aspects should be taken into account for the supported channel bandwidth(s), especially for minimum channel bandwidth. Some companies observed that a wider minimum channel bandwidth supported for a band may help to limit the number of synchronization raster entries in the band, if the same design principle for Rel-15 licensed bands applies. It should be noted that minimum channel bandwidth and synchronization raster entries will be defined by RAN4.

Available bandwidth within a given carrier for RMSI transmission for SSB and CORESET multiplexing pattern 2 and 3 is smaller than available bandwidth for multiplexing pattern 1. Some companies observed that the channel bandwidth supported for a band should be wide enough to enable multiplexing e.g. between SSB, CORESET0, and RMSI transmissions in multiplexing pattern 2 and 3. Some companies observed that depending on the supported carrier bandwidth and configured values of O and M, multiplexing pattern 1 can make available more time/frequency resources for RMSI PDSCH in a slot than pattern 2 and 3. Some companies observed that patterns 2 and 3 are more efficient than pattern 1 as they may potentially minimize the broadcast overhead in time.

It is recommended that both single and multi-carrier operation are supported to support higher data rates. Larger SCS may achieve larger aggregated bandwidth with multi-carrier operation given a maximum number of CCs.

### 4.1.3 Investigation of physical layer impact from candidate numerology and bandwidths

#### 4.1.3.1 General physical layer impacts

It is recommended to strive for maximum commonality for the system design for licensed and unlicensed operation for NR from 52.6GHz to 71GHz, and maximize re-use of the existing NR design.

Some companies noted that standardization effort to support 240 kHz, 480 kHz, and 960 kHz numerologies are comparable. Some companies noted that standardization effort for 240 kHz numerology could be relatively smaller compared to 480 kHz or 960 kHz numerologies.

The following, which is not an exhaustive list, are some potential physical layer impacts that are common to all numerologies:

- supporting unlicensed operation,

- if mixed numerology is supported, supporting mixed numerology operation,

- SSB and CORESET#0 offsets needed for supported channelization.

The following, which is not an exhaustive list, are some potential physical layer impact areas for each numerology:

- For 120 kHz subcarrier spacing:

- Potential consideration of PTRS enhancement for CP-OFDM and DFT-s-OFDM, if needed.

- For 240 kHz subcarrier spacing:

- Potential consideration of PTRS enhancement for CP-OFDM and DFT-s-OFDM, if needed,

- If common SSB/CORESET#0 numerology (240/240) is supported, SSB patterns, and CORESET#0 configuration,

- RO configuration,

- Timelines for scheduling, processing and HARQ,

- Potential enhancement to DM-RS, if needed,

- PDCCH monitoring.

- For 480 kHz subcarrier spacing:

- If 480 kHz SSB is supported, SSB patterns, and CORESET#0 configuration,

- Timelines for scheduling, processing and HARQ,

- RO configuration,

- Potential enhancement to DM-RS, if needed,

- PDCCH monitoring,

- Potential consideration of PTRS enhancement for CP-OFDM and DFT-s-OFDM, if needed.

- For 960 kHz subcarrier spacing:

- Potential consideration of ECP, if needed, depending on deployment scenarios,

- If 960 kHz SSB is supported, SSB patterns, and CORESET#0 configuration,

- Timelines for scheduling, processing and HARQ,

- RO configuration,

- Potential enhancement to DM-RS, if needed,

- PDCCH monitoring,

- Potential updates to smallest time unit, Tc, used in specifications depending on supported maximum carrier BW.

It was identified that support of the new subcarrier spacing, if agreed, will at least require investigation on the need for enhancements and standardization, of the following processing timelines:

- processing capability for PUSCH scheduled by RAR UL grant,

- dynamic SFI and SPS/CG cancellation timing,

- timeline for HARQ-ACK information in response to a SPS PDSCH release/dormancy,

- minimum time gap for wake-up and Scell dormancy indication (DCI format 2\_6),

- BWP switch delay,

- multi-beam operation timing (timeDurationForQCL, beamSwitchTiming, beam switch gap, beamReportTiming, etc.),

- timeline for multiplexing multiple UCI types,

- minimum of P\_switch for search space set group switching,

- appropriate configuration(s) of k0 (PDSCH), k1 (HARQ), k2 (PUSCH),

- PDSCH processing time (N1), PUSCH preparation time (N2), HARQ-ACK multiplexing timeline (N3),

- CSI processing time, Z1, Z2, and Z3, and CSI processing units,

- any potential enhancements to CPU occupation calculation,

- related UE capability(ies) for processing timelines,

- minimum guard period between two SRS resources of an SRS resource set for antenna switching.

#### 4.1.3.2 Physical layer impacts to synchronization and random access

For the study item, it is recommended to study on whether or not different SSB patterns should be supported for licensed and unlicensed bands is needed. For each licensed and unlicensed band, if issues are identified for reuse of existing SSB, consider at least beam switching gap between SSB(s) and between SSB and other signal(s)/channel(s), SSB pattern in time domain, and whether or not it is needed to define a transmission window (such as DRS window), and if needed, number of SSB transmission opportunities within a transmission window. For each licensed and unlicensed band, if issues are identified for reuse of all or some of the existing SSB and CORESET#0 multiplexing pattern, consider at least the following aspects for SSB, CORESET#0, and other signal/channel design:

- Supported multiplexing pattern type(s) (Pattern 1, 2, and/or 3) for SSB and CORESET#0 multiplexing,

- Multiplexing of other signal/channels (e.g. RMSI, paging, CSI-RS) with SSB,

- Configuration of Type0-PDCCH search space set.

For the study item, it is recommended to at least consider the following aspects for determination of supported SSB subcarrier spacing:

- detection performance of SSB (including PSS, SSS, PBCH DMRS, and PBCH) and SSB coverage requirement,

- impact on initial cell search complexity due to frequency errors (e.g. carrier frequency offset, Doppler shift, etc),

- timing detection accuracy and its relation to uplink transmission accuracy,

- signaling design for supporting different subcarrier spacing for SSB and CORESET#0 (if supported),

- multi-TRP delay considerations,

- consideration of SSB-based RRM/RLM and beam management if the SSB SCS is significantly different from that of the active BWP (e.g., switching gap, scheduling constraint, etc.).

For the study item, it is recommended to consider the at least following aspects for PRACH design of NR operating in 52.6 GHz to 71 GHz:

- PRACH coverage requirements,

- applicable PRACH Sequence length(s) and subcarrier spacing(s) for PRACH, including any impact on PRACH coverage and capacity from the applicable sequence length(s),

- RACH RO configurations with new SCS (if new SCS is supported),

- LBT gap between RACH occasions (RO).

Some companies noted SSB SCS selection should consider SCS of data/control channels and enablement of single subcarrier spacing operation.

Some companies noted support and use of (120 kHz,120kHz) or (240kHz,120kHz) for the pair of SSB SCS and CORESET#0 SCS in initial BWP, and activation of dedicated BWP with an SCS for data/control different than the initial BWP may enable re-use of existing NR specification and minimize standardization effort.

It was identified to further investigate considerations of SSB patterns, if needed, considering:

- unlicensed band operation if LBT is required for SSB, e.g. SSB cycling transmission within a DRS transmission window,

- beam switching time between SSB,

- coverage of SSB,

- multiplexing of SSB with CORESET and UL transmissions.

In order to benefit from higher transmit power, when maximum PSD regulatory requirements exist, RAN1 recommends support of longer PRACH sequence lengths, L=571 and L=1151, defined in Rel-16 NR specification, to be used for NR operating in 52.6 GHz to 71 GHz.

It is recommended to not support interlace design for PRACH for NR operating in 52.6 GHz to 71 GHz. It is recommended to further investigate whether or not to support configurations that enable non-consecutive RACH occasions in time domain to aid LBT processes if LBT is required.

Some companies noted that PRACH SCS selection should consider SCS of data/control channels and enablement of single subcarrier spacing operation. Some companies noted that 120 kHz SCS for PRACH (even if data/control channel may have different SCS) may be sufficient to support NR operating in 52.6 GHz to 71 GHz from coverage perspective.

It was identified that potential enhancements for PRACH should consider system coverage for PRACH with subcarrier spacing larger than 120 kHz, if supported.

#### 4.1.3.3 Physical layer impacts to PDSCH and PUSCH

For the study item, it is recommended to study of frequency domain scheduling enhancements/optimization for PDSCH/PUSCH, if needed, e.g. potential impact to UL scheduling if frequency domain resource allocation with different granularity than FR1/2 (e.g. sub-PRB, or more than one PRB) is supported, and study of time domain scheduling enhancements for PDSCH/PUSCH, if needed, e.g. increasing the minimum time-domain scheduling unit to be larger than one symbol, supporting multi-PDSCH scheduled by one DCI, supporting one TB mapped to multiple slots (i.e., TTI bundling).

Some companies have noted that interlace transmissions for PUSCH do not provide benefit over non-interlaced uplink allocations currently supported by NR for NR operating in 52.6 GHz to 71 GHz, while some companies have noted support of sub-PRB or PRB interlace transmissions for PUSCH may improve transmit power and possibly meets OCB requirements (some companies note OCB requirements can be met without introducing interlacing) when necessary.

It was identified that new subcarrier spacing, if agreed, may require further investigation of multi-PDSCH/PUSCH scheduling and standardization, if needed. The following aspects should be at least investigated for multi-PDSCH/PUSCH scheduling:

- whether to support a single TB and/or multiple TBs scheduled over multiple slots,

- applicable DCI format(s) (including potential new formats, if needed) for multi-PDSCH and multi-PUSCH scheduling,

- enhancement on multiple beam indication and association with multiple PDSCH/PUSCH scheduling,

- DM-RS enhancements such as DM-RS bundling, or changes to the time-domain pattern,

- HARQ enhancements for multi-PDSCH,

- applicability of Rel-16 multi-PUSCH scheduling.

#### 4.1.3.4 Physical layer impacts to PDCCH

For the study item, it is recommended to study the following aspects for new SCS for PDCCH that are not supported in Rel-15/16 NR, if agreed:

- investigate on the maximum number of BDs/CCEs for PDCCH monitoring per time unit, e.g. slot as Rel-15, or new scheduling/monitoring unit,

- any potential limitation to PDCCH monitoring configurations (e.g. search spaces, DCI formats, overbooking/dropping, etc) to help with UE processing, if needed, e.g. increased minimum PDCCH monitoring unit,

- potential enhancements for CORESET, if needed,

- related UE capability(ies) for PDCCH processing.

It was identified that the potential enhancements to PDCCH monitoring including potential limitation to UE PDCCH configuration, multiple PDSCH/PUSCH scheduling with a single DCI (using existing DCI formats or new DCI format(s)), spatial relation management for GC-PDCCH, capability related to PDCCH monitoring, and PDCCH coverage should be further investigated for higher subcarrier spacings, including the need for such enhancements.

It was observed that PDCCH processing capabilities per multiple slots for larger SCS (e.g. 480 or 960 kHz) can maintain scheduling framework same as for smaller SCS (e.g. 120 kHz) when the UE is configured to monitor the PDCCH every multiple slot.

#### 4.1.3.5 Physical layer impacts to PUCCH

It is recommended to further investigate potential enhancements to PUCCH to enable higher transmission power when regulatory limits apply. Majority of the sources have identified PUCCH format 0, 1, and 4 as potential candidates for enhancement. Two sources have identified all PUCCH formats as potential candidates for enhancement. Further potential enhancements to spatial relation management for configured and/or semi-persistent UL signals/channels may be considered.

#### 4.1.3.6 Physical layer impacts to reference signals

For the study item, it is recommended to consider at least the following aspects of PT-RS design for a given SCS:

- phase noise compensation performance of existing PT-RS design,

- study of need of any modification/changes to existing PT-RS design, including:

- potential modification to the PT-RS pattern or configuration to aid performance improvement for CP-OFDM and DFT-s-OFDM waveforms (if needed),

- potential methods to aid ICI compensation at the receiver (if needed).

For the study item, it is recommended to consider at least the following aspects of DM-RS design for a given SCS:

- Channel estimation performance of existing DM-RS design with existing and new SCSs (if any),

- Study whether there is a need of any modification/changes to existing DM-RS design, including potential modification or introduction of new DM-RS pattern, and configuration or indication to aid performance improvement for CP-OFDM and DFT-S OFDM waveforms (if needed).

It is recommended to further investigate the need for DL and UL PT-RS enhancement for the subcarrier spacings to be supported in specifications. PT-RS enhancements, if needed, can consider the following:

- support of high MCS values,

- applicability of ICI compensation techniques,

- PT-RS sequence,

- time and frequency resources for PT-RS with OFDM and DFT-s-OFDM waveforms.

It is recommended to further investigate the need for DL and UL DM-RS enhancements for the subcarrier spacings to be supported in specifications. DM-RS enhancements, if needed, can consider the following:

- coherence bandwidth and its impact to orthogonal codes used for DM-RS,

- frequency domain density and overhead,

- maximum number of DM-RS ports.

Some companies noted LBT failure may prevent transmission of periodic reference signals, such as P-TRS, and negatively impact performance. Some companies noted deferral of periodic reference signals may be rare and may not significantly impact system performance. Some companies noted aperiodic reference signals could be used to negate the potential impact from LBT failure.

#### 4.1.3.7 Physical layer impacts to beam management and CSI

For the study item, it is recommended to study potential enhancements or alternatives to the scheduling request mechanism to reduce scheduling latency due to beam sweeping, if needed.

For the study item, it is recommended to consider at least the following aspects in system operations with beams:

- study of BFR mechanism enhancements, if supported,

- e.g., the use of aperiodic CSI-RS for BFR, increased number of RSs for monitoring/candidates and efficient utilization of the increased number of RSs, enhanced reliability to cope with narrower beamwidth,

- study of UE capabilities on beam switch timing in beam management procedure,

- study of enhancements for beam management and corresponding RS(s) in DL and UL are needed further considering at least the following aspects, if supported:

- beam switching time, beam alignment delay (including initial access), LBT failure, and potential coverage loss (if large SCS is supported),

- study of beam switching gap handling for signals/channels (e.g. CSI-RS, PDSCH, SRS, PUSCH) for higher subcarriers spacing, if supported.

It is recommended to further investigate potential enhancements, if needed, to beam management at least considering one or more of potentially narrower beamwidths, CP duration, multiple beam indications for multi-PUSCH/PDSCH scheduling, triggering of reference signals for beam management, enhancements to beam management for random access procedure, intra- and/or inter-cell mobility, and adaptation to LBT failures. Minimum requirement on beam switching delay in > 52.6 GHz spectrum should be further studied by RAN4 when specification is further developed.

It is recommended to investigate whether or not enhancements to CSI processing unit (CPU) availability check is needed when the UE is required to process CSI reports corresponding to multiple numerologies across active BWPs in different component carriers.

## 4.2 RAN4 aspects

### 4.2.1 General description of study in RAN4

RAN4 and RAN1 had one common objective for the study on supporting NR from 52.6 GHz to 71 GHz, which is reproduced here from study item description.

- Study of required changes to NR using existing DL/UL NR waveform to support operation between 52.6 GHz and 71 GHz

- Study of applicable numerology including subcarrier spacing, channel BW (including maximum BW), and their impact to FR2 physical layer design to support system functionality considering practical RF impairments [RAN1, RAN4].

Aligned with this objective, RAN4 has studied practical RF impairments and captured relevant technology status in this TR. On top of aspects impacting FR2 physical layer design, aspects impacting RAN4 requirements have also been considered and documented.

### 4.2.2 Timing considerations

During the study item timing aspects were evaluated with to goal of providing observations and guidance on which technical topics need to be considered in the work item phase when timing related requirements are agreed. The evaluated topics were cell phase synchronization, base station timing alignment error, analog beam switching delay, UE timing advance operation and transient periods.

Currently transient times for UE is 5 us in FR2. For base stations it is 3 us in FR2. It was concluded during the SI, that possible improvements for transient times should be evaluated and the final agreement for transient time requirements shall be made during the work item.

Guard period is also related to cell phase synchronization as for overlapping cells, synchronization error needs to be taken into account as it contributes to the possibility of BS-to-BS and UE-to-UE interference. Due to smaller cell sizes in this frequency cells compared to lower frequencies and therefore shorter propagation delays possibility of such interference is reduced. Higher SCS provides more opportunities to achieve optimal configuration for with minimal overhead when compared to lower SCS due to the reduced symbol duration. It should be noted that extremely low latencies are not required in all use cases, e.g. if the optimization target is achieving high throughput. High throughput made possible by extremely wide available bandwidths appears as an attractive and feasible design target to be prioritized over improved latency. As network has control over guard period, motivation to re-visit cell-phase synchronization was not found during the SI.

The PHY-layer specifications for UE timing advance are defined to be scalable with SCS, i.e. the update granularity becomes more accurate when SCS increases. Similar behaviour exists in timing advance requirements. Overall, it is necessary to consider UE timing advance requirements, including UE initial access timing error limit, BS controlled timing advance and UE autonomous timing adjustment requirements during work item, taking into account the SCS selection.

### 4.2.3 Phase noise characteristics

It was considered which level of detail of the RF architecture is considered. The actual LO-architecture of an antenna array can vary ranging from a single LO driving the whole antenna array up to small sub-arrays each having their own LO. When multiple LOs are considered, the phase noise output of those can have a varying degree of correlation. The LO-structure is an implementation specific aspect and does not need to be considered in the standard.

### 4.2.4 Power amplifiers trends

The PA technology trends are based on PA performance survey in [74]. The referred PA survey captures a large power amplifier database consisting of more than 3400 data points with over 1200 data points for CMOS, SiGe PAs and over 1700 power amplifier data points has been collected for GaN, GaAs, InP. This database covers published results, both from the open literature, as well as commercial amplifiers from various vendors.

Based on the information in [74], the PA database information was summarized for all the considered RF technologies in figure 4.2.4-1 and 4.2.4-2, where the 52.6 – 71 GHz frequency range was highlighted. It can be observed that based on the available information, there is no data for the LDMOS technology for the 52.6 – 71 GHz range.

In order to derive more accurate PA trends data, figure 4.2.4-1 was plotted with PA operating frequencies much wider than just 52.6 – 71 GHz range. More detailed technology-specific plots (e.g. PAE vs. Psat, or Psat vs. frequency) can be found in the Excel spreadsheet capturing all the PA survey data in [74].

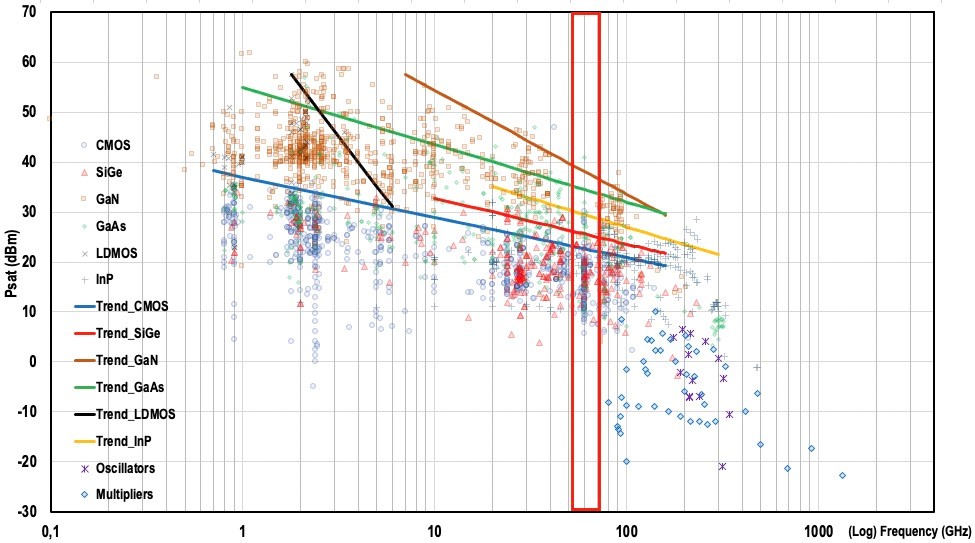
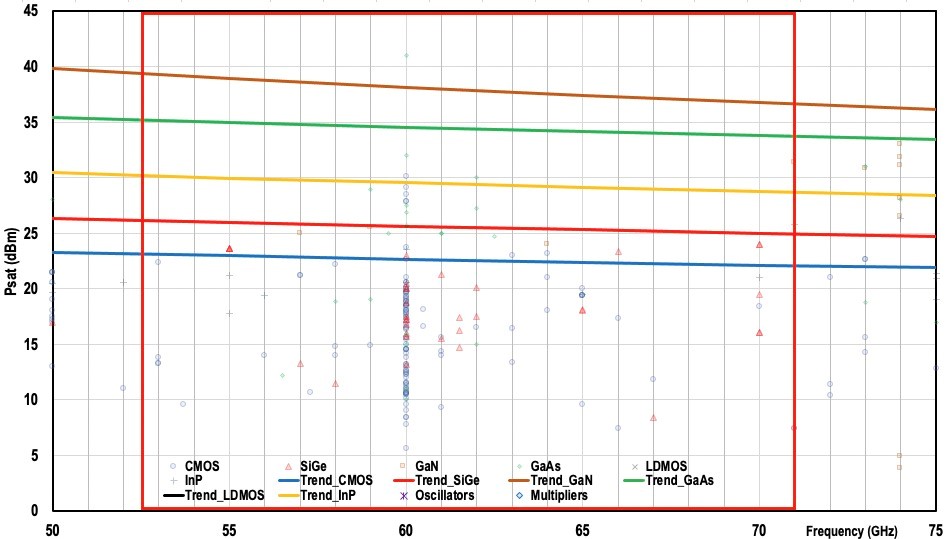


Figure 4.2.4-1: Saturated output power versus frequency (red box depicts 52.6 – 71 GHz range)

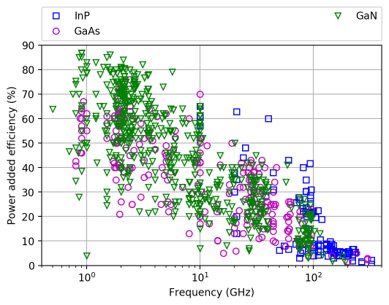
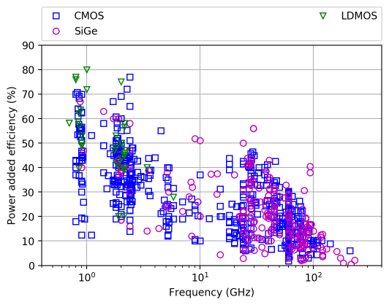
**Figure 4.2.4-2: Saturated output power versus frequency – focus on 52.6 – 71 GHz range**

Based on the analysis of the achievable Psat trends over the 52.6 – 71 GHz range, the saturated output power maximum trend values for 52.6 GHz and 71 GHz from [74] were extracted in table 4.2.4-1.

Table 4.2.4-1: Maximum trend values of the saturated output power

|  |  |  |
| --- | --- | --- |
| **RF technology** | **Estimated maximum trend value of the saturated output power @52.6 GHz (dBm)** | **Estimated maximum trend value of the saturated output power @71 GHz (dBm)** |
| CMOS | 23 | 22 |
| SiGe | 26 | 25 |
| GaN | 39 | 37 |
| GaAs | 35 | 34 |
| InP | 30 | 29 |

The same dataset used for peak power trends was used to study the efficiency of available semiconductor technologies. In Figure 4.2.4-3, a scatter diagram of peak Power Added Efficiency (PAE) as function of operating frequency for power amplifiers made using Silicon and semiconductor transistors (GaAs and GaN). As expected, the efficiency is mainly dependent on the operating frequency and not the transistor technology. The wide spread of data is mainly due to different power levels and different amplifier architectures.



**Figure 4.2.4-3: Peak power added efficiency versus frequency for power amplifiers using Silicon transistors (left) and GaN and GaAs transistors (right)**

The trend analysis indicates that from a technological perspective the power amplifier efficiency in the frequency range 52 to 71 GHz is worse compared to FR2. The need for AAS type of products for this frequency range, as well as high level of integration in limited space, requires care for thermal design and considerations.

As shown, with the support from both empirical data and theoretically established limits we know that that both power efficiency and RF saturated output power capability decrease with increasing frequency. The choice of process technology used in fabricating the PAs may offset the capabilities at a given frequency but the trends versus frequency of operation remains.

### 4.2.5 BS aspects

#### 4.2.5.1 BS antenna arrays

More detailed antenna array modelling may be further considered in work item if needed.

Antenna array configurations were evaluated with respect to target output power. It is assumed that each antenna array element has its own power stage and antenna elements have 60% aperture coupling efficiency. The EIRP can be calculated as shown in Table 4.2.4.2-3. While the example in table 4.2.5.1-1 is provided for 16x8 element array, the same principle can be used to evaluate the array sizes required to reach 40 dBm and 60 dBm EIRP, which we set for targets for system evaluations according to Annex A.2 The result is that reaching 40 dBm EIRP requires an 4x8 element array whereas 60 dBm EIRP requires 16x16 element array.

It should be noted that the estimates are very conservative, given that the power amplifier study [74] outlines the saturated power for CMOS technology between 22 and 23 dBm for 52.6 – 71 GHz frequency range. Therefore, plenty of design margin for possible front-end losses have been included.

Table 4.2.5.1-1: Example antenna arrays

|  |  |  |
| --- | --- | --- |
| **Carrier frequency** |  | **70.0GHz** |
| **Array size** |  | **16x8** |
| **System Gain & Coverage Analysis** |  |  |
| Total Conducted Power | dBm | 28.0 |
| Tx Arrayed Antenna Gain | dBi | 24.8 |
| **EIRP per polarization** | **dBm** | **52.8** |
| Number of antenna polarizations |  | 2 |
| Number of streams / polarizations |  | 1 |
| **Transmitter Array Information (per polarization)** |  |  |
| # elements in X |  | 16 |
| # elements in Y |  | 8 |
| Number of antenna elements |  | 128 |
| Element spacing | lambda | 0.5 |
| Array size, X dimension | mm | 34.3 |
| Array size, Y dimension | mm | 17.1 |
| Element directivity | dB | 6.0 |
| Array factor | dB | 21.0 |
| Antenna directive gain | dB | 27.0 |
| Antenna coupling efficiency | % | 60 % |
| Antenna coupling efficiency | dB | -2.2 |
| **Tx Array Antenna Gain** | **dB** | **24.8** |
| **Transmitter Power Amplifier Info (per polarization)** |  |  |
| PA OP1dB | dBm | 16 |
| Backoff, i.e. modulated signal PAPR | dB | 9.0 |
| Average power output per PA | dBm | 7 |
| Power into each sub-array or antenna element | dBm | 7 |
| Number of Tx sub-array PAs or antenna elements |  | 128 |
| Multi element or sub-array power gain | dB | 21 |
| **Total Conducted Power** | **dBm** | **28.0** |

The array sizes are similar to FR2 array in 24.25 – 52.6 GHz frequency range, and therefore also the beamwidths are similar.

#### 4.2.5.2 Noise figure

Referring to ETSI technical report TR 101 854 [75] on fixed radio point-to-point systems, one can find information on typical NF and associated industrial margins (IMF) values across wide range of frequencies. The IMF considers various performance variations of system elements over e.g. temperature extremes, voltage variations, or aging by capturing production spread of RF circuits.

For the 52.6 – 71 GHz range, the above NF values are in range of 10 – 13 dB.

Table 4.2.5.2-1: Typical Noise Figures (NF) and associated Industrial Margins (IMF)

|  |  |  |
| --- | --- | --- |
| **Frequency band**  **(GHz)** | **Typical Noise Figure (NF)**  **(dB)** | **Industrial margin (IMF)**  **(dB)** |
| 48 - 50 | ~9 | +3 |
| 52 - 55 | ~10 | +3 |
| 71 - 76 | ~13 | +4 |
| 81 - 86 | ~13 | +4 |

NOTE: The above ETSI originated Industrial Margins (IMF) shall not be confused with the Implementation Margins (IM) used in process of RAN4 conformance requirements derivation.

Referring to the system level evaluation assumptions in annex A, the BS NF was assumed as 7 dB, while UE NF was assumed as 10 dB (13 dB optionally).

Link level and system level simulation assumptions in annex A are assuming UE mobility (i.e. 3km/h), while the above referred ETRI TR treats about the fixed point-to-point applications. Still one can observe good alignment of NF values among the ETSI TR and those in this 52.6-71 GHz performance evaluation. This can be interpreted that the RF technology to be used for both static and mobile applications in 52.6-71 GHz frequency range will have similar and comparable capabilities, making the ETSI TR 101 854 [75] a valid reference for this technical report.

### 4.2.6 UE aspects

### 4.2.7 RAN4 conclusions on numerologies and channel bandwidths

# 5 Study of channel access mechanism for 60 GHz

## 5.1 Identification of regulatory aspects for consideration

The OCB requirement of draft version v2.1.20 of EN 302 567 [4] implies that

- device supports one or multiple declared nominal channel bandwidths,

- for each declared nominal channel bandwidth, RAN1 design should support at least one physical layer signal/channel transmission that occupies at least 70% of the nominal channel bandwidth.

Mapping of nominal channel bandwidth to bandwidth definitions in NR should be further studied when specifications are developed.

The understanding of the CCA check procedure in draft v2.1.20 of EN 302 567 is as follows:

- when performing CCA before initiating transmission, during count down, when an observation slot fails ED, the counter freezes, and will continue count down 8us after the interference is detected to be gone.

## 5.2 Channel access and interference mitigation techniques

### 5.2.1 Interference mitigation techniques

It is recommended to support both channel access with LBT mechanism(s) and a channel access mechanism without LBT for gNB and UE to initiate a channel occupancy. Further investigation of the following issues may be needed:

- LBT mechanisms such as omni-directional LBT, directional LBT, and receiver assisted LBT type of schemes when channel access with LBT is used,

- whether operation restrictions for channel access without LBT are needed, e.g. compliance with regulations, and/or in presence of ATPC, DFS, long term sensing, or other interference mitigation mechanisms, and

- the mechanism and condition(s) to switch between channel access with LBT and channel access without LBT (if local regulation allows).

For operation where LBT is not required, the following can be further discussed when specifications are developed:

- whether to introduce additional conditions/mechanisms for no-LBT to be used, or whether to leave it for gNB implementation,

- when no-LBT mode is used, whether to introduce additional restrictions, such as DFS needs to be applied, ATPC needs to be applied, long term sensing needs to be applied, certain duty cycle limitation, certain transmit power limitation, MCOT limits, etc, or leave the restriction for gNB implementation,

- when no-LBT mode is used, whether to introduce mechanism for the system to fallback to LBT mode, or whether to leave it for gNB implementation.

### 5.2.2 Listen before talk (LBT) design

Use the CCA check procedure in EN 302 567 as the baseline for channel access for 60GHz band when LBT is applied. The following can be discussed further during normative work:

- whether CAPC and contention window adjustment mechanisms are introduced,

- whether contention window range needs to be adjusted.

It can be further discussed when specifications are developed if and how the ED threshold provided by the ETSI BRAN 302 567 should be modified to account for aspects such as transmit power, LBT bandwidth, beamforming gain, coexistence etc. It should be noted that there is no consensus that all of the aspects above need to be considered.

For NR **at least when** operating with LBT, maximum channel occupancy time (MCOT) duration is 5 msec, including all gaps inside the COT. Discussions related to further reductions in MCOT due to potential definition of CAPC will be handled separately

On the LBT bandwidth (bandwidth over which a single contiguous LBT is performed) relative to channel bandwidth (as defined in RAN4), the following alternatives have been discussed. Further down-selection of one or more of these alternatives (if needed) should be further discussed when specifications are developed.

- Alt 1: LBT bandwidth equals channel bandwidth,

- Alt 2: LBT bandwidth equals the minimum of channel bandwidth and the transmission bandwidth (number of RBs for a given transmission),

- Alt 3: LBT bandwidth can be wider than channel bandwidth,

- Alt 4: LBT bandwidth can be narrower than the channel bandwidth, with multiple LBT subband within a channel,

- Alt 5: LBT bandwidth equals with minimum supported channel bandwidth or multiples of the minimum supported channel bandwidth.

When LBT mode is used, it can be further discussed when specifications are developed if a responding device should use a Cat 2 LBT to share the COT, and if yes, how to define the Cat 2 LBT and if a maximum gap is to be introduced between the initiating device and responding device transmissions.

Support contention-exempt short control signalling transmission in 60GHz band for regions where LBT is required and short control signaling without LBT is allowed. It should be noted that if regulations do not allow short control signaling exemption in a region when operating with LBT, operation with LBT for these short control signals should be supported. Restrictions to the transmission, such as, on duty cycle (airtime measured over a relatively long period of time), content, TX power, etc. can be discussed when specifications are developed.

It can be further discussed when specifications are developed if 3GPP specifications should define the relationship between the LBT beam and the transmission beam or leave it as implementation. If such relationship is defined, it can also be further discussed when specifications are developed if ED threshold should be adjusted by the choice of LBT beam and transmission beam.

When LBT mode is used, spatial domain multiplexing of different beams is supported. The LBT requirement (if any) for spatial domain multiplexing of multiple beams can be further discussed when specifications are developed. At least the following can be considered while other LBT considerations are not excluded:

- leave the LBT behaviour for implementation,

- one LBT beam covers all transmission beams,

- multiple LBT beams cover multiple transmission beams.

When LBT mode is used, time domain multiplexing of DL/UL transmissions in different beams in the same COT is supported. The LBT requirement (if any) for time domain multiplexing of DL/UL transmissions in multiple beams can be further discussed when specifications are developed. At least the following can be considered while other LBT considerations are not excluded:

- no additional LBT requirement defined and leave the LBT behaviour for implementation,

- perform directional or omni-directional LBT at the beginning of COT with sensing beam(s) that covers all TDM beams and with no LBT before each beam switching in the middle of COT,

- perform directional or omni-directional LBT at the beginning of COT with sensing beam(s) that covers all TDM beams or the first transmission beam, and additional directional LBT with sensing beam that covers the next transmission beam for each beam switching in the middle of COT.

### 5.2.3 Receiver assisted channel access and interference management

The following receiver assisted channel access and interference management schemes have been considered and can be further investigated when specifications are developed.

- Class A) Receiver provides assistance information (signalling) to transmitter only. The following aspects of Class A can be further discussed when specifications are developed.

- Applicability in the following potential channel access modes:

- LBT is performed prior to transmission,

- No LBT is performed prior to transmission.

- Details of assistance information (e.g., type, timing, content, how the assistance information is obtained etc.).

- Whether the assistance information can be obtained by LBT performed at the receiver prior to transmission.

- Whether the assistance information can be obtained by existing layer 1 and layer 3 measurements with enhancements if needed.

- If any specification changes are needed to support Class A.

Also, the following receiver assisted channel access schemes have been considered, and considering the system performance and complexity tradeoff, these schemes will not be further investigated in Rel-17

- Class B) Receiver provides assistance information (signalling) to other NR nodes, including non-serving nodes.

- In this case, cross RAT coexistence is based on ED.

- Class B1) Intra-operator only.

- Class B2) Also including inter-operator signalling.

- In this case, cross operator coexistence is based on ED.

- Class C) Receiver provides assistance information (signalling) to other NR nodes and nodes from other RAT.

# 6 Summary of evaluation study

## 6.1 Summary of link level evaluations

### 6.1.1 Observations on PDSCH/PUSCH

Key findings from the results of PDSCH/PUSCH evaluations in Annex B.1.1 are summarized below.

For CP-OFDM, with evaluation assumptions and parameters as in Table A.1-1, the following are observed when CPE-only compensation based on the existing Rel-15 NR PTRS structure is used for normal CP when delay spread is not large. The performance is measured in terms of SINR in dB achieving BLER target of 10% or 1%.

- For low MCS (QPSK) and medium MCS (16QAM), there is minor performance difference between different SCS values up to 960 kHz.

- For high MCS (64QAM), the performance improves in general as the increase of SCS.

- For high MCS (64QAM), 15 sources, [65], [72], [30], [60], [64], [68], [14], [6], [59], [25], [22], [29], [16], [71], [11], and [19], compared performance of 120 and 240 kHz SCS in 400 MHz bandwidth.

- For 10% BLER target, there is a performance gap between 120kHz and 240kHz SCS, where 240 kHz SCS performs better.

- One source [65] reported better performance of 240 kHz SCS in CDL-D. It also reported both SCS cannot meet 10% BLER target for the other evaluated channel model.

- 4 sources, [72], [68], [14], and [71], reported both SCS cannot meet 10% BLER target.

- 4 sources, [60], [64], [25], and [11], reported 120 kHz SCS cannot meet 10% BLER target, while 240 kHz SCS can.

- One source, [6] and additional results in [59], reported better performance of 240 kHz SCS at TDL-A 5 and 10ns. It also reported that both SCS cannot meet 10% BLER target for other evaluated cases.

- One source [16] reported better performance of 240 kHz SCS in CDL-D. It also reported that both SCS cannot meet 10% BLER target for other evaluated cases.

- 3 sources, [30], [22], and [19], reported better performance of 240 kHz SCS.

- One source [29], reported comparable performance for both SCS in CDL-D. It also reported better performance of 120 kHz SCS for the other evaluated channel models.

- For high MCS (64QAM), 14 sources, [65], [30], [60], [64], [68], [14], [6], [59], [25], [22], [29], [16], [71], [11], and [19], compared performance of 240 and 480 kHz SCS in 400 MHz bandwidth.

- For 10% BLER target, there is a performance gap between 240kHz and 480kHz SCS where 480 kHz SCS performs better.

- One source [65] reported better performance for 480 kHz SCS in CDL-D. It also reported 240 kHz SCS cannot meet 10% BLER target for the other evaluated channel model.

- 3 sources, [68], [14], and [71], reported 240 kHz SCS cannot meet 10% BLER target, while 480 kHz SCS can.

- One source [6] and additional results in [59], reported better performance of 480 kHz SCS at TDL-A 5 and 10ns. It also reported 240 kHz SCS cannot meet 10% BLER target for other evaluated cases.

- One source [16] reported better performance of 480 kHz SCS in CDL-D. It also reported 240 kHz SCS cannot meet 10% BLER target for other evaluated cases.

- 7 sources, [30], [60], [64], [25], [22], [11], and [19], reported better performance of 480 kHz SCS.

- One source [29], reported comparable performance for both SCS in CDL-D. It also reported better performance of 240 kHz SCS for the other evaluated channel models.

- For high MCS (64QAM), 15 sources, [65], [72], [30], [60], [64], [68], [14], [6], [59], [25], [22], [29], [16], [71], [11], and [19], compared performance of 480 and 960 kHz SCS in 400 MHz bandwidth.

- For 10% BLER target, there is a performance gap between 480kHz and 960kHz SCS where 960 kHz SCS performs better.

- 7 sources, [65], [64], [68], [14], [6], [59], [71], and [11], reported a greater than 1 dB gain of 960 kHz SCS.

- 3 sources, [30], [60], and [22], reported a smaller than 1 dB performance gain of 960 kHz SCS.

- One source [72] reported better performance of 480 kHz SCS for CDL-B 50ns and better performance of 960 kHz SCS for other evaluated cases. In all comparison, the difference is greater than 1 dB.

- Two sources, [25], and [16], reported a better performance of 480 kHz SCS than 960 kHz SCS at 20ns DS in TDL-A where 960 kHz SCS cannot meet 10% BLER target and comparable performance for both SCS in all other evaluated cases.

- One source [29] reported comparable performance for both SCS in CDL-D. It also reported better performance of 480 kHz SCS in TDL-A 5ns and better performance of 960 kHz SCS in CDL-B 20ns.

- One source [19] reported a smaller than 1 dB performance gain of 960 kHz SCS at 5 ns and 10 ns in TDL-A and a smaller than 1 dB performance gain of 480 kHz SCS at 20 ns in TDL-A.

- For 1% BLER target, the performance for 960kHz SCS is better than 480kHz SCS.

- Among sources reported SINR values when both SCS can meet 1% BLER target, the absolute value of the performance gap between 480 kHz and 960 kHz SCS is larger than that for 10% BLER target.

- For high MCS (64QAM), 4 sources, [65], [60], [14], and [22], compared performance of 480 and 960 kHz SCS in 1600 or 2000 MHz bandwidth. 4 out of 4 sources reported performance gain around 4 ~ 5 dB of 960 kHz SCS for 10% BLER target. All 4 sources also reported that 480 kHz SCS cannot meet 1% BLER target.

For CP-OFDM, with evaluation assumptions and parameters as in Table A.1-1 (including optional delay spread value), the following are observed when CPE-only compensation based on the existing Rel-15 NR PTRS structure is used with respect to CP type and large delay spread.

- When delay spread is not large (< 40 ns in TDL-A), there is minor performance difference between normal and extended CP for SCS values up to 960 kHz when compared on the basis of equal MCS (code rate). If comparing on the basis of equal TBS (equal throughput), the performance of ECP is degraded due to higher overhead of ECP.

- Among 11 sources, [65], [72], [30], [60], [64], [68], [6], [59], [5], [29], [16], and [11], evaluated with large delay spread (i.e. 40 ns in TDL-A and/or 50ns in CDL) based on the existing Rel-15 NR PTRS structure for normal CP, 10 sources observed that for low MCS (QPSK) and medium MCS (16QAM), there is minor performance difference between different SCS values up to 960kHz for 10% BLER target.

- The other source [5] evaluated SCS 960 kHz with CPE compensation at MCS16 with normal CP in TDL-A channel with 40ns DS. It reported that the BLER for SCS 960 kHz, MCS16, and Normal CP is not acceptable (cannot meet 10% BLER target) for 40ns DS.

- 10 sources, [65], [72], [30], [60], [64], [68], [6], [59], [29], [16], and [11], evaluated large delay spread (i.e. 40 ns in TDL-A and/or 50ns in CDL) with CPE compensation based on the existing Rel-15 NR PTRS structure with normal CP. Among 10 sources, 5 sources, [18], [72], [9], [60], [6], [59], and [29], also evaluated extended CP at least for 960 kHz SCS with CPE compensation based on the existing Rel-15 NR PTRS structure.

- 9 out 10 sources observed that for high MCS (64QAM) with normal CP, larger SCS (480 and 960 kHz) performs better than smaller SCS (120 and 240 kHz) when only CPE compensation based on the existing Rel-15 NR PTRS structure is used. The other source [29] reported better performance of smaller SCS.

- 5 out 5 sources observed the performance of 960 kHz SCS with extended CP is significantly improved compared to with normal CP for large delay spread case when compared on the basis of equal MCS (code rate).

- 4 sources, [18], [72], [9], [6], and [59], compared throughput of normal CP and extended CP at least for 960 kHz SCS with CPE compensation based on the existing Rel-15 NR PTRS structure. They all reported worse throughput of extended CP.

8 sources, [65], [72], [30], [60], [64], [68], [14], and [25], evaluated DFT-S-OFDM PUSCH BLER performance with different SCS.

- Compared to CP-OFDM when CPE-only compensation is enabled, DFT-s-OFDM is more robust under phase noise.

- For low and medium MCSs (QPSK and 16QAM), there’s minor performance difference among evaluated SCSs up to 960 kHz.

- With normal CP, for high MCS (64QAM), the performance improves as the increase of SCS, 120 kHz SCS shows up to ~2.0dB loss compared to other larger SCS.

- One source [65] reported a performance gap of 1.4 ~ 1.8 dB between 120 and 960 kHz SCS.

- One source [72] reported a performance gap of 1.3 ~ 2.5 dB between 120 and 960 kHz SCS.

- One source [30] reported a performance gap of 1.2 ~ 1.7 dB between 120 and 960 kHz SCS.

- One source [60] reported a performance gap of ~ 1.4 dB between 120 and 960 kHz SCS.

- One source [64] reported a performance gap of 1.4 ~ 1.8 dB between 120 and 960 kHz SCS

- One source [14] did not report numerical SINR results in table but provided figures showing approximately similar performance difference, ~ 2 dB, between 120 and 960 kHz SCS.

- One source [25] reported a performance gap of more than 7 dB performance gap between 120 kHz SCS and other SCS (240, 480 and 960 kHz) at TDL-A 5 ns DS. It also reported 120 kHz SCS cannot meet the BLER target of 10% at TDL-A 10ns DS and 960 kHz SCS cannot meet the BLER target of 10% at TDL-A 20ns DS.

- Another source [68] reported 120 and 240 kHz SCS cannot meet the BLER target of 10% for all evaluated DS values.

- For high MCS (64QAM) at large delay spread (TDL-A 40ns or CDL-B 50ns DS), there’s error floor for 960 kHz SCS at least for BLER target 1%.

- One source [30] reported an error floor for 960 kHz SCS for BLER target 1%.

- One source [60] reported an error floor for 960 kHz SCS for BLER target 10%.

- One source [68] reported no error floor of 960 kHz SCS for the BLER target of 10% and 1% for CDL-B 50ns but an error floor for 960 kHz SCS at TDL-A 20ns for BLER target 1%.

For CP-OFDM, the following are observed with respect to phase noise compensation and PTRS.

- Compared to no phase noise compensation, CPE compensation shows little gain at low and medium MCSs for all the evaluated SCS values; while significant gain is observed for high MCS (64QAM) for all the evaluated SCS values.

- Two sources, [61], and [15], reported that increased PTRS density in frequency domain based on Rel-15 configuration does not provide significant performance benefits.

- For a given SCS, the complexity of ICI compensation increases as the number of ICI filter tap increases

- For MCS 22 evaluation of the same SCS, performance gain of ICI compensation with additional complexity of multi-tap filtering compared to CPE-only compensation is observed when there is sufficient number of PTRS in the frequency domain for 120, 240 and 480 kHz SCS.

- One source [65] showed performance gain of ICI compensation compared to CPE-only compensation for all evaluated SCS

- One source [72] evaluated ICI compensation and compared with CPE-only compensation. It reported performance gain for all evaluated SCS.

- One source [30] compared the performance of CPE and ICI compensation for 120 kHz SCS reported performance gain of ICI compensation.

- One source [68] compared the performance of CPE and ICI compensation for all SCS. It reported performance gain of ICI compensation for 240 kHz and 480 kHz SCS. It reported performance gain of ICI compensation in CDL-B but a performance loss in TDL-A for 960 kHz SCS. It also reported that 120 kHz SCS still cannot meet 10% BLER target with ICI compensation.

- One source [14] reported performance gain of ICI compensation for 120, 240 and 480 kHz SCS. It also reported performance gain of ICI compensation for 960 kHz SCS at 2GHz bandwidth and a performance loss of ICI compensation for 960 kHz SCS at 400MHz bandwidth.

- One source [69] evaluated ICI compensation for different SCS with a new PTRS pattern. It reported improvement of ICI compensation compared to CPE-only compensation.

- One source [22] evaluated 120 kHz and 240 kHz SCS performance with ICI compensation based on some new PTRS pattern and reported performance improvement.

- One source [5] compared ICI performance among SCS. It reported performance gain of multi-tap ICI filter over CPE compensation for 120, 240 and 480 kHz SCS.

- One source [16] evaluated performance of de-ICI method for MCS 22 with small RB allocations for 240, 480 and 960 kHz SCS. It is observed that the de-ICI method do not work when there isn’t sufficient number of PTRS tones in the frequency domain.

- One source [19] compared the performance of CPE and ICI compensation for all SCS. It reported performance gain of ICI compensation for 120 kHz and 240 kHz SCS.

- For MCS 22 with normal CP when delay spread is not large, it is observed that ICI compensation of multi-tap filtering is required for 120, 240 and/or 480 kHz SCS to achieve comparable performance (< 1 dB difference) to that of 960 kHz SCS with CPE-only compensation for 10% BLER target

- 2 sources, [65], and [14], reported comparable performance of 480 kHz SCS with ICI compensation and 960 kHz SCS with CPE compensation in 1600 MHz bandwidth

- 3 sources, [68], [14], and [19], reported comparable performance of 480 kHz SCS with ICI compensation and 960 kHz SCS with CPE compensation in 400 MHz bandwidth

- One source [72] reported comparable performance of 240 kHz SCS with ICI compensation and 960 kHz SCS with CPE compensation in 400 MHz bandwidth

- One source [30] evaluated and compared 120 kHz SCS with ICI compensation to larger SCS with CPE compensation. It reported that at MCSs 22 and 24, 120 kHz SCS with ICI compensation performs almost equal to 960 kHz SCS with CPE-only compensation in 400 MHz bandwidth.

- One source [5] reported comparable performance of 480 kHz SCS with ICI compensation and 960 kHz SCS with CPE compensation in TDL-A 5 and 10ns as well as in CDL-D 30ns in 400 MHz bandwidth.

- At very high MCS (e.g., MCS 26 or MCS 28), 4 sources, [16], [30], [72], and [19], compared ICI and CPE compensation using the Rel-15 PTRS.

- One source [16] evaluated the phase noise compensation performance with MCS 28 when delay spread is not large. It is observed that de-ICI technique with 3-taps filter for smaller subcarrier spacing (240 kHz) fails even though there are sufficient number of PTRS tones available for ICI covariance construction.

- One source [30], compared the performance of CPE and ICI compensation and reported for MCS 26, 120kHz SCS with ICI compensation suffers from residual ICI and is outperformed by 960kHz SCS with CPE-only compensation when delay spread is not large.

- One source [72] showed that for MCS 28, de-ICI technique with large number of taps (11, 9 and 7 taps for 120, 240 and 480 kHz SCS respectively) outperforms 960 kHz with CPE compensation only when delay spread is not large. For normal CP, it also reported that 960 kHz with 3-tap ICI compensation has comparable performance to other SCS with larger number of taps (11, 9 and 7 taps for 120, 240 and 480 kHz SCS respectively) for MCS 28 when delay spread is not large. It also reported that with large delay spread (50ns in CDL), ECP and ICI compensation with at least 3 taps filter are needed for 960 kHz SCS to reach 1% BLER target for MCS 26.

- One source [19] evaluated 3-tap ICI and CPE compensation for MCS 26 at 10ns in TDL-A for all SCS with normal CP. It reported 960 kHz SCS with CPE-only compensation outperforms both 240 kHz and 480 kHz SCS with ICI compensation. It also reported that 120 kHz SCS with ICI compensation cannot meet 10% BLER target.

- For high MCS (64QAM) with normal CP when delay spread is large (TDL-A with 40 ns and/or CDL-B with 50ns), 4 sources compared performance of smaller SCS (120, 240 and/or 480 kHz) with ICI compensation to that of 960 kHz SCS with CPE compensation and reported worse performance of 960 kHz SCS with CPE compensation for 10% BLER target.

- One source [65] reported a performance gain of 5 dB in TDL-A 40ns and 0.3 dB in CDL-B 50ns for 480 kHz SCS with ICI compensation compared to 960 kHz SCS with CPE compensation in 1600 MHz bandwidth.

- One source [72] reported a performance gain of 2.6 dB (for 240 kHz SCS) and 1.6 dB (for 120 kHz SCS) in CDL-B 50ns with ICI compensation compared to 960 kHz SCS with CPE compensation.

- One source [68] reported a performance gain of 1 dB in CDL-B 50ns for 480 kHz SCS with ICI compensation compared to 960 kHz SCS with CPE compensation. It also reported the performance of 120 kHz with ICI compensation cannot meet the 10% BLER target.

- One source [5] reported the performance of 960 kHz SCS with CPE compensation cannot meet the 10% BLER target. It also reported that the performance of 480 kHz SCS with ICI compensation cannot meet the 10% BLER target in TDL-A 40ns. With ICI compensation, it also reported comparable performance of 120, 240 and 480 kHz SCS in CDL-B 50ns and comparable performance of 120 and 240 kHz SCS in TDL-A 40ns.

- Multiple sources evaluated and compared ICI compensation schemes using the existing Rel-15 NR distributed PTRS structure and/or new PTRS patterns. The results from different sources are not aligned on whether new PTRS patterns perform better than existing Rel-15 PTRS structure when ICI compensation is used.

- One source [15] evaluated with 120 and 240 kHz SCS and reported that the PN compensation with block-based PTRS and cyclic sequence significantly outperforms in spectral efficiency both CPE compensation and de-ICI Wiener filtering with distributed PTRS, even when the density of the scattered pattern is increased above the Rel.15 defined density.

- One source [18] reported that 3-tap direct de-ICI compensation with Rel-15 PTRS outperforms ICI filter approximation approach with clustered PTRS. 3-tap direct de-ICI compensation with a clustered PTRS structure does not offer any performance advantage over the existing Rel-15 NR distributed PTRS structure.

- One source [27] reported that with a 3-tap BLS ICI equalizer, a clustered PTRS structure does not offer any performance advantage over the existing Rel-15 NR distributed PTRS structure.

- One source [66] reported that the performance of clustered PTRS allocation is worse than that of Rel-15 PTRS based ICI compensation scheme and further showed that the performance of subcarrier nulling allocation is similar or superior (up to 2 dB gain especially in the scenarios with low PTRS overhead, K=4) to that of Rel-15 PTRS based ICI compensation scheme.

- Two sources, [22], and [69], evaluated the performance with some new PTRS patterns (e.g. chunk based PTRS pattern to allow adjacent PTRS symbols in frequency) and reported that the performance with ICI compensation based on new PTRS patterns is better than the Rel-15 pattern with CPE compensation only.

- One source [30] reported that for the same ICI compensation algorithm, the legacy PTRS pattern outperforms the block PTRS pattern. It showed that for ICI compensation (direct de-ICI filtering) with the legacy PTRS pattern, the performance improves with the increasing number of de-ICI filter taps (3 to 5 taps). It also observed that with a fixed transport block size, the performance improves as the PTRS overhead decreases (the performance loss due to increased effective code rate is more pronounced at higher MCSs) and with a fixed effective code rate, the performance slightly improves as the PTRS overhead increases.

- One source [72] compared BLER performance and spectrum efficiency of 120 kHz subcarrier spacing with Rel-15 PTRS and block PTRS in CDL-B/D 20ns delay spread for MCS 22. It reported a slight BLER performance gain (~ 0.5 dB) and spectrum efficiency gain (2% - 6%) of block PTRS for 10% BLER target when a sequence which has constant module in both time domain and frequency domain is used with block PTRS.

- For high MCS (64QAM) with normal CP, 2 sources, [65], and [14], compared performance of 480 and 960 kHz SCS in 1600 MHz bandwidth when ICI compensation is used based on Rel-15 PTRS.

- When delay spread is not large, both sources reported a smaller than 1 dB performance gain of 960 kHz SCS for both 10% and 1% BLER target in TDL-A. One source, [65], reported that for CDL-B, there is up to 1.1 dB gain at 1% BLER target for 960 kHz SCS.

- When delay spread is large (TDL-A with 40 ns DS), one source, [65], reported 480 kHz SCS performed 3.6 dB better than 960 kHz SCS at 10% BLER target and 960 kHz SCS cannot meet the 1% BLER target.

For CP-OFDM, the following are observed regarding the impact of DMRS to BLER performance.

- One source [61] reported performance improvement with increased number of DMRS symbols or increased DMRS density especially for higher modulation order for 960 kHz SCS in TDL-A (5 ns and 10 ns delay spread).

- One source [18] reported for 480 kHz SCS and below with large delay spread (TDL-A with 40 ns delay spread), the room for performance improvement with a change to the Rel-15 DMRS design is very limited.

- One source [16] reported a performance drop when frequency domain OCC is enabled especially for higher order modulation such as 64 QAM (MCS 22) for 960 kHz SCS in TDL-A (10ns and 20 ns delay spread) and 480 kHz SCS (20 ns delay spread). The performance gap increases when channel delay spread increases.

- One source [30] reported performance improvement with a new DMRS pattern featured by high frequency density (i.e., every RE) and 2-FD-OCC across adjacent REs for 960 kHz SCS in TDL-A (20 ns and 40 ns delay spread).

- One source [14] reported that with Rel-15 DMRS type-1, different delay spread values (10ns and 20ns) have a negligible impact to the demodulation performance of PDSCH for a high SCS (such as 960 kHz).

- One source [68] reported that with high SCS (960 kHz) in TDL-A 20ns delay spread, the frequency domain selectivity will introduce non-orthogonality among subcarriers when FD-OCC is applied, which further leads to some performance degradation for MCS 16.

For CP-OFDM, two sources, [65], and [72], evaluated PDSCH BLER performance with optional PN models in addition to PN model in Table A.1-1. Note that such optional PN models are not confirmed and/or recommended by RAN4 at the time of RAN1#103-e.

- When CPE-only compensation is used with an optional PN model at the UE or at BS and UE, it is observed by both sources that there is significantly less dependence of BLER performance on SCS compared to the PN model in Table A.1-1. For all test cases, no error floor is observed for smaller SCS with TDL-A or CDL-B/CDL-D for 1% BLER target. There is around 1 to 2 dB performance difference between consecutive SCSs for 1% BLER target.

- However, multiple sources expressed concerns on the validity of such optional PN models given no confirmation and/or recommendation from RAN4. In consequence, there’s a concern on whether and how the observations based on such optional PN models can be used given no RAN4 input on these optional PN models.

### 6.1.2 Observations on PSS/SSS and PBCH

Key findings from the results of PSS/SSS and PBCH evaluations in Annex B.1.2 are summarized below.

7 sources, [65], [30], [60], [68], [25], [29], and [16], reported evaluation results of PSS/SSS detection performance in terms of SINR in dB achieving cell ID detection probability of 90% by one-shot detection from PSS/SSS. 4 sources, [65], [30], [60], and [25], reported PBCH performance in terms of SINR in dB achieving PBCH BLER target of 10%. 2 sources, [9], and [65], compared link budget of SSB for difference SCS.

- For PSS and SSS detection performance, all evaluated candidate SCSs (120, 240, 480 and 960 kHz) show comparable performances with the channel models and delay spread values parameters provided in Table A.1-1. The following were observed from the evaluations:

- The performance degrades as the increase of SCS

- 6 out of 7 sources reported minor performance difference (< or ~ 1 dB) between adjacent SCS for all evaluated candidate SCSs (120, 240, 480 and 960 kHz). The other source [25] reported more than 3 dB performance gap of 960 kHz SCS compared to other 120, 240 and 480 kHz SCS. It also reported that the gap of 960 kHz increases as the delay spread increases.

- For PBCH BLER performance, all evaluated candidate SCSs (120, 240, 480 and 960 kHz) show comparable performances with the channel models and delay spread parameters provided in Table A.1-1.

- The performance degrades as the increase of SCS.

- All 4 sources reported minor performance difference (< or ~ 1 dB) between adjacent SCS for all evaluated candidate SCSs (120, 240, 480 and 960 kHz).

- The performance gap between 120 and 960 kHz is up to ~ 1.8 dB.

- In terms of SSB link budget, smaller SCS have better coverage than larger SCS.

- The MCL and MIL difference between 120 kHz SCS and 480 kHz SCS is about 5 dB. The MCL and MIL difference between 120 kHz SCS and 960 kHz SCS is about 8 dB.

### 6.1.3 Observations on PRACH

Key findings from the results of PRACH evaluations in Annex B.1.3 are summarized below.

9 sources, [65], [72], [30], [60], [64], [68], [29], [16], and [62], reported evaluation results of PRACH preamble detection performance in terms of SINR in dB achieving PRACH preamble misdetection probability of 1% with evaluation assumptions and parameters as in Table A.1-1. Two sources, [65], and [23], compared link budget of PRACH for different SCS. The following are observed:

- For PRACH preamble detection performances for the same PRACH format, all evaluated candidate SCSs (120, 240, 480 and 960 kHz) show comparable performances.

- 8 out of 9 sources reported minor performance difference (< or ~ 1 dB) between adjacent SCS for all evaluated candidate SCSs (120, 240, 480 and 960 kHz). The other source [68] reported minor performances difference among all SCS for TDL-A with 5 and 10ns delay spread. It reported infinite SINR for 960 kHz SCS and comparable SINR for 120, 240 and 480 kHz SCS in TDL-A with 20ns delay spread using the metrics of preamble miss detection probability of 1% and the estimated timing error is within [-Tcp/2, Tcp/2].

- For PRACH link budget of the same PRACH format and the same sequence length, maximum isotropic loss (MIL) and maximum coupling loss (MCL) degrade as the subcarrier spacing is increased, negatively impacting coverage.

- Two sources, [65], and [23], reported that with UE power limitation of 25 dBm EIRP, the MCL/MIL difference between 120 kHz SCS and 480 kHz SCS is about 4 to 5 dB; the MCL/MIL difference between 120 kHz SCS and 960 kHz SCS is about 8 dB.

- One source [65] reported that without UE power limitation of 25 dBm EIRP (but still under regulatory limits), the MCL difference between 120 kHz SCS and 480 kHz SCS is less than 2.5 dB; the MCL difference between 120 kHz SCS and 960 kHz SCS is less than 1 dB.

- One source [65] reported that without UE power limitation of 25 dBm EIRPs (but still under regulatory limits), compared to short PRACH sequence length, longer PRACH sequence length improve MCL/MIL significantly for 120 kHz SCS due to wider bandwidth for a given SCS.

## 6.2 Summary of system level evaluations

### 6.2.1 Description of channel access schemes modelled in evaluations

The following flavors of channel access schemes have been modeled.

- No-LBT: No LBT with Dynamic TDD. NR operation with no restrictions on channel access mechanism.

- TxED-omni: Tx side ED Based LBT with omnidirectional sensing, also referred to as ‘Tx Omni LBT’. Baseline LBT with sensing at the transmitter is expected to closely follow the ETSI EN 302 567 [4] based medium access procedure.

- TxED-Dir: Tx side ED Based LBT with directional sensing, also refered to as ‘Tx Directional LBT’.

- Multiple flavors of Rx Assistance have been modelled. The following are list of Rx Assisted LBT flavors:

- RxA-1: Receiver assisted LBT from source [65]. The LBT procedure is evaluated at the receiver instead of transmitter. The LBT result is assumed to be available instantly at the transmitter without accounting any overhead for exchanging this information between the transmitter and the receiver.

- RxA-2: From source [72]. Receiver performs directional LBT but transmitter performs Omni LBT. Further details for RxA-2 are as follows. When UE is the receiver, UE receives an RTS from the gNB. Then, UE sends a "message B" to the gNB with CCA measurements results (dBm value of the measured interference) upon a successful LBT procedure. The latency from the reception of RTS to the transmission of "message B" is calculated equal to 4 slots for 120 kHz SCS and 22 slots for 960 kHz SCS. This includes the required time at the UE side for CCA. Then, gNB transmits PDSCH to the UE. The PDSCH processing time is calculated as 3 slots for 120 kHz and 13 slots for 960 kHz. A CAT4 LBT is performed at the gNB side before RTS transmission. When gNB is the receiver, first gNB performs energy measurement at the directions of the UEs that have UL data. Then, gNB selects the UE with the lowest interference level. After, gNB sends PDCCH to schedule PUSCH transmission of that UE. Finally, PUSCH is transmitted after a successful CAT2 LBT. In our simulations, we have considered the preparation time from PDCCH reception to PUSCH transmission equal to 4 slots for 120 kHz SCS and 22 slots for 960 kHz SCS. A processing time for PUSCH at gNB is not modelled. The transmissions are restricted to Rank 1 for DL as well as UL throughout.

- RxA-3: From source [72]. Only Receiver performs directional LBT procedure. The procedure is similar to RxA-2 except that gNB does not perform any LBT before RTS transmission.

- RxA-4: From source [37]. RTS and CTS type mechanism is deployed after winning contention before transmission. The RTS/CTS type exchange is between serving gNB and the served UEs. The transmitter sends a request, and the receiver feedbacks a confirmation if the request could be successfully decoded. Unlike RTS/CTS mechanism in IEEE 802.11ad, both the request and confirmation do not silence any other node. The processing delay for the RTS/CTS is assumed to be zero. There is no LBT before CTS.

- RxA-5: From source [56]. Rx Assistance takes the form of protecting ongoing transmissions by silencing based on sensing at the transmitters and protecting intended transmission by silencing based on sensing at the receiver. The receiver also assists by sending silencing signals. Omni and directional sensing are applied at all nodes. In the simulated procedure, the ECCA is performed at the gNB followed by an exchange of request/response transmissions.

- Other LBT flavors:

- Dyn-RxA: Dynamic LBT from source [65]: a node operates without LBT unless the receiver experiences a failure in reception due to a drop in SINR, which reflects a presence of interferer. Only then, the node switches to LBT. Besides, when the LBT is switched on RxA-1 is used.

### 6.2.2 Detailed observations for indoor scenario A

Table 6.2.2-1 System level simulations setups for indoor scenario A

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Source** | **SCS, Bandwidth** | **DL:UL traffic ratio** | **File size (MB)** | **LBT flavours** | **ED Thresholds (dBm), CW (min,max)** | **Remarks** |
| [65] | 960 kHz / 2 GHz | 1:1 | 27 | No-LBT, TxED-Omni, TxED-Dir, RxA-1, Dyn-RxA, Mixed Coexistence | {-47, -68} for TxED-Omni,  {-47} for TxED-Dir  {-32 for gNB/-41 for UE} for TxED-Dir,  (0,3) | Also: No-LBT and TxED-Omni Coexistence Simulations |
| [72] | {960 kHz / 2 GHz} (InH-Open)  {120 kHz / 400 MHz} (InH mixed) | 1:1 | 27(InH-Open)  8(InH mixed) | No-LBT, TxED-Omni, TxED-Dir, RxA-2, RxA-3 | {-47 for gNB/-32 for UE}/(127,127) | InH-Open, InH Mixed, Rank1 Transmissions |
| [56] | 960 kHz / 2 GHz | 1:1 | 2,8 | TxED-Omni, TxED-Dir, RxA-5-Omni, RxA-5-Dir | {-47, -67,-72}, (0,3) | Two Antenna Config. at gNB |
| [37] | 960 kHz / 2 GHz | 1:1 | 27 | No-LBT, TxED-Omni, TxED-Dir, RxA-4-Omni, RxA-4-Dir | {-47}, (0,3), |  |
| [64] | 960 kHz / 2 GHz  120 kHz / 400 MHz | 1:1  1:0  1:0 | 8  27  27 | TxED-Omni, TxED-Dir, | { -62, -68}, (0,10) | Also: TxED-Dir and TxED-Omni Coexistence Simulations |
| [62] | 960 kHz / 2 GHz | 1:1  1:0 |  | No-LBT, TxED-Omni, TxED-Dir, | {-47}, (0,3) |  |
| [67] | 960 kHz / 2 GHz | 1:1 | 27 | No-LBT, TxED-Omni, TxED-Dir, | {-47}, (0,3) |  |
| [43] | 960 kHz / 2 GHz | 1:1 | 2 | No-LBT, TxED-Omni, TxED-Dir, | {-48, -55, -65}, (0,15) | Two Antenna Config. at UE |

The following discussion refers to 5th percentile users as ‘tail’ users and 95th percentile users as ‘upper-tail’ users. Remarks mentioning ‘all users’ are applicable to tail, median and upper tail users at once.

For comparison of No-LBT (NLBT) and Tx side ED based omnidirectional sensing (TxED-Omni) for Indoor scenario A, 6 companies have compared No-LBT with Tx Side ED based Omni sensing TxED-Omni LBT and provide the following observations:

- Source [37], show tail and median benefits of using TxED-Omni LBT on DL, at high loading. In other cases, including all loads for UL and other loads for DL, TxED-Omni LBT scheme shows losses. All results are at ED threshold -47 dBm.

- Source [43] shows gains for 5%ile DL throughput at high loads with TxED-Omni LBT. In other cases, including all loads for UL and other loads for DL, TxED-Omni LBT scheme shows losses. All results are at ED threshold -47 dBm.

- Source [65], [35], [42], [56] and [67] show loss for TxED-Omni LBT with an EDT of -47 dBm or -48 dBm for all cases.

For comparison of No-LBT with directional LBT (TxED-Dir) for Indoor Scenario A, 6 sources, [37], [72], [62], [67], [43], and [65], provided results and the following are observations from the evaluations:

- Results from source [37] show gain for directional LBT (TxED-Dir with EDT -47 dBm) over No-LBT for DL, high load, for tail, median and upper tail users, and for UL, high load for tail users. For all other cases in this comparison, TxED-Dir underperforms No-LBT.

- Results from source [62], provided evaluations for 100% DL presented low, medium and high load results. For all loads, their results show significant loss for both directional and omni-directional LBT for median and high-end users. Only the tail users may have some benefit from directional LBT (as compared to No-LBT), while omni-LBT provides loss also in this case (EDT -48 dBm).

- Results from source [65] show No-LBT outperforms directional LBT with EDT -47 dBm and directional LBT with ED -32 dBm for gNB, ED -41 dBm for UE.

- Results from [67] show gain in medium and high loads for directional LBT over No-LBT at EDT -47 dBm for all users for DL as well as for UL. At low loads TxED-Dir underperforms No-LBT.

- Results from source [43] shows gains for DL throughput at high loads with TxED-Dir LBT for all antenna configurations when BSs are ceiling mounted, and gains for 5%ile DL throughput at high loads when the BS are not ceiling mounted. In other cases, including all loads for UL, TxED-Dir LBT scheme shows losses. All results are at ED threshold of -48 dBm.

- Results from source [72] largely shows loss for directional LBT over No-LBT for all loading levels and users, except DL, tail users at high loading where the results are comparable. Results were based on TxED-Dir with CW-Max of 127 with EDT of -47 dBm.

For comparison of Omni LBT (TxED-Omni) with directional LBT (TxED-Dir) for Indoor Scenario A, 8 sources, [37], [64], [62], [67], [43], [56], [65], and [72], provided results and the following are observations from the evaluations:

- For Omni LBT (TxED-Omni) with directional LBT (TxED-Dir) have been done with using the same ED Threshold. Additionally, source [65] evaluated directional LBT with adjusted thresholds ED -32 dBm for gNB, and ED -41 dBm for UE. Multiple companies have evaluated adjustments to ED Threshold with directional sensing either implicitly or explicitly.

- Results from source [37] show that omni-directional is better than directional LBT in tail and median performance, and marginal difference in other cases. Both omni-directional and directional LBT use the same ED threshold of -47 dBm.

- Results from source [67] shows gain at all loading levels for directional LBT over omni-LBT (-47 dBm) for all users, for DL and UL traffic.

- Results from source [43] shows that for UL TxED-Dir LBT provides better performance relative to TxED-Omni for low ED thresholds (i.e., -55 and -65 dBm) but losses for high thresholds (i.e., -48 dBm). As for DL, TxED-Dir LBT provides consistently better performances than TxED-Omni. The gain of directionality increases with more directional UE beams.

- Results from source [56] show largely a comparable performance for omni and directional sensing using equal threshold, with small benefit of directionality under gNBs with narrower beams.

- Results from source [65] show that directional LBT with adjusted thresholds (ED -32 dBm for gNB, ED -41 dBm for UE) and directional LBT with ED -47 dBm, and omni-directional LBT with ED -47 dBm have comparable performance.

- For 100% DL traffic, results from source [62] show that directional LBT TxED-Dir outperforms TxED-Omni at low as well as medium loads – for median, tail as well as upper tail users. The results use EDT -48 dBm.

- For 100% DL traffic, results from source [64] shows gains in directional LBT for tail users and median users at ED thresholds -68 dBm and -62 dBm. The gains are also present in DL+UL Traffic at ED threshold -68 dBm and -62 dBm.

- For coexistence, results from source [64] shows that an operator using directional LBT benefits in the presence of an operator using Omni LBT, relative to a deployment where both operators use Omni-LBT. The results used ED threshold of -68 dBm.

- Results from source [72] show that directional LBT (TxED-Dir) does not outperform Omni LBT (TxED-Omni).

For comparison of No-LBT with receiver assisted LBT for Indoor Scenario A, 3 sources, [65], [72], and [37], provided results and the following are observations from the evaluations:

- Description of the different versions of receiver assistance modelled are provided in section 6.2.1.

- Results from source [65] uses omni-sensing at receiver. The results do not show benefit for receiver assistance over No-LBT.

- Results from source [37] use an EDT -47 dBm and in the results, RxA-4-Omni gains in both DL and UL relative to No-LBT for tail users at high loads. RxA-4-Omni gains in DL but loses in UL relative to No-LBT for medium and high loads at all other user percentiles and mean.

- Results from source [72], the receiver-only LBT (RxA-3) shows tail UPT and mean UPT gain compared to No-LBT in low, medium, and high traffic loads with InH Open Office channel model and InH mixed channel model in both UL and DL.

- In comparison with No-LBT, results from source [72] shows Receiver-assisted LBT (RxA-2) tail UPT gain in DL with high traffic load for InH open office channel model and loss in other cases. Also, the results show Receiver-assisted LBT Tail UPT gain in DL with low, moderate and high traffic load for InH mixed channel model and loss in other cases.

For comparison of receiver assisted LBT versions with Omni LBT (Tx-ED-omni), and directional LBT (TxED-dir) for Indoor Scenario A, 4 sources, [72], [56], [37], and [65], provided results and the following are observations from the evaluations:

- Results from [65] show similar performance of receiver assisted LBT (RxA-1) and omni- directional LBT (TxED-Omni). Nonetheless, the RxA-1 implementation does not model the overhead of information exchange between the transmitter and receiver. Hence, it is expected that the actual performance of RxA-1 is worse than the simulated one.

- Results from [72] show both flavors of receiver assistance, Rx-Assisted LBT (RxA-2), and Receiver Only LBT (RxA-3), and they outperform Tx-ED-Omi and Tx-ED-Dir at all loading levels and users percentiles with larger benefits to tail users.

- Results from [56] show gains with receiver assisted LBT for DL and UL in the median as well as tail, primarily at higher loading levels.

- The results show receiver assisted LBT RxA-5 Omni with EDT -67 dBm and RxA-5 Dir with -67 dBm. Results with -67 dBm outperforms TxED-Omni and TxED-Dir as loading level increases.

- The results show comparable performance of RxA-5 Omni and RxA-5 Dir for the baseline gNB antenna configuration.

- As directionality increases at the gNB with more antenna elements, (i.e. when gNB configuration (Mg,Ng,M,N,P) = (1,1,4,8,2) is replaced with (Mg,Ng,M,N,P) = (1,1,8,16,2)), the relative benefits of Rx-Assistance are shown to be larger.

- As silencing threshold is decreased from -67 to -72 dBm, the relative gains of Rx-Assistance increase. At 2 GHz bandwidth, a silencing threshold of -72 dBm is close to noise floor and may not be achieved as ED but may require a sequence detection mechanism.

- Results from [37] show gains with receiver assisted LBT RxA-4-Omni relative to TxED-Omni primarily for uplink, at medium and high loads for all users. For DL, the performance is comparable between RxA-4 Omni and TxED-Omni, except at high load tail, where RxA-4-Omni underperforms.

For Indoor scenario A, following observations were made:

- Results from [72] shows receiver-only LBT (RxA-3) tail UPT and mean UPT gain compared to receiver-assisted LBT (RxA-2) in low, medium, and high traffic loads with InH Open Office channel model and InH mixed channel model.

- Results from source [65] in coexistence scenario with Operator A performing No-LBT and Operator B performing TxED-Omni LBT at -47 dBm EDT show that the operator B performance does not degrade (i.e. no losses observed) as compared to the case when Operator B coexists with another operator using LBT.

- Results from source [65] for Dyn-RxA shows that the performance of the network can be improved when the decision to perform LBT is done dynamically per node, as compared to semi-statically operating all nodes with LBT.

### 6.2.3 Detailed observations for indoor scenario B

Table 6.2.3-1 System level simulations setups for indoor scenario B

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Source** | **SCS, Bandwidth** | **DL:UL traffic ratio** | **File size (MB)** | **LBT flavours** | **ED Thresholds (dBm), CW (min,max)** | **Remarks** |
| [65] | 960K/2G | 1:1 | 27 | No-LBT, TxED-Omni, TxED-Dir, RxA-1, Dyn-RxA, Mixed Coexistence | {-47, -68} for TxED-Omni,  {-47} for TxED-Dir  {-32 for gNB/-41 for UE} for TxED-Dir,  (0,3) | No-LBT and TxED-Omni Coexistence Simulations |

One source submitted results for Indoor Scenario B in [65], which is a smaller indoor scenario with 2 operators and 1 gNB each. Their observations for this case are in line with their observations for Indoor Scenario A.

### 6.2.4 Detailed observations for indoor scenario C

Table 6.2.4-1 System level simulations setups for indoor scenario C

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Source** | **SCS, Bandwidth** | **DL:UL traffic ratio** | **File size (MB)** | **LBT flavours** | **ED Thresholds (dBm), CW (min,max)** | **Remarks** |
| [65] | 960 kHz / 2 GHz | 1:1 | 27 | No-LBT, TxED-Omni, TxED-Dir, RxA-1, Dyn-RxA, , Mixed Coexistence | {-47, -68} for TxED-Omni,  {-47} for TxED-Dir  {-32/-41} for TxED-Dir,  (0,3) | Also: No-LBT and TxED-Omni Coexistence Simulations |
| [72] | 960 kHz / 2 GHz | 1:1 | 27 | No-LBT, TxED-Omni, TxED-Dir, RxA-2, | {-47 for gNB/-32 for UE}, (127,127) | Rank 1, InH-Open |
| [64] | 960 kHz / 2 GHz | 1:0 | 27 | TxED-Omni, TxED-Dir, | {-68} (0,10) |  |
| [49] | 120 kHz / 400 MHz | 1:0 | 27 | No-LBT, | - |  |
| [54] | 960 kHz / 2 GHz  960 kHz / 400 MHz | 1:1 |  | No-LBT, | - |  |
| [71] | 480 kHz / 400 MHz | 1:1,  5:2,  2:1 | 0.5 | No-LBT, TxED-Omni | {-47} |  |

The following discussion refers to 5th percentile users as ‘tail’ users and 95th percentile users as ‘upper-tail’ users. Remarks mentioning ‘all users’ are applicable to tail, median and upper tail users at once.

For comparison of No-LBT with omnidirectional LBT (TxED-Omni) for Indoor Scenario C, source [65], and source [72] show loss for TxED-Omni LBT, source [71] shows roughly comparable performance.

- Results from [65] show worse performance for TxED-Omni LBT relative to No-LBT for both threshold -47 dBm and -68 dBm. The loss is higher for EDT -68 dBm.

- Results from [71] with low load and DL:UL ratio of 50:50 show loss for TxED-Omni LBT over No-LBT. Their medium load DL:UL ratio 5:2 results show gains in DL tail user and UL median user, loss in UL tail user and comparable performance for other cases. Their high load results for DL:UL ratio ~2:1, show small tail gain and median loss for DL and comparable performance for UL.

- Results from [72] show loss for TxED-Omni LBT over No-LBT at -47 dBm EDT for gNB and -32 dBm EDT for UE.

For comparison of omnidirectional LBT (TxED-Omni) with directional LBT (TxED-Dir) for Indoor Scenario C, following observations were made:

- Results from source [72] and [65] with equal ED threshold, Directional sensing (TxED-Dir) and Omni sensing (Tx-ED-Omni) show comparable results.

- Results from source [64] show gains for directional LBT in median users as well as tail users at -68 dBm ED threshold for 100% DL traffic

For comparison of Rx-Assistance LBT schemes with others for Indoor scenario C, the following observations were made:

- Results from [65] results show similar performance of Rx Assistance (RxA-1 -Omni) and TxED-Omni LBT but loss relative to no-LBT at both modelled ED thresholds. There is no benefit of using RxA-1 scheme over TxED-Dir LBT scheme for ED Threshold -47 dBm.

- Another form of Rx-Assistance, referred as, Dyn-RxA is shown by source [65] to provide similar performance as No-LBT for ED Threshold -47 dBm.

- Results from [72] show consistent loss for receiver assistance scheme RxA-2 compared to No-LBT. RxA-2 is shown to outperform TxED-Omni and TxED-Dir for this scenario.

### 6.2.5 Detailed observations for outdoor scenario B

Table 6.2.5-1 System level simulations setups for outdoor scenario B

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Source** | **SCS, Bandwidth** | **DL:UL traffic ratio** | **File size (MB)** | **LBT flavours** | **ED Thresholds (dBm), CW (min,max)** | **Remarks** |
| [65] | 960 kHz / 2 GHz | 1:1 | 27 | No-LBT, TxED-Omni, | {-47, -68} for TxED-Omni,  (0,3) |  |
| [72] | 960 kHz / 2 GHz | 1:1 | 27 | No-LBT, TxED-Omni, TxED-Dir, RxA-2, | {-47 for gNB/-32 for UE}/(127,127) | 1 Site,  7 Sites |

The following discussion refers to 5th percentile users as ‘tail’ users and 95th percentile users as ‘upper-tail’ users. Remarks mentioning ‘all users’ are applicable to tail, median and upper tail users at once.

For outdoor scenario B, following observations were made:

- Results from source [65] show loss of TxED-Omni LBT schemes compared to No-LBT, for two ED thresholds -47 and -68 dBm. TxED-Omni LBT with ED Threshold of -68 dBm and -47 dBm has similar performance.

- Results from source [72] shows loss for LBT schemes with respect to no-LBT for 1-site and 7 -site scenarios. Directional and omni LBT are comparable at -47dBm EDT for gNB and -32dBm EDT for UE.

- Results from source [72] show loss of TxED Omni LBT scheme compared to No-LBT for EDT -47 dBm. TxED Omni and TxED-Dir are shown to have comparable performance. Receiver assisted LBT (RxA-2) is seen to improve tail performance and to a small extent median user performance at high loading levels compared to TxED-Omni, and in all other cases seen to have comparable performance. RxA-2 simulated underperforms No-LBT in all cases. These trends hold for 7-site as well as 1-site simulations.

### 6.2.6 Summary of observations

The baseline flavor of LBT modeled in all SLS evaluations submitted was a Transmitter Side Energy Detection (TxED) based scheme conforming closely to ETSI BRAN 302 567 v.2.1.20 with omni-directional sensing performed. Another common scheme for submitted results was No-LBT (unconstrained medium access). LBT and No-LBT schemes were simulated for 2 operator scenarios (Indoor Scenario A, B and Outdoor Scenario B), as well as for a single operator scenario, namely Indoor Scenario C.

The additional scenarios simulated, with a selection of parameter combinations, were Transmitter Side Energy Detection with directional sensing, 5 flavors of receiver assistance and multiple ED thresholds. Main traffic profile was 50:50 DL:UL traffic with FTP3, modeled with different file sizes.

Comparative results of No-LBT with TxED-Omni for a threshold of -47 dBm or -48 dBm were provided by 6 sources. Corresponding detailed observations can be found in Section 6.2.2.

Comparisons of Omnidirectional sensing (TxED-Omni), with directional LBT (TxED-Dir) could be undertaken for results from 8 sources. The corresponding detailed observations can be found in Section 6.2.2.

Receiver assistance was modeled in studies from 4 sources with multiple flavors of receiver assistance (as described in Section X). Detailed observations can be found in Section 6.2.2.

One source conducted coexistence studies between operators using No-LBT and forms of LBT with ED threshold -47 dBm, where its observations can be found in Section 6.2.2.

Two sources provided results for an outdoor scenario with 2 operators, namely Outdoor Scenario B where their detailed observations can be found in Section 6.2.5.

Detailed observation corresponding to Indoor Scenario C, done by 6 companies, can be found in Section 6.2.4.

One source submitted results for Indoor Scenario B where its observations can be found in Section 6.2.3.

## 6.3 Summary of delay spread evaluations

The following are observations on the delay spread distribution:

- One source [60] observed that for the delay spread distributions for the typical indoor scenarios evaluated, the delay spread of almost 80% of the users are less than 30 nsec.

- One source [18] observed that Factory Scenario A (InF-DH) results in post-beamforming delay spreads that are a significant fraction of the CP duration for 960 kHz SCS.

- One source [63] observed that 85% of the UE experience r.m.s delay spread small than CP length of 1.92 MHz subcarrier spacing (i.e. 36.6ns) in indoor, outdoor, and factory scenarios.

- One source [30] observed that for small range indoor hotspot deployment, the channel delay spread is not an issue with normal CP. For outdoor scenarios with larger ISD and at moderate to high SNR (this may be produced by higher EIRP or smaller BW), normal CP demonstrates SINR degradation compared to extended CP. However, for such large coverage, high EIRP, and small BW use cases, we can choose to use a small SCS, e.g., 120kHz, with NCP.

- One source [38] observed that while each scenario experiences different amounts of r.m.s. delay spread, regardless of scenarios, most of UEs experience smaller r.m.s. delay spreads than normal CP of 960 kHz.

# 7 Conclusions

Study of required changes to NR using existing DL/UL NR waveform to support operation between 52.6 GHz and 71 GHz was conducted. The study included study of applicable numerology including subcarrier spacing, channel BW (including maximum BW), and their impact to FR2 physical layer design to support system functionality considering practical RF impairments, and identification of potential critical problems to physical signal/channels, if any. Study of channel access mechanism, considering potential interference to/from other nodes, assuming beam-based operation, in order to comply with the regulatory requirements applicable to unlicensed spectrum for frequencies between 52.6 GHz and 71 GHz was also conducted.

As an outcome of the study, it is recommended to support 120 kHz subcarrier spacing with normal CP length, and at least one additional subcarrier spacings among 240 kHz, 480 kHz, and 960 kHz subcarrier spacing candidates. It is recommended to consider supporting at most up to three subcarrier spacings including 120 kHz. It is not recommended to consider support of only 240 kHz SCS for PDCCH/PDSCH/PUCCH/PUSCH in addition to 120 kHz. Subcarrier spacing outside 120 kHz to 960 kHz are not supported for any signals and channels. The applicability of the supported subcarrier spacing to particular signals and channels should be further discussed when specifications are developed. It is additionally recommended to limit the maximum FFT size required to 4096 and to limit the maximum of RBs per carrier to 275 RBs. The candidate supported maximum carrier bandwidth(s) for a cell should be between 400 MHz and 2160 MHz. Further investigation of the details of required changes to NR may be needed.

As an outcome of the channel access study, it is recommended to support both channel access with LBT mechanism(s) and a channel access mechanism without LBT for gNB and UE to initiate a channel occupancy. Further investigation of the details of the channel access mechanism may be needed.

# Annex A: Evaluations methodology

## A.1 Link level evaluation assumptions

This subclause describes the link level simulation assumptions used for evaluations. The link level simulation assumption is given in Tables A.1-1. The primary objective of the evaluation is to evaluate performance of PDSCH/PUSCH including study of phase noise impairment impact for various numerology (i.e. subcarrier spacing, CP length) and possibly for various carrier frequencies. The evaluation KPI(s) include BLER. The secondary objective of the evaluation is to evaluate performance of SSB/PRACH including study of phase noise impairment impact for various numerology (i.e. subcarrier spacing, CP length) and possibly for various carrier frequencies. Evaluation KPI(s) include miss-detection, and false alarm.

Table A.1-1: Link level evaluation assumptions and parameters

| Assumptions | Value |
| --- | --- |
| Carrier Frequency [GHz] | 60 GHz    Optional: 70 GHz |
| Subcarrier Spacing [kHz] | PDSCH/PUSCH:  - {120, 240, 480, 960} kHz  -optional: 1920 kHz  Optional:  - if evaluated companies are asked to provide information on other channels/signals and subcarrier spacing |
| Bandwidth [MHz] | PDSCH/PUSCH:  - {400, 2000} MHz    Optional:  - Companies are asked to provide information if other bandwidths are evaluated  Note: Evaluation of listed channel bandwidth does not mean RAN1 has agreed to support such channel bandwidth and are only for evaluation purposes to obtain useful insights. |
| Number of RB | For 400 MHz:  - 256 (120 kHz),  - 128 (240 kHz),  - 64 (480 kHz),  - 32 (960 kHz),  - N/A (1920 kHz)  For 2000 MHz:  - N/A (120 kHz),  - N/A (240 kHz),  - 320 (480 kHz) (optional),  - 160 (960 kHz),  - 80 (1920 kHz),    For other channel bandwidths:  - Companies are asked to provide information. Companies are encouraged to utilize linearly scaled PRB sizes for a given bandwidth based on above.  Note: Other bandwidth and sub-carrier spacing combinations can be optionally used. |
| Waveform | For PDSCH:  CP-OFDM  For PUSCH:  CP-OFDM and DFT-s-OFDM |
| CP Type | Normal CP  Extended CP  Note: ECP is not expected to be applicable in all SCS and channel conditions, and companies providing results for ECP are encouraged to provide evaluation results with motivation/justification of simulated ECP cases |
| Channel Model | TDL model as defined in of TR38.901 Section 7.7.2:  - TDL-A (5ns, 10ns, 20ns DS)  - optional DS for consideration: 40ns, 60ns DS  CDL model as defined in of TR38.901 Section 7.7.1:  - CDL-B (20ns, 50ns DS)  - CDL-D (20ns, 30ns DS) with K-factor = 10 dB  - optional DS for consideration: 100ns DS  Optional modification CDL-B/D model  (a) Indoor Office NLOS: CDL-B (20 ns DS), and Indoor Office LOS: CDL-D (20 ns DS)  - Use mean angular spread values from Table 7.5.6-Part2 (for ASD, ASA, and ZSA) and Table 7.5-10 (for ZSD)  - Use mean angles of CDL-B/D for desired mean angles as baseline (no angle translation)  - Note that the angular spread values in the table are quoted in log units  - Mean K-factor for CDL-D from Table 7.5.6-Part2 (9 dB)  (b) UMi – Street Canyon NLOS: CDL-B (50 ns DS), and UMi – Street Canyon LOS: CDL-D (30 ns)  - Use mean angular spread values from Table 7.5.6-Part1 (for ASD, ASA, and ZSA) and Table 7.5-8 (for ZSD).  - Use mean angles of CDL-B/D for desired mean angles as baseline (no angle translation)  - Note that the angular spread values in the table are quoted in log units  - Use mean K-factor for CDL-D from Table 7.5.6-Part1 (7 dB)  Note: Mean angular spread values are used as desired AS value to scale the ray angles as described in TR38.901 section 7.7.5.1. As baseline, the ray angles are not translated, meaning (TR38.901 section 7.7.5.1). If companies perform translation of the ray angles they are encouraged to report the details. The mean K-factor is used to scale the tap powers as described in TR38.901 section 7.7.6.  Note 2: for TDL/CDL model, the delay spread (DS) value mentioned is the delay spread scaling value (i.e. corresponding to normalized delay of 1.0).  Note 3: Other models (either TDL or CDL) with DS values not listed are optional.  Note 4: Companies are encouraged to provide evaluation results with motivation/justification of simulated DS values. |
| Antenna Configuration (Mg,Ng,M,N,P) | For TDL model:  - 2x2  - 1x2 (optional)  For CDL model:  Configuration 1:  - (Mg,Ng,M,N,P) = (1,1,8,16,2) BS with (0.5 dv, 0.5 dH)  - (Mg,Ng,M,N,P) = (1,1,4,4,2) UE with (0.5 dv, 0.5 dH)  Configuration 2:  - (Mg,Ng,M,N,P) = (1,1,4,8,2) BS with (0.5 dv, 0.5 dH)  - (Mg,Ng,M,N,P) = (1,1,2,2,2) UE with (0.5 dv, 0.5 dH) |
| Mobility | 3 km/hr |
| PA Model | Optional:  - Companies to provide modelling (in lieu of pre-loaded Tx EVM) |
| gNB TRP PN Model | 3GPP TR38.803 example 2 BS PN profile  Optional:  - If other PN profile is used, companies to provide information on the modelling used  Note: companies to provide information about the LO distribution model assumed in the simulations. |
| UE PN Model | 3GPP TR38.803 example 2 UE PN profile  Optional:  - If other PN profile is used, companies to provide information on the modelling used  Note: companies to provide information about the LO distribution model assumed in the simulations. |
| Pre-loaded Tx EVM | Optional:  - 3% at Tx (In lieu of PA model),  - If other values are used companies are asked to provide information on the values selected for simulation. |
| Additive Rx EVM | Optional:  - 5% at Rx,  - If other values are used companies are asked to provide information on the values selected for simulation. |
| I-Q Imbalance | Optional:  - (-26dBc),  - (-31dBc),  - If other values are used companies are asked to provide information on the values selected for simulation. |
| Frequency Offset | Optional:  - 0.1 ppm (for PDSCH/PUSCH)  - 5, 10, 20 ppm (for initial access) |
| Channel Estimation | Realistic channel estimation |
| Transmission Rank | Rank 1  Note: companies are asked to provide information the precoding scheme (including granularity) used in the evaluations. |
| PDSCH SLIV | (S=2, L=12)  Optional:(S=0, L=14)  Note: Starting symbol, S, (indexed from 0) and length, L. |
| DMRS Configuration | 1 DMRS symbol (front loaded), or 2 DMRS symbols at (2,11) symbol index  Note: no data multiplexing is assumed in DMRS symbols |
| PTRS Configuration | For CP-OFDM:  (K = 4, L = 1) or (K = 2, L = 1)  Note: PTRS per K number of PRBs, and PTRS every L number of OFDM symbols  For DFT-s-OFDM:  (Ng = 2, Ns = 2, L = 1)  (Ng = 2, Ns = 4, L = 1)  (Ng = 4, Ns = 2, L = 1)  (Ng = 4, Ns = 4, L = 1)  (Ng = 8, Ns = 4, L = 1)  Note: Ng number of PT-RS groups, Ns number of samples per PT-RS group, and PTRS every L number of DFT-s-OFDM symbols  Note 2: companies are asked to provide the PT-RS configuration used for DFT-s-OFDM simulation among the listed above, where the selection of the PT-RS is chosen such that it provides similar overhead as the chosen PT-RS configuration for PUSCH CP-OFDM (if simulated). |
| CSI-RS / TRS | CSI-RS/TRS is assumed to be off (for RS overhead) |
| MCS/TBS | From MCS Table 1 (TS38.214):  - MCS 7 (QPSK),  - MCS 16 (16QAM),  - MCS 22 (64QAM),  From MCS Table 2 (TS38.214):  - MCS 27 (256QAM) (optional)  Assume NohPRB = 0 for MCS calculations.  Note: If normal CP and extended CP are to be compared, companies are asked to provide information on the MCS values used that provide similar payload sizes for the comparison. Companies to provide actual code rate used in the evaluations. |

## A.2 System level evaluation assumptions

This subclause describes the system level simulation assumptions used for evaluations. The system level simulation assumption is given in Tables A.2-1. The primary objective is evaluation of single operator and multi-operator deployments including study of interference impact and coexistence between nodes. The evaluation KPI(s) include user throughput, latency, average buffer occupancy, ratio of mean served throughput and offered cell throughput, and resource utilization. The secondary objective is to obtain delay spread profiles (and inter-symbol interference statistics) for deployment scenarios of interest. Note that performance impact from delay spread should be conducted in link level simulations, the system level simulations would be used to supplement the findings.

Table A.2-1: System level evaluation assumptions and parameters

| Assumptions | Value |
| --- | --- |
| Carrier Frequency [GHz] | 60 GHz  Optional: 70 GHz |
| Subcarrier Spacing [kHz] | For 2000MHz BW:  - 960 kHz  - optional: 120, 240, 480 kHz  For 400MHz BW:  - 120 kHz  - optional: 240, 480, 960 kHz  Note: Other than value above, companies are encouraged to evaluating using subcarrier spacing values determined to be feasible from LLS study. Values for the subcarrier spacing may be revisited after further investigation from LLS study. |
| Bandwidth [MHz] | 2000 MHz  400 MHz  Note: Channel bandwidth evaluated may be revisited after further investigation. |
| Number of RB | For 2000 MHz:  - N/A (120 kHz),  - N/A (240 kHz),  - 320 (480 kHz) (optional),  - 160 (960 kHz),  - 80 (1920 kHz),  For 400 MHz:  - 256 (120 kHz),  - 128 (240 kHz),  - 64 (480 kHz),  - 32 (960 kHz),  - N/A (1920 kHz)    For other channel bandwidths:  - Companies are asked to provide information. Companies are encouraged to utilize linearly scaled PRB sizes for a given bandwidth based on above. |
| Deployment Scenario | - Scenario indoor-A (for two operator case)  - Scenario indoor-C (for single operator case)  **Secondary scenarios:**  - Scenario outdoor-B  Optional:  - other scenarios listed below  **Indoor Office:**  **Scenario Indoor-A)** InH open office model:  Office box 120m x 50 m, 12 BS per operator, 2 operator, BS height at 3m (ceiling), UE height 1m, x-axis ISD = 20m and y-axis ISD = 25m, where ISD is define by the distance between two adjacent 10m x 10m virtual box, BS randomly deployed within 10m x 10m virtual box, minimum distance between BS of different operators is 2m.  Optional: single operator deployment in Scenario Indoor-A    **Scenario Indoor-B)** small InH open office model:  Office box 20m x 20 m, 1 BS per operator, 2 operator, BS height at 3m (ceiling), UE height 1m, BS randomly deployed within 10m x 10m virtual box, minimum distance between BS of different operators is 2m.    **Scenario Indoor-C)** InH open office model:  Office box 120m x 50 m, 12 BS per operator, 1 operator, BS height at 3m (ceiling), UE height 1m, BS fixed position, ISD = 20m      **Scenario Indoor-D)** InH open office model:  Office box 120m x 50 m, 6 BS per operator, 2 operator, BS height at 3m (ceiling), UE height 1m, BS fixed position, ISD = 20m  FFS: if the office box scenario can be reduced down to 50m x 50m      **Scenario Indoor-E)** InH open office model:  Office box 120m x 80 m, 3 BS per operator, 2 operator, BS height at 3m (ceiling), UE height 1m, BS fixed position, a=20m, b=40m, c=20m, and d=40m  image001    **Dense Urban:**  **Scenario Outdoor-A)** Dense Urban with 1 layer  Hexagonal grid, single layer, 3 sectors per site, 7 sites locations, BS height 10m, UE height 1.5m, ISD = 150m  FFS: whether ISD needs to be smaller  optional: Reducing deployment size from 7 sites to 1 site with wrap around      **Scenario Outdoor-B)** Dense Urban with 2 layers  Macro layer (sub 7GHz – not necessarily need to be simulated for the 60GHz evaluation):  Hexagonal grid, single layer, 3 sectors per site, 7 sites locations  BS height 25m, UE height 1.5m, ISD = 100m, fixed BS position  Micro layer (above 52.6 GHz):  BS height 10m, UE height 1.5m, 2 operator, 2 BS per hexgrid per operator, random position within macro hexagonal grid per operator, minimum distance between TRP and UE: 10m, minimum distance between micro gNBs’ of the same operator: 10m  optional: Reducing deployment size from 7 sites to 1 site with wrap around.      **Scenario Outdoor-C)** Dense Urban with 1 layer  Hexagonal grid, single layer, 3 sectors per site, 3 sites locations, BS height 10m, UE height 1.5m, ISD = 150m    **Indoor Factory Hall:**  **Scenario Factory-A)** Indoor factory with Dense cluster & low BS (InF-DL)  Grid, 300m x 150m x 10m factor hall  ISD 50m, BS height 1.5m, UE height 1.5m, Typical clutter size 2m, Clutter height 6m, Clutter density 60%  **Scenario Factory-B)** Indoor factory with sparse clutter & High BS (InF-SH)  Grid, 300m x 150m x 10m factor hall  ISD 50m, BS height 8m, UE height 1.5m, Typical clutter size 10m, Clutter height 2m, Clutter density 20% |
| UE distribution | Average of 5 or 10 UE per BS    UE are either 100% indoor or 100% outdoor depending on deployment scenario. |
| Channel Model | **InH open office:**  - gNB-to-gNB and gNB-to-UE links: InH – office channel & PL model from TR38.901, indoor – open office LOS probability from TR38.901 (optional: indoor – mixed office LOS probability from TR38.901)  - UE-to-UE links: InH – office channel & PL model from TR38.901, indoor – mixed office LOS probability from TR38.901    **Dense Urban:**  - gNB-to-gNB and gNB-to-UE links: UMi street canyon channel & PL model from TR38.901  - UE-to-UE links: [outdoor to outdoor D2D channel & PL model from TR36.843 Section A.2.1.2], [(optional: UMi street canyon channel & PL model from TR38.901)]    **Indoor factory:**  - gNB-to-gNB and gNB-to-UE links: InF channel & PL model from TR38.901  - UE-to-UE links: [InF channel & PL model from TR38.901]  Note: 3D distance between an gNB and a UE is applied. 3D distance is also used for LOS probability and break point distance.  Note: channel models in brackets, [ ], are working assumption and may be revisited.  Note: For D2D channel model used for UE-to-UE links companies should report how they scaled the model to 60 GHz. |
| Mobility | 3 km/hr |
| BS Antenna Configuration (Mg,Ng,M,N,P) | For outdoor macro/sectorized scenarios:  (Mg,Ng,M,N,P) = (1,1,8,16,2)  with (0.5 dv, 0.5 dH)  For outdoor micro-layer scenarios:  (Mg,Ng,M,N,P) = (1,3,8,16,2)  with (0.5 dv, 0.5 dH)  Note: 3 Panel single sector gNB with {0,+120,-120} degree boresight orientations. The gNB will only utilize 1 panel at given moment.  For indoor scenarios:  (Mg,Ng,M,N,P) = (1,1,4,8,2) with (0.5 dv, 0.5 dH)  optional: (Mg,Ng,M,N,P) = (1,1,8,16,2) per pol with (0.5 dv, 0.5 dH) |
| BS Antenna Pattern | For outdoor scenarios:  - Antenna power pattern given in Table 7.3-1 of TR38.901  (with exception of antenna element gain)  For indoor scenarios:  - Antenna power pattern given in Table A.2.1-7 of TR38.802 for ceiling mount  (with exception of antenna element gain)  For factory scenarios:  Companies to provide information on the antenna orientation and pattern used. |
| BS Antenna element gain | 5 dBi |
| UE Antenna Configuration (Mg,Ng,M,N,P) | Configuration 1:  (Mg,Ng,M,N,P) = (1,2,2,2,2)  with (0.5 dv, 0.5 dH)  Configuration 2 (optional):  (Mg,Ng,M,N,P) = (1,2,4,4,2)  with (0.5 dv, 0.5 dH)  Note: In both configurations, the 2 panels are back-to-back with panel selection done the at receiver. The UE will only utilize 1 panel at a given moment. |
| UE Antenna Pattern | Antenna power pattern given in Table A.2.1-8 of TR38.802  For indoor factory scenarios:  Boresight orientation should be fixed in all simulation drops  For other scenarios:  Boresight orientation should be randomized between [0°, 360°) in the horizontal plane in each simulation drop  Note: Companies to provide information about boresight orientation (e.g. random orientation, vertical to ground, parallel to ground, etc) |
| UE Antenna element gain | 5 dBi |
| BS Power Limitation | 40 dBm EIRP  Optional: 60 dBm EIRP  Maximum TxP adjusted to meet EIRP limits |
| UE Power Limitation | 25 dBm EIRP with 21 dBm max TxP    Optional: 40dBm EIRP with 21 dBm max TxP |
| BS NF | 7 dB |
| UE NF | 10 dB  Optional: 13dB |
| Transmission Rank | Rank adaptative transmission between Rank 1 and 2 |
| PDCCH Overhead | 2 symbol per slot |
| DMRS Overhead | 1 symbol per slot |
| CSI-RS Overhead | Companies to provide information |
| SRS Overhead | Companies to provide information |
| Other Overhead | Companies to provide information |
| Data Processing Latency | UE processing timeline in microseconds are assumed to be same as 120 kHz SCS PDSCH/PUSCH processing latency  Optional:  UE processing timeline in microseconds are assumed to be half of 120 kHz SCS PDSCH/PUSCH processing latency |
| TDD DL/UL Ratio | Companies to provide information (if applicable) |
| CSI feedback | Ideal feedback |
| Additive Rx EVM | Note: additive Rx EVM values may be revisited after LLS study |
| Traffic Model | FTP Model 3 (27Mbyte file)    Optional:  - Full buffer,  - FTP Model 1 (27, 8 Mbyte file),  - FTP Model 3 (0.5, 2, 8, 16 Mbyte file) |
| UE Receiver | MMSE-IRC |
| Cell selection criteria | Random select from strongest RSRP with 1 dB HO Margin  Note: UE with RSRP below a -71 dBm + 10 log10( bandwidth/2GHz ) are not considered in simulation and not counted toward UE distribution count |
| DL/UL Traffic Ratio | 50% DL, 50% UL    Optional:  100% DL, 0% UL,  80% DL, 20% UL  0% DL, 100% UL |
| Channel access modelling | Companies to report details of LBT procedure and parameters (e.g. ED, CWmax, COT, etc.) if LBT procedure is used in the evaluations. |
| Synchronization Assumption | Companies are asked to provide information on the synchronization assumption made between operators for 2 operator deployment scenarios. |

## A.3 LBT procedure for system level evaluation

This subclause describes the LBT procedure assumed for system level simulation evaluations. Figure A.3-1 shows an illustration of the LBT procedure assumed for system level simulation evaluations. LBT procedures in draft v2.1.20 of EN 302 567 as the baseline system evaluation with LBT [4]. Enhancements to ED threshold, contention window sizes etc. can be considered as part of the evaluations. When the node is performing CCA before initiating transmission, during count down, when an observation slot fails energy detect (ED), the counter freezes, and will continue count down 8 μs after the interference is detected to be gone. Any enhancements to ED threshold, contention window sizes, Zmin and Zmax, can be considered as part of the evaluations. The smallest value of Zmax for contention window size is 3, and Zmin is equal to 0.



Figure A.3-1: Illustration of LBT procedure assumed for system level simulation evaluations

# Annex B: Evaluations results

## B.1 Link level evaluation results

### B.1.1 Evaluation results for PDSCH/PUSCH

#### B.1.1.1 Source 1 [65]

Table B.1.1.1-1: SNR in dB achieving PDSCH BLER of 10% or 1% with CPE compensation for PN model set 1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 480 kHz/1.6 GHz | 960KHz / 1.6 GHz | 960KHz /2GHz |
| R1-2007984 / Source 1 | 7 | TDL-A, 5ns | 3.1/5.5 | 2.9/5.3 | 2.8/5.1 | 2.2/3.7 | 2.2/3.9 | 2.1/3.8 |
| TDL-A, 10ns | 2.6/4.6 | 2.4/4.5 | 2.5/4.3 | 2.1/3.4 | 2.2/3.7 | 2.2/3.6 |
| TDL-A, 20ns | 2.3/4.0 | 2.3/3.9 | 2.5/4.2 | 2.2/3.6 | 2.4/3.8 | 2.4/3.7 |
| TDL-A, 40 ns | 2.2/3.7 | 2.4/3.9 | 2.7/4.3 | 2.5/3.8 | 2.8/4.2 | 2.8/4.2 |
| CDL-B, 20ns | 2.6/5 | 2.3/4.6 | 2.3/4.6 | 1.7/3.2 | 1.7/3.2 | 1.7/3.2 |
| CDL-B, 50ns | 1.8/3.4 | 1.8/3.2 | 1.9/3.4 | 1.7/2.9 | 1.8/3 | 1.8/3 |
| CDL-D, 20ns | 0.3/1.5 | 0.2/1.4 | 0.1/1.2 | 0.2/1.3 | 0.2/1.4 | 0.2/1.4 |
| CDL-D, 30ns | 0.3/1.5 | 0.2/1.4 | 0/1.2 | 0.2/1.4 | 0.2/1.4 | 0.2/1.4 |
| 16 | TDL-A, 5ns | 11.8/14.3 | 11.3/13.88 | 11.0/13.4 | 10.5/12.4 | 10.0/11.9 | 10.0/11.8 |
| TDL-A, 10ns | 11.3/13.5 | 10.8/13.0 | 10.6/12.6 | 10.3/11.9 | 9.8/11.4 | 9.9/11.3 |
| TDL-A, 20ns | 11.0/12.9 | 10.5/12.3 | 10.3/12.0 | 10.2/11.6 | 9.9/11.2 | 9.9/11.3 |
| TDL-A, 40 ns | 10.8/12.5 | 10.4/11.9 | 10.4/11.9 | 10.5/11.7 | 10.8/12.4 | 11.0/12.7 |
| CDL-B, 20ns | 11.2/13.8 | 10.7/13 | 10.5/13.0 | 10.0/11.7 | 9.4/10.9 | 9.4/10.9 |
| CDL-B, 50ns | 10.5/12.3 | 10.0/11.7 | 9.9/11.5 | 9.8/11.2 | 9.4/10.5 | 9.5/10.7 |
| CDL-D, 20ns | 8.7/9.9 | 8.2/9.4 | 8.0/9.2 | 8.3/9.6 | 7.8/9.0 | 7.9/9.1 |
| CDL-D, 30ns | 8.7/9.6 | 8.2/9.4 | 8.0/9.2 | 8.3/9.6 | 7.8/8.9 | 7.9/9.1 |
| 22 | TDL-A, 5ns | -/- \*Note | -/- \*Note | 17.2/19.7 | 21.1/- \*Note | 16.1/18.2 | 16.3/18.6 |
| TDL-A, 10ns | -/- \*Note | -/- \*Note | 16.8/20.0 | 21.3/- \*Note | 15.9/17.8 | 16.1/18.3 |
| TDL-A, 20ns | -/- \*Note | -/- \*Note | 16.6/19.6 | 21.4/- \*Note | 16.1/18.0 | 16.3/18.6 |
| TDL-A, 40 ns | -/- \*Note | -/- \*Note | 16.7/20.1 | 22/- \*Note | 20.7/- \*Note | 21.6/- \*Note |
| CDL-B, 20ns | -/- \*Note | -/- \*Note | 16.7/20.4 | 21.4/- \*Note | 15.4/17.5 | 15.8/18.1 |
| CDL-B, 50ns | -/- \*Note | -/- \*Note | 16.2/19.5 | 21.5/- \*Note | 15.5/17.4 | 15.9/18.3 |
| CDL-D, 20ns | 21.8/- \*Note | 17.4/- \*Note | 14.0/15.8 | 17.0/- \*Note | 13.6/15.0 | 13.9/15.5 |
| CDL-D, 30ns | 21.8/- \*Note | 17.4/- \*Note | 13.9/15.8 | 16.9/- \*Note | 13.5/14.9 | 13.9/15.5 |
| Additional report/notes:  PN model set 1: BS: Ex2 BS and UE: Ex2 UE (c.f. Section 3.3.1 of R1-2007982)  CPE compensation  Normal CP  antenna configuration for CDL model  Configuration 2:  - (Mg,Ng,M,N,P) = (1,1,4,8,2) BS with (0.5 dv, 0.5 dH)  - (Mg,Ng,M,N,P) = (1,1,2,2,2) UE with (0.5 dv, 0.5 dH)  PTRS: K=2, L=1  DMRS configuration: 2 DMRS symbols at (2,11)  No TRS, No CSI-RS  The effective CR for MCS22, MCS16, and MCS 7 are 0.685, 0.678, and 0.539, respectively.  \*Note: missing values indicate that required SNR for 10%/1% BLER is either >22 dB or Inf (due to error floor) | | | | | | | |

Table B.1.1.1-2: SNR in dB achieving PDSCH BLER of 10% or 1% with ICI compensation for PN model set 1

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 480 kHz/1.6 GHz | 960KHz / 1.6 GHz | 960KHz /2GHz |
| R1-2007984 / Source 1 | 7 | TDL-A, 5ns | 3.2/5.6 | 3.2/5.6 | 3.3/3.9 | 2.3/4.3 | 2.4/4 | 2.4/4 |
| TDL-A, 10ns | 2.7/4.7 | 2.7/4.9 | 2.9/3.6 | 2.2/4.0 | 2.4/3.8 | 2.4/3.8 |
| TDL-A, 20ns | 2.4/4.0 | 2.5/4.1 | 3.0/4.7 | 2.3/3.6 | 2.7/4.1 | 2.6/4.0 |
| TDL-A, 40 ns | 2.3/3.8 | 2.6/4.1 | 3.2/4.8 | 2.6/3.9 | 3.0/4.5 | 3.0/4.5 |
| CDL-B, 20ns | 2.6/5.1 | 2.5/4.8 | 2.8/5.1 | 1.8/3.3 | 2.0/3.5 | 2.0/3.5 |
| CDL-B, 50ns | 1.9/3.5 | 2.0/3.4 | 2.4/3.9 | 1.8/3.0 | 2.1/3.3 | 2.1/3.3 |
| CDL-D, 20ns | 0.4/1.5 | 0.4/1.6 | 0.6/1.7 | 0.3/1.5 | 0.5/1.7 | 0.5/1.7 |
| CDL-D, 30ns | 0.3/1.5 | 0.4/1.6 | 0.5/1.7 | 0.3/1.5 | 0.5/1.7 | 0.5/1.7 |
| 16 | TDL-A, 5ns | 11.3/13.7 | 11.0/13.4 | 11.2/13.6 | 10.0/11.7 | 10.1/13.4 | 10.0/13.4 |
| TDL-A, 10ns | 10.8/12.9 | 10.5/12.6 | 10.7/12.7 | 9.8/11.3 | 9.9/11.4 | 9.9/11.3 |
| TDL-A, 20ns | 10.4/12.2 | 10.2/11.9 | 10.4/12.1 | 9.7/11.0 | 10.0/11.3 | 10.0/11.3 |
| TDL-A, 40 ns | 10.2/11.8 | 10.0/11.5 | 10.6/11.9 | 10.0/11.1 | 10.9/12.4 | 11.0/12.5 |
| CDL-B, 20ns | 10.6/14.0 | 10.3/12.7 | 10.6/13.1 | 9.5/11.0 | 9.4/11 | 9.5/11 |
| CDL-B, 50ns | 9.9/11.6 | 9.7/11.2 | 10.0/11.6 | 9.3/10.5 | 9.5/10.6 | 9.5/10.7 |
| CDL-D, 20ns | 8.2/9.4 | 8.0/9.1 | 8.2/9.3 | 7.9/9.1 | 7.9/9.1 | 8.0/9.2 |
| CDL-D, 30ns | 8.2/9.4 | 8.0/9.1 | 8.1/9.3 | 7.9/9.1 | 7.9/9 | 8.0/9.1 |
| 22 | TDL-A, 5ns | 18.5/- | 17.0/19.6 | 16.3/18.7 | 16.1/18.0 | 15.6/17.4 | 15.5/17.3 |
| TDL-A, 10ns | 18.2/21.3 | 16.5.18.7 | 15.8/17.8 | 15.8/17.5 | 15.4/16.9 | 15.3/16.8 |
| TDL-A, 20ns | 17.8/20.6 | 16.2/18.1 | 15.5/17.2 | 15.6/17 | 15.5/16.9 | 15.5/16.9 |
| TDL-A, 40 ns | 17.5/20.6 | 16.0/17.6 | 15.7/17.2 | 15.7/17.1 | 19.3/- \*Note | 19.4/- \*Note |
| CDL-B, 20ns | 18.2/- | 16.5/19.1 | 15.7/18.2 | 15.7/17.6 | 14.8/16.5 | 14.9/16.5 |
| CDL-B, 50ns | 17.5 /20.8 | 15.8/17.6 | 15.0/16.7 | 15.2/16.6 | 14.8/16.1 | 14.9/16.4 |
| CDL-D, 20ns | 14.7/16.4 | 13.7/15.0 | 13.2/14.5 | 13.5/14.9 | 13.1/14.3 | 13.3/14.5 |
| CDL-D, 30ns | 14.7/16.4 | 13.7/15.0 | 13.2/14.5 | 13.5/14.9 | 13.0/14.3 | 13.3/14.5 |
| Additional report/notes:  PN model set 1: BS: Ex2 BS and UE: Ex2 UE (c.f. Section 3.3.1 of R1-2007982)  ICI compensation (c.f. Section 3.3.2 of R1-2007982)  Normal CP  antenna configuration for CDL model  Configuration 2:  - (Mg,Ng,M,N,P) = (1,1,4,8,2) BS with (0.5 dv, 0.5 dH)  - (Mg,Ng,M,N,P) = (1,1,2,2,2) UE with (0.5 dv, 0.5 dH)  PTRS: K=2, L=1  DMRS configuration: 2 DMRS symbols at (2,11)  No TRS, No CSI-RS  The effective CR for MCS22, MCS16, and MCS 7 are 0.685, 0.678, and 0.539, respectively.  \*Note: missing values indicate that required SNR for 10%/1% BLER is either >22 dB or Inf (due to error floor) | | | | | | | |

Table B.1.1.1-3: SNR in dB achieving PDSCH BLER of 10% or 1% with CPE compensation for PN model set 2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 480 kHz/1.6 GHz | 960KHz / 1.6 GHz |
| R1-2007984 / Source 1 | 16 | TDL-A, 10ns | 10.6/12.7 | 10.5/12.6 | 10.6/12.6 | 10.1/11,5 | 10.0/11.5 |
| TDL-A, 40ns | 10.1/11.58 | 10.1/11.5 | 10.3/11.7 | 10.1/11.4 | 11.2/12.9 |
| 22 | TDL-A, 10ns | 17.8/20.3 | 17.3/19.7 | 16.5/18.7 | 17.6/20.3 | 16.9/18.9 |
| TDL-A, 40ns | 17.2/19.0 | 16.8/18.5 | 16.4/18.1 | 17.7/20.8 | -/- \*Note |
| Additional report/notes:  PN model set 2: BS: Ex2 BS and UE: R4-2011494 (c.f. Section 3.3.1 of R1-2007982)  CPE compensation  Normal CP  PTRS: K=2, L=1  DMRS configuration: 2 DMRS symbols at (2,11)  No TRS, No CSI-RS  The effective CR for MCS22, MCS16, and MCS 7 are 0.685, 0.678, and 0.539, respectively.  \*Note: missing values indicate that required SNR for 10%/1% BLER is either >22 dB or Inf (due to error floor) | | | | | | |

Table B.1.1.1-4: SNR in dB achieving PDSCH BLER of 10% or 1% with ICI compensation for PN model set 2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 480 kHz/1.6 GHz | 960KHz / 1.6 GHz |
| R1-2007984 / Source 1 | 16 | TDL-A, 10ns | 10.6/12.7 | 10.5/12.6 | 10.8/12.8 | 10.0/11.4 | 10.0/11.5 |
| TDL-A, 40ns | 10.1/11.6 | 10.1/11.6 | 10.6/12.0 | 10.0/11.2 | 11.2/12.9 |
| 22 | TDL-A, 10ns | 17.4/19.7 | 17.0/19.2 | 16.4/18.4 | 16.4/18.0 | 15.9/17.4 |
| TDL-A, 40ns | 16.8/18.4 | 16.4/18.0 | 16.2/17.8 | 16.3/17.8 | 21.0/- \*Note |
| Additional report/notes:  PN model set 2: BS: Ex2 BS and UE: R4-2011494 (c.f. Section 3.3.1 of R1-2007982)  ICI compensation (c.f. Section 3.3.2 of R1-2007982)  Normal CP  PTRS: K=2, L=1  DMRS configuration: 2 DMRS symbols at (2,11)  No TRS, No CSI-RS  The effective CR for MCS22, MCS16, and MCS 7 are 0.685, 0.678, and 0.539, respectively.  \*Note: missing values indicate that required SNR for 10%/1% BLER is either >22 dB or Inf (due to error floor) | | | | | | |

Table B.1.1.1-5: SNR in dB achieving PDSCH BLER of 10% or 1% with CPE compensation for PN model set 3

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 480 kHz/1.6 GHz | 960KHz / 1.6 GHz |
| R1-2007984 / Source 1 | 16 | TDL-A, 10ns | 10.6/12.7 | 10.5/12.6 | 10.5/12.6 | 10.0/11.5 | 10.0/11.4 |
| TDL-A, 40ns | 10.1//11.6 | 10.0/11.5 | 10.3/11.7 | 10.0/11.3 | 11.2/12.9 |
| 22 | TDL-A, 10ns | 17.8/20.4 | 17.3/19.7 | 16.4/18.6 | 17.4/20.5 | 16.6/18.6 |
| TDL-A, 40ns | 17.3/19.1 | 16.8/18.6 | 16.3/18.0 | 17.6/21.3 | -/- \*Note |
| Additional report/notes:  PN model set 3: PN model: BS: R4-2010176 DM=0 dB and UE: R4-2010176 DM=5 dB (c.f. Section 3.3.1 of R1-2007982)  CPE compensation  Normal CP  PTRS: K=2, L=1  DMRS configuration: 2 DMRS symbols at (2,11)  No TRS, No CSI-RS  The effective CR for MCS22, MCS16, and MCS 7 are 0.685, 0.678, and 0.539, respectively.  \*Note: missing values indicate that required SNR for 10%/1% BLER is either >22 dB or Inf (due to error floor) | | | | | | | |

Table B.1.1.1-6: SNR in dB achieving PDSCH BLER of 10% or 1% with ICI compensation for PN model set 3

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 480 kHz/1.6 GHz | 960KHz / 1.6 GHz |
| R1-2007984 / Source 1 | 16 | TDL-A, 10ns | 10.6/12.7 | 10.6/12.7 | 10.6/12.7 | 10.0/11.3 | 10.0/11.7 |
| TDL-A, 40ns | 10.1/11.6 | 10.1/11.6 | 10.4/11.8 | 10.0/11.2 | 11.2/12.8 |
| 22 | TDL-A, 10ns | 17.3/19.6 | 16.8/19.0 | 16.2/18.2 | 16.2/17.8 | 15.7/17.1 |
| TDL-A, 40ns | 16.7/18.4 | 16.3/17.8 | 16.1/17.7 | 16.1/17.6 | 20.2/- \*Note |
| Additional report/notes:  PN model set 3: BS: R4-2010176 DM=0 dB and UE: R4-2010176 DM=5 dB (c.f. Section 3.3.1 of R1-2007982)  ICI compensation (c.f. Section 3.3.2 of R1-2007982)  Normal CP  PTRS: K=2, L=1  DMRS configuration: 2 DMRS symbols at (2,11)  No TRS, No CSI-RS  The effective CR for MCS22, MCS16, and MCS 7 are 0.685, 0.678, and 0.539, respectively.  \*Note: missing values indicate that required SNR for 10%/1% BLER is either >22 dB or Inf (due to error floor) | | | | | | | |

Table B.1.1.1-7: SNR in dB achieving PUSCH BLER of 10% or 1% with PN compensation for PN model set 1

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 960KHz /2GHz |
| R1-2007984 / Source 1 | 7 | TDL-A, 5ns | 3.3/5.6 | 3.0/5.0 | 3.0/5.0 | 3.1/4.6 |
| TDL-A, 10ns | 3.1/5.1 | 3.0/4.6 | 2.9/4.6 | 3.2/4.6 |
| 16 | TDL-A, 5ns | 11.2/13.6 | 10.5/12.5 | 10.4/12.4 | 10.2/11.7 |
| TDL-A, 10ns | 10.6/12.7 | 10.2/11.8 | 10.2/11.8 | 10.2/11.5 |
| 22 | TDL-A, 5ns | 17.3/20.1 | 16.5/19.1 | 16.0/18.3 | 15.5/17.2 |
| TDL-A, 10ns | 17.0/19.4 | 16.2/19.0 | 15.7/17.8 | 15.4/16.8 |
| Additional report/notes:  PN model set 1: BS: Ex2 BS and UE: Ex2 UE (c.f. Section 3.3.1 of R1-2007982)  PN compensation  Normal CP  PUSCH waveform: DFT-S-OFDM  PTRS: Ng = 8, Ns = 4, L =1  DMRS configuration: 2 DMRS symbols at (2,11) | | | | | | |

#### B.1.1.2 Source 2 [72]

Table B.1.1.2-1: SINR in dB achieving PDSCH/PUSCH BLER of 10% /1% for CP-OFDM

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120 kHz  @400 MHz | | 240 kHz  @400 MHz | | 480 kHz  @400 MHz | | 960 kHz  @400 MHz |
| PHN | CPE | ICI | CPE | ICI | CPE | ICI | CPE |
| R1-2009610 / Source 2 | 7 | CDL-B, 20ns | 2/4.8 | -- | 2/4.8 | -- | 2/4.8 | -- | 2/4.8 |
| CDL-B, 50ns | 2.9/4.2 | -- | 2.6/4.2 | -- | 2.7/4.2 | -- | 2.6/3.9 |
| CDL-D, 20ns | -0.7/0 | -- | -0.4/0.3 | -- | -0.1/0.6 | -- | -0.3/0.3 |
| CDL-D, 30ns | -1.4/-1 | -- | -1.2/-1 | -- | -1.6/-1.4 | -- | -1.7/-1.7 |
| 16 | CDL-B, 20ns | 10.5/12.5 | -- | 10/12.3 | -- | 11.8/12 | -- | 10.7/11.9 |
| CDL-B, 50ns | 11.2/12.6 | -- | 11.2/13.4 | -- | 11.6/14.0 | -- | 11.9/13.3 |
| CDL-D, 20ns | 6.8/7.4 | -- | 7.2/7.9 | -- | 7.3/7.9 | -- | 7.1/7.6 |
| CDL-D, 30ns | 7/7.2 | -- | 6.8/7.1 | -- | 6.7/6.8 | -- | 6.6/6.8 |
| 22 | CDL-B, 20ns | NAN | 16.8/20 | NAN | 15.3/17.2 | 17/-- | 17/19 | 15.7/18 |
| CDL-B, 50ns | NAN | 16.8/18.1 | NAN | 15.8/18.2 | 18/26 | 16.9/19.1 | 18.4/20.8 |
| CDL-D, 20ns | NAN | 11.9/12.7 | NAN | 12.3/13.0 | 13.7/-- | 12.6/13.3 | 12.5/13.1 |
| CDL-D, 30ns | NAN | 12.5/12.9 | NAN | 11.8/12.4 | 13.2/14.8 | -- | 12.1/12.5 |
| Additional report/notes:  CP type:  NCP  antenna configuration for CDL model:  (Mg,Ng,M,N,P) = (1,1,4,8,2) BS with (0.5 dv, 0.5 dH)  (Mg,Ng,M,N,P) = (1,1,2,2,2) UE with (0.5 dv, 0.5 dH)  waveform in case of PDSCH:  CP-OFDM  PTRS configuration:  K=2 in frequency domain, L=1 in time domain  DMRS configuration  1/2 in frequency in each port  any optional or other assumption/parameters used not as in the baseline:  PN model: Example 2 phase noise model scaling to 60 GHz in 38.803 | | | | | | | | |

Table B.1.1.2-2: SINR in dB achieving PDSCH/PUSCH BLER of 10% /1% for CP-OFDM and MCS28

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /Source | MCS | Channel | 120 kHz  @400 MHz | 240 kHz  @400 MHz | | 480 kHz  @400 MHz | 960 kHz  @400 MHz | |
| ICI-11 | ICI-9 | ICI-5 | ICI-7 | CPE | ICI-3 |
| R1-2009610 / Source 2 | 28 | CDL-B, 20ns | 26.2/30 | 24.3/28.8 | 25.5/33.7 | 25.1/28.8 | NAN/NAN | 25.3/30.5 |
| CDL-B, 50ns | 24.7/28.8 | 25.5/29.7 | 25.5/NAN | 25.0/29.5 | NAN/NAN | NAN/NAN |
| CDL-D, 20ns | 19.3/20.7 | 19.6/21.2 | 20.1/22.4 | 19.7/21 | 26/NAN | 19.7/21.4 |
| CDL-D, 30ns | 19.3/20.7 | 19.6/21.3 | 20.1/22.4 | 19.8/21 | 26/NAN | 19.8/21.2 |
| Additional report/notes:  CP type:  NCP  antenna configuration for CDL model:  (Mg,Ng,M,N,P) = (1,1,4,8,2) BS with (0.5 dv, 0.5 dH)  (Mg,Ng,M,N,P) = (1,1,2,2,2) UE with (0.5 dv, 0.5 dH)  waveform in case of PDSCH:  CP-OFDM  PTRS configuration:  K=2 in frequency domain, L=1 in time domain  DMRS configuration  1/2 in frequency in each port  any optional or other assumption/parameters used not as in the baseline:  PN model: Example 2 phase noise model scaling to 60 GHz in 38.803 | | | | | | | |

Table B.1.1.2-3: SINR in dB achieving PDSCH/PUSCH BLER of 10% /1% for CP-OFDM and 960 kHz with different CP length

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tdoc /Source | MCS | PHN | Channel | 960 kHz @400 MHz | |
| NCP | ECP |
| R1-2009610 / Source 2 | 22 | CPE | CDL-D, 50ns | 17.7/20 | 17.3/19 |
| 24 | CPE | CDL-D, 50ns | 21/27.4 | 19.6/21.8 |
| 26 | ICI-3 | CDL-D, 50ns | 24.9/NAN | 22.2/24.8 |
| Additional report/notes:  CP type:  NCP and ECP  antenna configuration for CDL model:  (Mg,Ng,M,N,P) = (1,1,4,8,2) BS with (0.5 dv, 0.5 dH)  (Mg,Ng,M,N,P) = (1,1,2,2,2) UE with (0.5 dv, 0.5 dH)  waveform in case of PDSCH:  CP-OFDM  PTRS configuration:  K=2 in frequency domain, L=1 in time domain  DMRS configuration  1/2 in frequency in each port  any optional or other assumption/parameters used not as in the baseline:  PN model: Example 2 phase noise model scaling to 60 GHz in 38.803 | | | | |

Table B.1.1-4: SINR in dB achieving PDSCH/PUSCH BLER of 10% /1% for CP-OFDM with optional phase noise model and MCS22 when only CPE compensation is used

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Tdoc /Source | MCS | Channel | 120 kHz@400 MHz | 240 kHz@400 MHz | 480 kHz@400 MHz | 960 kHz@400 MHz |
| R1-2009610 / Source 2 | 22 | CDL-B, 20ns | 18.4/21.3 | 17.3/19.8 | 16.4/19 | 15.7/18.2 |
| CDL-D, 20ns | 13.1/13.9 | 12.9/13.6 | 12.6/13.3 | 12.3/12.9 |
| Additional report/notes:  CP type:  NCP  antenna configuration for CDL model:  (Mg,Ng,M,N,P) = (1,1,4,8,2) BS with (0.5 dv, 0.5 dH)  (Mg,Ng,M,N,P) = (1,1,2,2,2) UE with (0.5 dv, 0.5 dH)  waveform in case of PDSCH:  CP-OFDM  PTRS configuration:  K=2 in frequency domain, L=1 in time domain  DMRS configuration  1/2 in frequency in each port  any optional or other assumption/parameters used not as in the baseline:  PN model:  BS: Example 2 phase noise model for BS scaling to 60 GHz in 38.803  UE: an optional phase noise model defined in R4-2011494 | | | | | |

Table B.1.1.2-5: SINR in dB achieving PUSCH BLER of 10% /1% for CP-OFDM and different PTRS patterns at MCS22

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tdoc /Source | MCS | Channel | Rel-15 PTRS | Block PTRS with Rel15 sequence | Block PTRS with new sequence |
| R1-2009610 / Source 2 | 22 | CDL-B, 20ns | 17.7/21.9 | 17.8/22.6 | 17.2/21.5 |
| CDL-D, 20ns | 13.9/14.8 | 14.2/15.4 | 13.6/14.5 |
|  | Additional report/notes:  CP type:  NCP  antenna configuration for CDL model:  (Mg,Ng,M,N,P) = (1,1,4,8,2) BS with (0.5 dv, 0.5 dH)  (Mg,Ng,M,N,P) = (1,1,2,2,2) UE with (0.5 dv, 0.5 dH)  waveform in case of PDSCH:  CP-OFDM  PTRS configuration:  Rel-15: K=4 in frequency domain, L=1 in time domain  Block-PTRS: block number-1, block size-16,17  DMRS configuration  1/2 in frequency in each port  any optional or other assumption/parameters used not as in the baseline:  PN model: Example 2 phase noise model scaling to 60 GHz in 38.803  PTRS sequence: when block size is 17, a new sequence which has constant module at both frequency domain and time domain for block PTRS is used | | | |

Table B.1.1.2-6: SINR in dB achieving PUSCH BLER of 10% /1% for DFT-s-OFDM

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120 kHz  @400 MHz | 240 kHz  @400 MHz | 480 kHz  @400 MHz | 960 kHz  @400 MHz |
| R1-2009610 / Source 2 | 7 | CDL-B, 20ns | 3.0/4.3 | 2.4/4.4 | 3.2/5.0 | 2.8/4.7 |
| CDL-B, 50ns | 3.0/4.4 | 2.9/5.1 | 2.8/5.6 | 3.3/5.5 |
| CDL-D, 20ns | -0.4/0.2 | -0.2/0.5 | -0.5/0.3 | -0.1/0.4 |
| CDL-D, 30ns | -0.4/0.2 | -0.2/0.5 | -0.5/0.3 | -0.1/0.4 |
| 16 | CDL-B, 20ns | 12.1/13.7 | 11.1/13.8 | 12.2/15.4 | 12.5/15.5 |
| CDL-B, 50ns | 12.6/14.9 | 11.6/14.4 | 12.2/15.2 | 14.1/16.1 |
| CDL-D, 20ns | 7.0/7.6 | 7.5/8.1 | 7.3/8.0 | 8.1/8.6 |
| CDL-D, 30ns | 7.0/7.6 | 7.5/8.1 | 7.3/8.0 | 8.1/8.5 |
| 22 | CDL-B, 20ns | 20.9/NAN | 17.4/20.6 | 19.1/22.7 | 18.4/21.4 |
| CDL-B, 50ns | 21.4/NAN | 18.0/21.2 | 18.8/22.2 | 19.7/21.9 |
| CDL-D, 20ns | 14.7/NAN | 13.4/14.4 | 13.2/14.3 | 13.4/13.8 |
| CDL-D, 30ns | 14.7/NAN | 13.4/14.4 | 13.2/14.3 | 13.4/13.8 |
| Additional report/notes:  CP type:  NCP  antenna configuration for CDL model:  (Mg,Ng,M,N,P) = (1,1,4,8,2) BS with (0.5 dv, 0.5 dH)  (Mg,Ng,M,N,P) = (1,1,2,2,2) UE with (0.5 dv, 0.5 dH)  waveform in case of PUSCH:  DFT-s-OFDM  PTRS configuration:  L=1 in time domain, and \* are:  8\*4 for 120 kHz  8\*4 for 240 kHz  4\*4 for 480 kHz  4\*2 for 960 kHz  DMRS configuration:  1/2 in frequency in each port  any optional or other assumption/parameters used not as in the baseline:  PN model: Example 2 phase noise model scaling to 60 GHz in 38.803 | | | | | |

#### B.1.1.3 Source 3 [30]

Table B.1.1.3-1: CINR in dB achieving PDSCH iBLER of 10% ∕ 1%: 1 DMRS symbol

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 960KHz /400MHz | 960KHz /2GHz |
| R1-2008615 / Source 3 | 7 | TDL-A, 5ns | -1.3/0.8 | -1.2/0.8 | -0.9/1.0 | -0.1/2.2 | -1.3/0.2 |
| TDL-A, 10ns | -1.4/0.2 | -1.4/0.2 | -1.0/0.7 | 0.2/1.9 | -0.9/0.4 |
| TDL-A, 20ns | -1.4/0.6 | -1.1/0.8 | 0.2/1.5 | 0.9/2.5 | 0.4/1.0 |
| CDL-B, 20ns (Cfg. 1) | -7.3/0.5 | -7.4/0.5 | -7.3/1.0 | -6.8/1.7 | -7.2/1.2 |
| CDL-B, 50ns (Cfg. 1) | -7.4/0.6 | -7.2/1.1 | -7.0/1.6 | -6.1/3.3 | -6.5/2.9 |
| CDL-D, 20ns (Cfg. 1) | -17.3/-11.1 | -17.3/-10.9 | -17.3/-10.9 | -17.0/-10.4 | -17.4/-11.1 |
| CDL-D, 30ns (Cfg. 1) | -17.3/-11.1 | -17.3/-11.0 | -17.3/-10.9 | -16.8/-10.4 | -17.4/-11.1 |
| CDL-B, 20ns (Cfg. 2) | -1.0/5.5 | -1.1/5.8 | -1.0/6.3 | -0.4/7.2 | -0.6/6.6 |
| CDL-B, 50ns (Cfg. 2) | -0.8/5.6 | -0.6/6.4 | -0.4/7.0 | 0.7/9.0 | 0.4/8.7 |
| CDL-D, 20ns (Cfg. 2) | -5.4/0.5 | -5.3/0.9 | -5.4/0.9 | -5.0/1.6 | -5.5/0.8 |
| CDL-D, 30ns (Cfg. 2) | -5.4/0.6 | -5.3/0.9 | -5.3/1.0 | -5.0/1.7 | -5.4/1.1 |
| 16 | TDL-A, 5ns | 6.6/8.6 | 6.5/8.6 | 6.6/8.6 | 6.9/9.1 | 6.3/7.9 |
| TDL-A, 10ns | 6.4/7.9 | 6.4/7.9 | 6.7/8.7 | 7.1/9.0 | 6.7/8.0 |
| TDL-A, 20ns | 6.0/7.8 | 6.3/7.9 | 6.8/8.3 | 7.9/9.8 | 7.4/8.7 |
| CDL-B, 20ns (Cfg. 1) | 1.1/8.3 | 1.0/8.5 | 1.2/8.7 | 1.2/8.9 | 0.8/8.8 |
| CDL-B, 50ns (Cfg. 1) | 1.2/8.7 | 1.1/8.8 | 1.2/9.3 | 1.6/11.9 | 1.3/12.0 |
| CDL-D, 20ns (Cfg. 1) | -9.0/-2.9 | -9.1/-3.3 | -9.1/-3.3 | -9.1/-3.5 | -9.5/-3.4 |
| CDL-D, 30ns (Cfg. 1) | -8.9/-3.2 | -9.1/-3.3 | -9.1/-3.4 | -9.2/-3.4 | -9.5/-3.6 |
| CDL-B, 20ns (Cfg. 2) | 7.2/13.4 | 7.2/13.6 | 7.6/14.0 | 7.6/14.5 | 7.6/14.3 |
| CDL-B, 50ns (Cfg. 2) | 7.6/13.9 | 7.6/14.1 | 8.1/14.9 | 9.0/19.0 | 8.8/19.0 |
| CDL-D, 20ns (Cfg. 2) | 2.9/8.5 | 2.8/8.4 | 2.9/8.7 | 2.9/8.7 | 2.6/8.5 |
| CDL-D, 30ns (Cfg. 2) | 3.0/8.7 | 2.9/8.5 | 2.9/8.8 | 2.9/8.8 | 2.6/8.7 |
| 22 | TDL-A, 5ns | 13.2/15.1 | 12.5/14.7 | 11.8/13.8 | 12.0/14.1 | 11.6/13.0 |
| TDL-A, 10ns | 13.4/15.4 | 12.3/14.3 | 11.9/13.7 | 12.3/14.0 | 11.9/13.5 |
| TDL-A, 20ns | 13.2/15.6 | 12.7/14.6 | 12.3/14.3 | 13.4/15.0 | 13.1/14.5 |
| CDL-B, 20ns (Cfg. 1) | 7.7/15.3 | 7.1/14.8 | 6.4/13.9 | 6.5/14.0 | 6.4/14.1 |
| CDL-B, 50ns (Cfg. 1) | 7.6/15.5 | 7.1/15.0 | 6.7/14.8 | 7.1/− | 7.2/− |
| CDL-D, 20ns (Cfg. 1) | -3.0/2.9 | -3.5/2.6 | -4.0/1.9 | -4.1/1.7 | -4.1/1.7 |
| CDL-D, 30ns (Cfg. 1) | -3.1/2.9 | -3.5/2.5 | -4.0/1.9 | -4.1/1.8 | -4.2/1.7 |
| CDL-B, 20ns (Cfg. 2) | 13.8/20.5 | 12.9/20.1 | 12.7/19.4 | 12.9/20.0 | 13.0/20.2 |
| CDL-B, 50ns (Cfg. 2) | 14.1/21.1 | 13.8/20.8 | 13.5/21.0 | 14.9/− | 15.0/− |
| CDL-D, 20ns (Cfg. 2) | 8.8/14.8 | 8.6/14.6 | 8.4/14.4 | 8.3/14.6 | 8.2/14.4 |
| CDL-D, 30ns (Cfg. 2) | 9.0/14.9 | 8.9/14.9 | 8.5/14.6 | 8.3/14.6 | 8.3/14.6 |
| Additional report/notes:  CP type: NCP  antenna configuration for CDL model: Config 1 and Config 2  waveform in case of PUSCH  PTRS configuration: (K=4, L=1)  DMRS configuration: 1 DMRS, front loaded  any optional or other assumption/parameters used not as in the baseline: CPE compensation | | | | | | |

Table B.1.1.3-2: CINR in dB achieving PDSCH iBLER of 10% ∕ 1%: 2 DMRS symbol

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 960KHz /400MHz | 960KHz /2GHz |
| R1-2008615 / Source 3 | 7 | TDL-A, 5ns | -1.4/0.8 | -1.5/0.8 | -1.4/1.0 | -0.2/1.7 | -1.6/0.4 |
| TDL-A, 10ns | -1.8/0.5 | -1.7/0.5 | -1.4/0.7 | -0.1/1.4 | -1.4/0.5 |
| TDL-A, 20ns | -1.8/0.2 | -1.5/0.5 | -1.2/0.8 | 0.2/1.6 | -1.2/0.7 |
| CDL-B, 20ns (Cfg. 1) | -7.5/0.3 | -7.6/0.4 | -7.6/0.6 | -7.1/1.2 | -7.6/0.6 |
| CDL-B, 50ns (Cfg. 1) | -7.6/0.3 | -7.5/0.4 | -7.3/0.8 | -6.5/2.3 | -7.1/1.7 |
| CDL-D, 20ns (Cfg. 1) | -17.4/-11.2 | -17.4/-11.2 | -17.4/-11.2 | -17.0/-10.5 | -17.5/-11.3 |
| CDL-D, 30ns (Cfg. 1) | -17.4/-11.3 | -17.4/-11.2 | -17.5/-11.1 | -17.1/-10.5 | -17.5/-11.4 |
| CDL-B, 20ns (Cfg. 2) | -1.2/5.1 | -1.3/5.5 | -1.2/5.8 | -0.7/6.6 | -0.7/5.9 |
| CDL-B, 50ns (Cfg. 2) | -1.0/5.4 | -0.8/5.6 | -0.7/6.3 | -0.1/7.8 | -0.4/7.5 |
| CDL-D, 20ns (Cfg. 2) | -5.5/0.5 | -5.5/0.7 | -5.5/0.8 | -5.0/1.5 | -5.6/0.7 |
| CDL-D, 30ns (Cfg. 2) | -5.6/0.6 | -5.4/0.7 | -5.5/0.8 | -5.1/1.5 | -5.4/0.8 |
| 16 | TDL-A, 5ns | 6.2/8.6 | 6.3/8.0 | 6.3/8.3 | 6.7/8.9 | 5.9/7.4 |
| TDL-A, 10ns | 6.1/7.9 | 6.0/7.8 | 6.4/7.9 | 6.7/8.7 | 6.1/7.5 |
| TDL-A, 20ns | 5.9/7.5 | 6.2/7.8 | 6.7/7.9 | 7.0/8.8 | 6.4/7.7 |
| CDL-B, 20ns (Cfg. 1) | 0.9/8.0 | 0.7/7.8 | 1.0/7.9 | 1.2/8.1 | 0.5/8.00 |
| CDL-B, 50ns (Cfg. 1) | 1.0/8.2 | 0.8/8.2 | 0.9/8.5 | 1.7/10.8 | 1.1/11.2 |
| CDL-D, 20ns (Cfg. 1) | -9.2/-3.5 | -9.3/-3.5 | -9.3/-3.5 | -9.3/-3.5 | -9.6/-3.7 |
| CDL-D, 30ns (Cfg. 1) | -9.2/-3.5 | -9.3/-3.6 | -9.3/-3.4 | -9.3/-3.5 | -9.6/-3.7 |
| CDL-B, 20ns (Cfg. 2) | 7.0/13.2 | 6.9/13.3 | 7.2/13.6 | 7.3/14.0 | 7.1/13.7 |
| CDL-B, 50ns (Cfg. 2) | 7.3/13.6 | 7.4/13.6 | 7.6/14.3 | 8.5/17.8 | 8.3/18.1 |
| CDL-D, 20ns (Cfg. 2) | 2.7/8.3 | 2.7/8.3 | 2.8/8.4 | 2.8/8.5 | 2.5/8.2 |
| CDL-D, 30ns (Cfg. 2) | 2.8/8.5 | 2.7/8.4 | 2.8/8.5 | 2.8/8.6 | 2.4/8.3 |
| 22 | TDL-A, 5ns | 13.1/15.8 | 12.4/14.9 | 11.6/13.6 | 11.7/13.9 | 11.4/12.9 |
| TDL-A, 10ns | 13.0/15.7 | 12.3/14.3 | 11.5/13.2 | 11.7/13.7 | 11.6/12.9 |
| TDL-A, 20ns | 12.9/15.5 | 12.5/14.8 | 11.9/13.4 | 12.5/14.0 | 12.4/13.9 |
| CDL-B, 20ns (Cfg. 1) | 7.8/15.2 | 7.1/14.7 | 6.1/13.5 | 6.0/13.6 | 6.3/13.9 |
| CDL-B, 50ns (Cfg. 1) | 7.7/15.3 | 7.1/14.9 | 6.2/13.9 | 6.6/− | 6.9/− |
| CDL-D, 20ns (Cfg. 1) | -2.9/2.9 | -3.4/2.6 | -4.1/1.7 | -4.2/1.7 | -4.1/1.7 |
| CDL-D, 30ns (Cfg. 1) | -2.9/2.9 | -3.3/2.7 | -4.1/1.7 | -4.2/1.6 | -4.1/1.7 |
| CDL-B, 20ns (Cfg. 2) | 13.8/20.5 | 13.2/19.3 | 12.5/19.1 | 12.5/19.3 | 12.8/19.6 |
| CDL-B, 50ns (Cfg. 2) | 14.0/20.9 | 13.6/20.4 | 12.8/19.9 | 14.2/− | 14.7/− |
| CDL-D, 20ns (Cfg. 2) | 9.0/14.9 | 8.8/14.9 | 8.2/14.0 | 8.1/14.3 | 8.3/14.5 |
| CDL-D, 30ns (Cfg. 2) | 9.2/15.2 | 9.0/15.1 | 8.3/14.1 | 8.1/14.3 | 8.3/15.0 |
| Additional report/notes:  CP type: NCP  antenna configuration for CDL model: Config 1 and Config 2  waveform in case of PUSCH  PTRS configuration: (K=4, L=1)  DMRS configuration: 2 DMRSs, (2, 11)  any optional or other assumption/parameters used not as in the baseline: CPE compensation | | | | | | |

Table B.1.1.3-3: CINR in dB achieving PUSCH iBLER of 10% ∕ 1%: 1 DMRS symbol

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 960KHz /400MHz | 960KHz /2GHz |
| R1-2008615 / Source 3 | 7 | TDL-A, 5ns | 2.5/5.7 | 2.3/5.6 | 2.1/5.2 | 1.9/4.8 | 2.9/5.6 |
| TDL-A, 10ns | 2.8/5.7 | 2.7/5.6 | 2.6/5.5 | 2.6/5.0 | 3.4/5.8 |
| TDL-A, 20ns | 3.0/5.7 | 3.0/5.6 | 3.1/5.7 | 3.3/5.5 | 4.0/6.5 |
| CDL-B, 20ns (Cfg. 1) | -4.4/4.9 | -4.6/4.8 | -4.6/4.7 | -4.7/4.7 | -3.5/5.3 |
| CDL-B, 50ns (Cfg. 1) | -4.0/4.9 | -3.8/4.9 | -3.8/5.1 | -3.8/6.1 | -3.1/6.8 |
| CDL-D, 20ns (Cfg. 1) | -15.3/-8.5 | -15.2/-8.6 | -15.5/-9.1 | -15.9/-9.2 | -15.4/-8.8 |
| CDL-D, 30ns (Cfg. 1) | -15.2/-8.4 | -15.4/-8.7 | -15.4/-9.0 | -16.0/-9.3 | -15.4/-8.8 |
| CDL-B, 20ns (Cfg. 2) | 2.0/10.3 | 2.2/10.3 | 2.1/10.2 | 1.9/9.9 | 2.0/9.9 |
| CDL-B, 50ns (Cfg. 2) | 2.0/10.3 | 2.3/9.9 | 2.5/10.6 | 2.9/12.0 | 2.6/11.7 |
| CDL-D, 20ns (Cfg. 2) | -3.3/3.6 | -3.4/3.4 | -3.4/3.1 | -3.9/2.9 | -3.5/3.6 |
| CDL-D, 30ns (Cfg. 2) | -3.4/3.6 | -3.5/3.0 | -3.5/3.2 | -4.0/2.8 | -3.5/3.5 |
| 16 | TDL-A, 5ns | 8.8/11.8 | 8.3/11.3 | 8.1/11.2 | 8.4/11.4 | 9.0/11.2 |
| TDL-A, 10ns | 9.5/12.0 | 8.8/11.2 | 8.7/11.0 | 9.1/11.6 | 9.6/11.2 |
| TDL-A, 20ns | 9.8/12.0 | 8.9/11.3 | 9.1/11.0 | 10.3/12.5 | 10.5/12.0 |
| CDL-B, 20ns (Cfg. 1) | 3.5/11.6 | 2.9/10.9 | 2.8/11.0 | 3.2/11.5 | 3.6/11.8 |
| CDL-B, 50ns (Cfg. 1) | 3.7/11.7 | 3.2/11.3 | 3.2/11.6 | 3.6/16.0 | 3.9/15.8 |
| CDL-D, 20ns (Cfg. 1) | -8.4/-2.5 | -9.1/-3.2 | -9.2/-3.3 | -9.0/-3.2 | -8.9/-2.9 |
| CDL-D, 30ns (Cfg. 1) | -8.4/-2.5 | -9.1/-3.1 | -9.2/-3.3 | -9.0/-3.1 | -9.0/-3.0 |
| CDL-B, 20ns (Cfg. 2) | 10.1/16.9 | 9.5/16.5 | 9.3/16.4 | 9.9/17.1 | 10.3/17.0 |
| CDL-B, 50ns (Cfg. 2) | 10.4/16.7 | 10.1/16.5 | 10.1/17.1 | 11.3/27.9 | 11.3/− |
| CDL-D, 20ns (Cfg. 2) | 3.5/9.4 | 3.0/8.9 | 3.0/8.8 | 3.1/9.1 | 3.2/9.1 |
| CDL-D, 30ns (Cfg. 2) | 3.6/9.4 | 3.2/9.0 | 2.9/9.0 | 3.1/9.0 | 3.2/9.6 |
| 22 | TDL-A, 5ns | 15.8/20.4 | 13.7/17.1 | 13.3/16.5 | 13.4/16.7 | 14.6/16.5 |
| TDL-A, 10ns | 16.6/21.2 | 14.5/17.5 | 13.9/16.6 | 14.4/16.7 | 14.9/16.9 |
| TDL-A, 20ns | 17.0/21.7 | 14.8/17.5 | 14.5/16.8 | 15.9/18.0 | 16.3/17.9 |
| CDL-B, 20ns (Cfg. 1) | 10.4/18.5 | 8.8/16.7 | 8.5/16.4 | 8.7/17.0 | 9.3/17.3 |
| CDL-B, 50ns (Cfg. 1) | 10.7/18.6 | 9.2/16.9 | 8.9/17.3 | 9.4/− | 9.6/− |
| CDL-D, 20ns (Cfg. 1) | -1.9/3.9 | -3.6/2.3 | -3.9/1.9 | -3.9/1.9 | -3.7/2.4 |
| CDL-D, 30ns (Cfg. 1) | -2.1/3.9 | -3.5/2.4 | -3.9/1.9 | -3.9/2.1 | -3.6/2.3 |
| CDL-B, 20ns (Cfg. 2) | 17.1/24.4 | 15.3/22.2 | 15.1/21.9 | 15.4/22.7 | 15.9/22.1 |
| CDL-B, 50ns (Cfg. 2) | 17.4/24.3 | 15.8/22.2 | 15.7/23.2 | 17.7/− | 18.1/− |
| CDL-D, 20ns (Cfg. 2) | 10.1/16.2 | 8.7/14.6 | 8.5/14.8 | 8.6/15.2 | 8.9/15.2 |
| CDL-D, 30ns (Cfg. 2) | 10.3/16.6 | 8.9/15.0 | 8.6/14.8 | 8.7/15.1 | 8.9/15.8 |
| Additional report/notes:  CP type: NCP  antenna configuration for CDL model: Config 1 and Config 2  waveform in case of PUSCH: DFT-s-OFDM  PTRS configuration: (Ng=4, Ns=4, L=1)  DMRS configuration: 1 DMRS, front loaded  any optional or other assumption/parameters used not as in the baseline | | | | | | |

Table B.1.1.3-4: CINR in dB achieving PUSCH iBLER of 10% ∕ 1%: 2 DMRS symbol

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 960KHz /400MHz | 960KHz /2GHz |
| R1-2008615 / Source 3 | 7 | TDL-A, 5ns | 2.2/5.3 | 1.8/5.4 | 1.3/4.0 | 1.5/4.3 | 2.4/5.2 |
| TDL-A, 10ns | 2.5/5.4 | 2.1/5.1 | 1.7/4.3 | 2.0/4.5 | 2.8/5.4 |
| TDL-A, 20ns | 2.8/5.3 | 2.4/4.9 | 1.9/4.0 | 2.4/4.8 | 3.1/5.7 |
| CDL-B, 20ns (Cfg. 1) | -4.7/4.5 | -5.0/4.1 | -5.4/3.7 | -5.3/4.0 | -4.0/4.6 |
| CDL-B, 50ns (Cfg. 1) | -4.2/4.6 | -4.4/4.3 | -4.9/4.0 | -4.4/4.9 | -3.9/6.1 |
| CDL-D, 20ns (Cfg. 1) | -15.4/-9.0 | -15.7/-9.1 | -16.2/-9.6 | -16.0/-9.5 | -15.6/-9.1 |
| CDL-D, 30ns (Cfg. 1) | -15.4/-8.8 | -15.7/-9.0 | -16.3/-9.5 | -16.1/-9.4 | -15.5/-9.0 |
| CDL-B, 20ns (Cfg. 2) | 1.9/10.1 | 1.8/9.5 | 1.1/8.8 | 1.4/9.5 | 2.3/9.9 |
| CDL-B, 50ns (Cfg. 2) | 1.9/9.8 | 2.0/9.4 | 1.5/9.1 | 2.1/10.6 | 2.8/11.6 |
| CDL-D, 20ns (Cfg. 2) | -3.6/3.2 | -3.6/2.6 | -4.3/2.2 | -4.1/2.5 | -3.6/3.2 |
| CDL-D, 30ns (Cfg. 2) | -3.7/3.4 | -3.9/3.2 | -4.4/2.3 | -4.2/2.6 | -3.7/3.3 |
| 16 | TDL-A, 5ns | 8.9/11.9 | 8.0/11.4 | 7.9/10.8 | 8.1/10.9 | 8.7/10.8 |
| TDL-A, 10ns | 9.3/12.0 | 8.6/11.0 | 8.8/10.8 | 8.6/10.9 | 9.0/10.9 |
| TDL-A, 20ns | 9.5/11.7 | 8.9/10.9 | 8.8/10.8 | 9.2/11.3 | 9.6/10.9 |
| CDL-B, 20ns (Cfg. 1) | 3.6/11.6 | 2.9/11.0 | 2.9/10.8 | 2.9/11.1 | 3.1/11.2 |
| CDL-B, 50ns (Cfg. 1) | 3.7/11.7 | 3.2/11.0 | 3.1/11.2 | 3.1/13.9 | 3.3/14.7 |
| CDL-D, 20ns (Cfg. 1) | -8.4/-2.4 | -9.0/-3.0 | -9.1/-3.1 | -9.2/-3.3 | -9.2/-3.1 |
| CDL-D, 30ns (Cfg. 1) | -8.4/-2.4 | -9.0/-2.9 | -9.0/-3.2 | -9.2/-3.2 | -9.2/-3.2 |
| CDL-B, 20ns (Cfg. 2) | 10.2/17.2 | 9.5/16.5 | 9.3/16.2 | 9.4/16.5 | 9.7/16.4 |
| CDL-B, 50ns (Cfg. 2) | 10.4/16.8 | 9.8/16.2 | 10.0/16.7 | 10.5/22.1 | 10.6/23.9 |
| CDL-D, 20ns (Cfg. 2) | 3.6/9.4 | 3.1/8.9 | 3.1/8.9 | 2.9/8.8 | 3.1/9.0 |
| CDL-D, 30ns (Cfg. 2) | 3.8/9.6 | 3.3/8.9 | 3.0/8.9 | 2.9/8.9 | 3.1/9.1 |
| 22 | TDL-A, 5ns | 15.4/18.9 | 13.6/17.1 | 12.9/16.1 | 12.9/16.0 | 14.2/16.4 |
| TDL-A, 10ns | 16.1/19.1 | 14.2/16.9 | 13.7/15.9 | 13.7/16.1 | 14.6/16.5 |
| TDL-A, 20ns | 16.3/19.2 | 14.7/16.8 | 14.0/16.1 | 14.8/17.3 | 15.6/17.2 |
| CDL-B, 20ns (Cfg. 1) | 10.3/18.2 | 8.9/16.7 | 8.2/16.1 | 8.3/16.5 | 9.1/16.8 |
| CDL-B, 50ns (Cfg. 1) | 10.4/18.3 | 9.1/16.7 | 8.6/16.6 | 8.9/− | 9.5/− |
| CDL-D, 20ns (Cfg. 1) | -2.1/3.7 | -3.4/2.5 | -4.1/1.8 | -4.1/1.8 | -3.6/2.4 |
| CDL-D, 30ns (Cfg. 1) | -2.0/3.8 | -3.5/2.5 | -4.1/1.8 | -4.0/1.9 | -3.6/2.4 |
| CDL-B, 20ns (Cfg. 2) | 16.8/23.9 | 15.3/22.1 | 14.8/21.5 | 15.0/22.0 | 15.7/22.5 |
| CDL-B, 50ns (Cfg. 2) | 17.1/23.7 | 15.8/21.9 | 15.2/22.4 | 16.9/− | 17.5/− |
| CDL-D, 20ns (Cfg. 2) | 10.1/16.2 | 8.8/14.7 | 8.3/14.5 | 8.4/14.7 | 9.0/15.0 |
| CDL-D, 30ns (Cfg. 2) | 10.4/16.1 | 9.0/15.2 | 8.4/14.6 | 8.5/14.9 | 9.0/15.6 |
| Additional report/notes:  CP type: NCP  antenna configuration for CDL model: Config 1 and Config 2  waveform in case of PUSCH: DFT-s-OFDM  PTRS configuration: (Ng=4, Ns=4, L=1)  DMRS configuration: 2 DMRS, (2, 11)  any optional or other assumption/parameters used not as in the baseline | | | | | | |

#### B.1.1.4 Source 4 [60]

Table B.1.1.4-1: SINR in dB achieving CP-OFDM PDSCH BLER of 10% /1% for NCP

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 960KHz /400MHz | 960KHz /2GHz |
| R1-2007654 / Source 4 | 7 | TDL-A, 5ns | 1.8/  3.6 | 1.8/  3.6 | 1.8/  3.8 | 2.2/  4.2 | 1.5/  2.8 |
| TDL-A, 10ns | 1.7/  2.9 | 1.7/  2.9 | 1.8/  3.1 | 2.9/  4.3 | 2.4/  3.6 |
| TDL-A, 20ns | 1.4/  2.8 | 1.4/  2.8 | 2.4/  3.7 | 4.2/  5.2 | 3.6/  4.4 |
| TDL-A, 40ns | 1.5/  2.6 | 2.4/  3.4 | 3.8/  4.9 | 6.9/  7.8 | 6.5/  7.4 |
| 16 | TDL-A, 5ns | 10.3/  12.2 | 10/  11.7 | 9.9/  11.7 | 10/  11.7 | 9.4/  10.4 |
| TDL-A, 10ns | 10.1/  11.5 | 9.7/  11.2 | 9.7/  11.2 | 10.5/  11.9 | 10.3/  11.2 |
| TDL-A, 20ns | 10/  11.4 | 9.8/  10.9 | 10.5/  11.6 | 11.6/  12.9 | 11.1/  11.8 |
| TDL-A, 40ns | 10/  11.3 | 10.6/  11.7 | 11.5/  12.5 | 14.4/  16.6 | 13.7/  14.9 |
| 22 | TDL-A, 5ns |  | 19.8/ | 16/  18.8 | 15.1/  17.1 | 15.2/  17.3 |
| TDL-A, 10ns |  | 19.9/ | 16/  18.5 | 15.9  17.2 | 16.4/  18.2 |
| TDL-A, 20ns |  | 20/ | 16.8/  19.1 | 17.1/  18.8 | 17.5/  20 |
| TDL-A, 40ns |  | 21/ | 18.2/  21 |  |  |
| Additional report/notes:  CP type: NCP  Waveform: CP-OFDM waveform for PDSCH  PTRS configuration: K=2, L=1  DMRS configuration: Type 1 DMRS  Precoder: random precoder  No TRS, No CSI-RS | | | | | | |

Table B.1.1.4-2: SINR in dB achieving CP-OFDM PDSCH BLER of 10% /1% for ECP

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 960KHz /400MHz | 960KHz /2GHz |
| R1-2007654 / Source 4 | 7 | TDL-A, 5ns | 1.9/  3.7 | 1.9/  3.7 | 1.9/  3.9 | 2.4/  4.4 | 1.4/  2.6 |
| TDL-A, 10ns | 1.7/  3.1 | 1.7/  3.1 | 1.9/  3.4 | 3.1/  4.5 | 2.3/  3.5 |
| TDL-A, 20ns | 1.6/  2.9 | 1.7/  2.9 | 2.6/  3.7 | 4.3/  5.4 | 3.5/  4.6 |
| TDL-A, 40ns | 1.6/  2.8 | 2.5/  3.5 | 4/  4.9 | 7/  8 | 6.2/  7 |
| 16 | TDL-A, 5ns | 10.1/  12.2 | 9.9/  11.6 | 9.8/  11.6 | 9.9/  11.6 | 9.3/  10.3 |
| TDL-A, 10ns | 10/  11.5 | 9.6/  11.1 | 9.5/  10.9 | 10.3/  11.7 | 10.3/  12.2 |
| TDL-A, 20ns | 9.7/  11.3 | 9.6/  10.8 | 10.4/  11.3 | 11.4/  12.8 | 11.1/  11.8 |
| TDL-A, 40ns | 9.9/  11.2 | 10.5/  11.5 | 11.3/  12.2 | 13.8/  15.9 | 13.5/  14.5 |
| 22 | TDL-A, 5ns | 23.5/ | 18.5/ | 15.9/  18.5 | 15/  17 | 18.5/ |
| TDL-A, 10ns | 24.5/ | 18.9/ | 15.8/  18.2 | 15.7/  17.1 | 16/  17.8 |
| TDL-A, 20ns | 25/ | 19/ | 16.6/  19 | 16.7/  18.1 | 17/  19 |
| TDL-A, 40ns | 26/ | 19.9/ | 17.8/  20.3 |  |  |
| Additional report/notes:  CP type: ECP  Waveform: CP-OFDM waveform for PDSCH  PTRS configuration: K=2, L=1  DMRS configuration: Type 1 DMRS  Precoder: random precoder  No TRS, No CSI-RS | | | | | | |

Table B.1.1.4-3: SINR in dB achieving DFT-S-OFDM PUSCH BLER of 10% /1% for NCP

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 960KHz /400MHz | 960KHz /2GHz |
| R1-2007654 / Source 4 | 7 | TDL-A, 5ns | 5.5/  8.9 | 5.5/  8.5 | 6.4/  9.8 | 6.5/  9.9 | 4.8/  6.7 |
| TDL-A, 10ns | 5.1/  7.8 | 5.1/  7.8 | 6.1/  8.6 | 6.2/  9 | 4.8/  6.4 |
| TDL-A, 20ns | 5/  7 | 5/  7 | 6/  8.4 | 6.3/  8.8 | 4.6/  6.2 |
| TDL-A, 40ns | 5/  6.6 | 5/  6.6 | 6.2/  8.1 | 7.5/  10.1 | 5.4/  7.2 |
| 16 | TDL-A, 5ns | 12.2/  15.7 | 12.2/  15.2 | 12.3/  15.3 | 12.5/  15.7 | 11.5/  13.4 |
| TDL-A, 10ns | 11.8/  14.5 | 11.8/  14.5 | 11.9/  14.4 | 12.3/  15 | 11.5/  13.3 |
| TDL-A, 20ns | 11.7/  14.1 | 11.8/  14.1 | 11.9/  14.2 | 13.8/  15 | 11.9/  13.4 |
| TDL-A, 40ns | 11.8/  13.8 | 12/  13.8 | 12.5/  14.4 | 17/ | 15.5/  22 |
| 22 | TDL-A, 5ns | 18.7/  25 | 18.2/  22 | 17.4/  20.5 | 17.4/  20.7 | 17.3/  20 |
| TDL-A, 10ns | 18.5/  23 | 18.3/  21.7 | 17/  19.7 | 17.5/  20 | 17.8/  20.3 |
| TDL-A, 20ns | 19.5/ | 19.4/ | 17.2/  19.5 | 18.5/  21.5 | 19/  22.7 |
| TDL-A, 40ns | 20.4/ | 20.6/ | 18.4/  21.1 |  |  |
| Additional report/notes:  CP type: NCP  Waveform: DFT-S-OFDM waveform for PUSCH  PTRS configuration:  400MHz: SCS120: chunk5; SCS240: chunk4; SCS480: chunk3; SCS960: chunk1  2GHz: SCS480: chunk5; SCS960: chunk4  (chunk1: 2\*2, chunk2: 2\*4, chunk3: 4\*2, chunk4: 4\*4, chunk5: 8\*4);  occupy symbol index: 2-13  DMRS configuration: Type 1 DMRS  Precoder: random precoder  No TRS, No CSI-RS | | | | | | |

Table B.1.1.4-4: SINR in dB achieving DFT-S-OFDM PUSCH BLER of 10% /1% for ECP

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 960KHz /400MHz | 960KHz /2GHz |
| R1-2007654 / Source 4 | 7 | TDL-A, 5ns | 5.1/  8.6 | 5.2/  8.3 | 6.1/  9.1 | 6.6/  9.8 | 4.7/  6.8 |
| TDL-A, 10ns | 5/  7.5 | 5/  7.4 | 5.9/  8.3 | 6.1/  9 | 4.8/  6.5 |
| TDL-A, 20ns | 4.8/  6.9 | 4.8/  6.8 | 5.6/  7.9 | 6.5/  8.8 | 4.5/  6.1 |
| TDL-A, 40ns | 4.8/  6.5 | 4.8/  6.5 | 5.9/  7.7 | 7.3/  9.9 | 5.3/  7 |
| 16 | TDL-A, 5ns | 12/  15.4 | 12/  15.2 | 12.1/  15.2 | 12.3/  15.6 | 11.3/  13.5 |
| TDL-A, 10ns | 11.7/  14.4 | 11.7/  14.4 | 11.9/  14.4 | 12.3/  14.9 | 11.5/  13.2 |
| TDL-A, 20ns | 11.6/  13.8 | 11.7/  13.9 | 11.9/  14 | 12.7/  14.9 | 11.6/  13.3 |
| TDL-A, 40ns | 11.5/  13.5 | 11.8/  13.6 | 12.3/  14.3 | 16.8/  25 | 14.1/  17.5 |
| 22 | TDL-A, 5ns | 18.4/  24 | 18/  21.7 | 17.3/  20.4 | 17.4/  20.6 | 17.5/  20.3 |
| TDL-A, 10ns | 18/  22.5 | 18/  21.3 | 17/  19.6 | 17.3/  20 | 18/  20.9 |
| TDL-A, 20ns | 19/  25 | 19/ | 17.1/  19.4 | 18.1/  21 | 18.5/  22.3 |
| TDL-A, 40ns | 19.5/ | 20.2/ | 18/  20.5 |  |  |
| Additional report/notes:  CP type: ECP  Waveform: DFT-S-OFDM waveform for PUSCH  PTRS configuration:  400MHz: SCS120: chunk5; SCS240: chunk4; SCS480: chunk3; SCS960: chunk1  2GHz: SCS960: chunk4  (chunk1:2\*2, chunk2:2\*4, chunk3:4\*2, chunk4:4\*4, chunk5:8\*4);  occupy symbol index: 2-11  DMRS configuration: Type 1 DMRS  Precoder: random precoder  No TRS, No CSI-RS | | | | | | |

#### B.1.1.5 Source 5 [64]

Table B.1.1.5-1: SINR in dB achieving PDSCH BLER of 10% /1% (with PN and CPE compensation)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 960KHz /400MHz |
| R1-2009450/ Source 5 | 7 | TDL-A, 5ns | 7.5/13.4 | 7.1/13.5 | 6.7/12.5 | 6.6/12 |
| TDL-A, 10ns | 5.2/11.4 | 5.0/10.9 | 5.6/10.0 | 5.5/9.6 |
| TDL-A, 20ns | 5.8/9.7 | 4.8/10.6 | 4.6/10.2 | 4.5/10.2 |
| CDL-B, 20ns | 8.2/10.6 | 8.0/10.3 | 7.7/9.5 | 7.7/9.4 |
| CDL-B, 50ns | 8.0/10.7 | 7.8/10.5 | 7.7/10.3 | 7.6/9.5 |
| 16 | TDL-A, 5ns | 17.1/28.8 | 14.6/23.5 | 14.8/22.3 | 14.7/21.7 |
| TDL-A, 10ns | 17.2/- | 14.8/23.5 | 15.5/23.1 | 15.5/22.6 |
| TDL-A, 20ns | 18.8/- | 16.1/26.1 | 16.4/24.9 | 16.4/24.6 |
| CDL-B, 20ns | 17.9/22.4 | 16.2/19.2 | 16.3/18.5 | 16.8/19.0 |
| CDL-B, 50ns | 17.6/21.4 | 16.3/18.4 | 16.6/18.8 | 16.8/18.9 |
| 22 | TDL-A, 5ns | -/- | -/- | 21.6/30.2 | 20.4/27.4 |
| TDL-A, 10ns | -/- | -/- | 22.5/32.2 | 21.0/28.5 |
| TDL-A, 20ns | -/- | 31.1/- | 24.2/- | 22.7/31.7 |
| CDL-B, 20ns | -/- | 25.8/- | 21.9/25.3 | 21.1/23.5 |
| CDL-B, 50ns | -/- | 25.0/30.7 | 22.1/24.8 | 21.9/23.9 |
| Additional report/notes:  CP type: Normal CP  antenna configuration for CDL model: Config.1  waveform in case of PUSCH: CP-OFDM  PTRS configuration: (K=2, L=1)  DMRS configuration: 2 DMRS (2,11)  any optional or other assumption/parameters used not as in the baseline:  Actual transmission RB number is 8/4/2/1 for SCS 120kHz/240kHz/480kHz/960kHz | | | | | |

Table B.1.1.5-2: SINR in dB achieving PDSCH BLER of 10% /1% (without PN)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 960KHz /400MHz |
| R1-2009450/ Source 5 | 7 | CDL-B, 20ns | 7.7/9.2 | 7.4/9.0 | 7.4/9.0 | 7.4/9.0 |
| 16 | TDL-A, 5ns | 12.0/16.6 | 11.5/16.4 | 11.6/16.1 | 11.6/16.3 |
| CDL-B, 20ns | 14.5/15.7 | 14.4/15.7 | 14.3/15.6 | 14.3/15.6 |
| 22 | TDL-A, 5ns | 16.4/21.0 | 16.2/20.8 | 16.1/21.0 | 16.3/21.1 |
| CDL-B, 20ns | 18.4/20.2 | 18.2/19.5 | 18.2/19.5 | 18.2/19.5 |
| Additional report/notes:  CP type: Normal CP  antenna configuration for CDL model: Config.1  waveform in case of PUSCH: CP-OFDM  PTRS configuration: (K=2, L=1)  DMRS configuration: 2 DMRS (2,11)  any optional or other assumption/parameters used not as in the baseline:  Actual transmission RB number is 8/4/2/1 for SCS 120kHz/240kHz/480kHz/960kHz  Note: This table is for calibration only. | | | | | |

Table B.1.1.5-3: SINR in dB achieving PUSCH BLER of 10% /1% (with PN and PN compensation)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 960KHz /400MHz |
| R1-2009450/ Source 5 | 7 | TDL-A, 5ns | 4.2/7.8 | 3.8/7.6 | 4.6/8 | 4.6/8.5 |
| TDL-A, 10ns | 3.6/6 | 3.9/7.4 | 4/7.3 | 4.4/7.7 |
| 16 | TDL-A, 5ns | 13.3/17.3 | 12.6/16.6 | 13/16.9 | 13.1/17.3 |
| TDL-A, 10ns | 12.8/16 | 12.7/16.4 | 12.8/16.4 | 12.9/16.2 |
| 22 | TDL-A, 5ns | 19.8/25.4 | 18.5/23.2 | 18.2/22.8 | 18.3/22.4 |
| TDL-A, 10ns | 20.5/27.9 | 19.4/24.8 | 18.7/24.2 | 18.7/23 |
| Additional report/notes:  CP type: Normal CP  waveform in case of PUSCH: DFT-S-OFDM  PTRS configuration: (Ng = 8, Ns = 4, L = 1)  DMRS configuration: 2 DMRS (2,11)  any optional or other assumption/parameters used not as in the baseline:  Actual transmission RB number is 48/24/12/6 for SCS 120kHz/240kHz/480kHz/960kHz | | | | | |

#### B.1.1.6 Source 6 [68]

Table B.1.1.6-1: SNR in dB achieving PDSCH BLER of 10% or 1% with CPE compensation for PN model set 1

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 960KHz /400MHz |
| R1-2009615 / Source 6 | 7 | TDL-A, 5ns | 2.96/ 5.1 | 2.77/ 4.8 | 3/ 5.14 | 3.4/ 5.7 |
| TDL-A, 10ns | 2.6/ 4.6 | 2.5/ 4.4 | 2.9/ 4.8 | 3.3/ 5.56 |
| TDL-A, 20ns | 2.5/ 4.5 | 2.5/ 4.4 | 3 /4.8 | 3.5/ 5.35 |
| CDL-B, 20ns | -21.7/ -19.1 | -21.8/ -19.1 | -21.7/ -18.6 | -21.6/ -19 |
| CDL-B, 50ns | -22.2/ -19.5 | -22.1/ -19.5 | -21.9/ -19.5 | -21.8/ -19 |
| 16 | TDL-A, 5ns | 11.9/ 14.4 | 11.2/ 13.6 | 11/ 13.1 | 11/ 13.3 |
| TDL-A, 10ns | 11.7/14.1 | 11/ 13.2 | 10.9/12.8 | 11.1/ 13 |
| TDL-A, 20ns | 11.5/ 13.5 | 11/ 12.8 | 10.9/12.5 | 11.5/ 13.5 |
| CDL-B, 20ns | -12.8/ -9.56 | -13.4/ -10 | -13.7/ -11.1 | -13.9/ -10.7 |
| CDL-B, 50ns | -13.2/ -10.2 | -13.5/ -10.8 | -14.1/ -11.4 | -14.0/ -11.3 |
| 22 | TDL-A, 5ns | inf | inf | 19.8/ inf | 17.3/ 19.7 |
| TDL-A, 10ns | inf | inf | 20/ inf | 17.3/ 19.7 |
| TDL-A, 20ns | inf | inf | 20.2/ inf | 19.1/ 22.3 |
| CDL-B, 20ns | inf | inf | -4/inf | -7.4/-4.1 |
| CDL-B, 50ns | inf | inf | -4.3/ inf | -7.8/-4.6 |
| Additional report/notes:  PN model set 1: BS: Ex2 BS and UE: Ex2 UE  CPE compensation  Normal CP  antenna configuration for CDL model  Configuration 1:  - (Mg,Ng,M,N,P) = (1,1,8,16,2) BS with (0.5 dv, 0.5 dH)  - (Mg,Ng,M,N,P) = (1,1,4,4,2) UE with (0.5 dv, 0.5 dH)  PTRS: K=4, L=1  DMRS configuration: 1 DMRS symbol at (2)  No TRS, No CSI-RS | | | | | | |

Table B.1.1.6-2: SNR in dB achieving PDSCH BLER of 10% or 1% with ICI compensation for PN model set 1

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 960KHz /400MHz |
| R1-2009615 / Source 6 | 22 | TDL-A, 5ns | inf | 18.2/ 21.4 | 18.1/20.4 | 19.8/ 22.4 |
| TDL-A, 10ns | inf | 18.1/ 20.8 | 18.1/20.3 | 19.1/ 21.5 |
| TDL-A, 20ns | inf | 18/ 20.5 | 18.3/ 20.3 | 22.8/ - |
| CDL-B, 20ns | inf | -6.6/ -3.2 | -6.6 / -3.2 | -5.1/ -1.7 |
| CDL-B, 50ns | inf | -6.7/ -3.2 | -6.8/ -3.9 | -5.2/ -1.9 |
| Additional report/notes:  PN model set 1: BS: Ex2 BS and UE: Ex2 UE  ICI compensation with 3 taps  Normal CP  antenna configuration for CDL model  Configuration 1:  - (Mg,Ng,M,N,P) = (1,1,8,16,2) BS with (0.5 dv, 0.5 dH)  - (Mg,Ng,M,N,P) = (1,1,4,4,2) UE with (0.5 dv, 0.5 dH)  PTRS: K=4, L=1  DMRS configuration: 1 DMRS symbol at (2)  No TRS, No CSI-RS | | | | | | |

Table B.1.1.6-3: SNR in dB achieving PUSCH BLER of 10% or 1% with CPE compensation for PN model set 1

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 960KHz /400MHz |
| R1-2009615 / Source 6 | 7 | TDL-A, 5ns | 7.7/ 10.8 | 7.43/10.6 | 7.7/ 10.25 | 7.8/ 10.3 |
| TDL-A, 10ns | 7.6/ 10.1 | 7.54/9.9 | 7.68/10.26 | 7.8/ 10.6 |
| TDL-A, 20ns | 7.5/ 9.7 | 7.4/ 9.56 | 7.8/ 9.7 | 8.2/ 10.4 |
| CDL-B, 20ns | -16.9/ -13.1 | -16.9/ -13.2 | -16.9/ -13.1 | -16.9/ -13.6 |
| CDL-B, 50ns | -17 /-14 | -17.3/ -14.3 | -17 / -13.7 | -17 / -14.2 |
| 16 | TDL-A, 5ns | 16.7/ 20.5 | 15.7/ 18.5 | 15.3/18.4 | 15.5/ 18.2 |
| TDL-A, 10ns | 16.6/20 | 15.7/18.3 | 15.4/ 18.1 | 15.6/ 18.3 |
| TDL-A, 20ns | 17/ 20.7 | 15.8/ 18.1 | 15.6/ 18 | 16.2/18.8 |
| CDL-B, 20ns | -8 /-4.3 | -9/-4.7 | -9.3/ -5 | -9/ -5.66 |
| CDL-B, 50ns | -8 /-4.9 | -8.84/ -5.66 | -9.4/ -6.2 | -9.2/ -5.7 |
| 22 | TDL-A, 5ns | inf | inf | 26.3/Inf | 22.8/26.2 |
| TDL-A, 10ns | inf | inf | 27/ Inf | 23.3/26 |
| TDL-A, 20ns | inf | inf | 28/- | 27.2/Inf |
| CDL-B, 20ns | inf | inf | 1.1/Inf | -1.9/ 1.76 |
| CDL-B, 50ns | inf | inf | 1.8/Inf | -1.65/ 1.7 |
| Additional report/notes:  PN model set 1: BS: Ex2 BS and UE: Ex2 UE  CPE compensation  Normal CP  antenna configuration for CDL model  Configuration 1:  - (Mg,Ng,M,N,P) = (1,1,8,16,2) BS with (0.5 dv, 0.5 dH)  - (Mg,Ng,M,N,P) = (1,1,4,4,2) UE with (0.5 dv, 0.5 dH)  PTRS: K=4, L=1  DMRS configuration: 1 DMRS symbol at (2)  No TRS, No CSI-RS | | | | | | |

#### B.1.1.7 Source 7 [62]

Table B.1.1.7-1: SINR in dB achieving PDSCH BLER of 10% /1%

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 960KHz /400MHz | 960KHz /2GHz |
| R1-2007928 / Source 7 | 7 | TDL-A, 5ns | 3.2/ 6 | 3.1/5.6 | 3.1/5.8 | 3.2/5.4 | 1.9/3.4 |
| TDL-A, 10ns | 2.7/4.7 | 2.6/4.7 | 2.6/4.6 | 2.6/4.9 | 2/3.2 |
| TDL-A, 20ns | 2.3/4.2 | 2.3/4.1 | 2.4/4.2 | 2.6/4.5 | 1.8/3.1 |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| CDL-D, 20ns |  |  |  |  |  |
| CDL-D, 30ns |  |  |  |  |  |
| 16 | TDL-A, 5ns | 11.9/14.6 | 11.4/14 | 11/13.3 | 10.9/13.4 | 9.9/11.4 |
| TDL-A, 10ns | 11.2/13.4 | 10.7/13 | 10.3/12.2 | 10.3/12.5 | 9.8/11.2 |
| TDL-A, 20ns | 11.1/13.3 | 10.4/12.1 | 10.1/11.9 | 10.4/12.5 | 9.9/11.5 |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| CDL-D, 20ns |  |  |  |  |  |
| CDL-D, 30ns |  |  |  |  |  |
| 22 | TDL-A, 5ns | inf/inf | inf/inf | 17.5/20.9 | 16.2/18.6 | 16.2/19.0 |
| TDL-A, 10ns | inf/inf | inf/inf | 17.1/20.7 | 16.1/18.2 | 16.1/18.2 |
| TDL-A, 20ns | inf/inf | inf/inf | 16.8/19.3 | 16.1/17.9 | 16.3/18.8 |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| Additional report/notes:  CP type normal  antenna configuration for CDL model  waveform in case of PUSCH  PTRS configuration every 2nd RB (CPE compensation)  DMRS configuration front-loaded  any optional or other assumption/parameters used not as in the baseline | | | | | | |

Table B.1.1.7-2: SINR in dB achieving PDSCH BLER of 10% /1% with ICI u=1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz  /400MHz | 240KHz  /400MHz | 480KHz  /400MHz | 960KHz  /400MHz | 960KHz  /2GHz |
| R1-2007928 / Source 7 | 7 | TDL-A, 5ns | 3.3/ 5.8 | 3.3/6.1 | 3.7/6.4 | 4.4/7.3 | 2.2/3.8 |
| TDL-A, 10ns | 2.6/4.5 | 2.7/5.1 | 3.3/5.7 | 4.0/6.2 | 2.2/3.8 |
| TDL-A, 20ns | 2.4/4.2 | 2.5/4.4 | 2.9/5.3 | 3.9/6.4 | 2.1/3.4 |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| CDL-D, 20ns |  |  |  |  |  |
| CDL-D, 30ns |  |  |  |  |  |
| 16 | TDL-A, 5ns | 11.2/14.1 | 11.1/13.2 | 11.1/13.4 | 11.4/13.9 | 9.9/11.7 |
| TDL-A, 10ns | 10.6/13.0 | 10.3/12.4 | 10.4/12.1 | 11.0/13.0 | 9.8/11.5 |
| TDL-A, 20ns | 10.1/12.3 | 9.9/11.8 | 10.1/12.0 | 11.1/13.3 | 9.7/11.2 |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| CDL-D, 20ns |  |  |  |  |  |
| CDL-D, 30ns |  |  |  |  |  |
| 22 | TDL-A, 5ns | 19.9/inf | 16.9/19.9 | 16.4/18.6 | 16.5/19.0 | 15.1/ 16.8 |
| TDL-A, 10ns | 19.3/inf | 16.4/18.7 | 16.0/17.9 | 16.2/18.5 | 15.2/16.9 |
| TDL-A, 20ns | 19.0/inf | 16.1/17.9 | 15.6/17.7 | 16.3/18.4 | 15.0/16.7 |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| Additional report/notes:  CP type normal  antenna configuration for CDL model  waveform in case of PUSCH  PTRS configuration every 2nd RB (ICI compensation,u=1)  DMRS configuration front-loaded  any optional or other assumption/parameters used not as in the baseline | | | | | | |

Table B.1.1.7-3: SINR in dB achieving PDSCH BLER of 10% /1% with ICI u=2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz  /400MHz | 240KHz  /400MHz | 480KHz  /400MHz | 960KHz  /400MHz | 960KHz  /2GHz |
| R1-2007928 / Source 7 | 7 | TDL-A, 5ns | 3.4/ 6.0 | 3.5/6.2 | 4.3/7.0 | 5.3/8.3 | 2.4/4.2 |
| TDL-A, 10ns | 2.7/5.0 | 3.1/5.2 | 3.7/6.1 | 5.0/7.6 | 2.3/3.8 |
| TDL-A, 20ns | 2.5/4.5 | 2.8/4.8 | 3.7/5.6 | 4.9/8.1 | 2.3/4.0 |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| CDL-D, 20ns |  |  |  |  |  |
| CDL-D, 30ns |  |  |  |  |  |
| 16 | TDL-A, 5ns | 11.0/13.7 | 11.1/13.6 | 11.3/14.0 | 12.2/15.4 | 10.1/11.9 |
| TDL-A, 10ns | 10.2/12.7 | 10.7/13.1 | 10.8/13.1 | 11.8/14.2 | 10.0/11.9 |
| TDL-A, 20ns | 10.1/12.2 | 10.1/12.2 | 10.6/12.4 | 11.7/14.1 | 9.8/11.4 |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| CDL-D, 20ns |  |  |  |  |  |
| CDL-D, 30ns |  |  |  |  |  |
| 22 | TDL-A, 5ns | 18.1/21.7 | 16.6/19.4 | 16.4/18.8 | 17.1/20.0 | 15.1/17.3 |
| TDL-A, 10ns | 17.4/20.5 | 16.3/18.6 | 16.1/18.3 | 16.6/19.1 | 15.2/16.8 |
| TDL-A, 20ns | 17.1/19.8 | 15.9/17.5 | 16.0/17.8 | 16.9/19.3 | 15.1/16.7 |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| Additional report/notes:  CP type normal  antenna configuration for CDL model  waveform in case of PUSCH  PTRS configuration every 2nd RB (ICI compensation,u=2)  DMRS configuration front-loaded  any optional or other assumption/parameters used not as in the baseline | | | | | | |

Table B.1.1.7-4: SINR in dB achieving PDSCH BLER of 10% /1% with ICI u=3

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz  /400MHz | 240KHz  /400MHz | 480KHz  /400MHz | 960KHz  /400MHz | 960KHz  /2GHz |
| R1-2007928 / Source 7 | 7 | TDL-A, 5ns | 3.6/6.1 | 3.9/6.5 | 4.8/7.6 | 6.5/9.7 | 2.6/4.5 |
| TDL-A, 10ns | 2.9/5.1 | 3.2/5.2 | 4.3/6.8 | 6.2/8.8 | 2.6/4.4 |
| TDL-A, 20ns | 2.6/4.5 | 3.1/5.0 | 4.0/6.2 | 6.2/9.1 | 2.5/4.2 |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| CDL-D, 20ns |  |  |  |  |  |
| CDL-D, 30ns |  |  |  |  |  |
| 16 | TDL-A, 5ns | 11.2/13.9 | 11.0/14.3 | 11.6/14.1 | 13.1/16.1 | 10.2/12.2 |
| TDL-A, 10ns | 10.4/12.8 | 10.5/13.3 | 11.2/13.6 | 12.9/15.5 | 10.1/11.8 |
| TDL-A, 20ns | 10.0/12.1 | 10.3/12.4 | 11.0/13.0 | 12.9/15.7 | 10.0/11.6 |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| CDL-D, 20ns |  |  |  |  |  |
| CDL-D, 30ns |  |  |  |  |  |
| 22 | TDL-A, 5ns | 17.5/21.6 | 16.6/19.5 | 16.8/19.5 | 18.2/21.0 | 15.2/16.7 |
| TDL-A, 10ns | 17.1/19.8 | 16.2/18.1 | 16.4/18.5 | 17.6/20.3 | 15.3/16.9 |
| TDL-A, 20ns | 16.7/19.1 | 15.9/17.5 | 16.2/18.3 | 18.2/21.0 | 15.2/16.9 |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| Additional report/notes:  CP type normal  antenna configuration for CDL model  waveform in case of PUSCH  PTRS configuration every 2nd RB (ICI compensation,u=3)  DMRS configuration front-loaded  any optional or other assumption/parameters used not as in the baseline | | | | | | |

#### B.1.1.8 Source 8 [59]

Table B.1.1.8-1: SNR in dB achieving PDSCH BLER of 10% /1%

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 960KHz /400MHz | 960KHz /2GHz |
| R1-2007560 / Source 8 | 7 | TDL-A, 5ns | 3/ 5.2 | 3.2/ 5.17 | 3.2/5.22 | 3.7/5.9 | 2.4/ 3.9 |
| TDL-A, 10ns | 2.6/ 4.5 | 2.7/ 4.7 | 2.7/ 4.7 | 3.5/5.5 | 2.4/ 3.9 |
| TDL-A, 20ns | 2.4/ 3.9 | 2.6/ 4.1 | 3.1/ 4.5 | 4/ 5.9 | 2.4/ 3.8 |
| TDL-A, 40ns | 2.4/3.9 | 2.6/4.4 | 3.8/5.4 | 5.1/7 |  |
| CDL-B, 20ns | 4.9/5.9 | 5.2/6.1 | 6/6.8 | 5.2/6.2 | 5/6.2 |
| CDL-B, 50ns | 5.1/7 | 5.3/6.8 | 7/8.3 | 7.8/8.9 | 7.5/8.7 |
| 16 | TDL-A, 5ns | 11.2/ 14.4 | 11.2/ 14.2 | 10.9/ 13.5 | 11 /13.8 | 10.9/ 12.8 |
| TDL-A, 10ns | 10.8/ 13 | 10.8/ 13 | 10.5/ 12.5 | 11/13.7 | 10.9/ 12.9 |
| TDL-A, 20ns | 10.7/ 12.6 | 10.7/ 12.6 | 10.7/ 12.6 | 11.5/ 13.8 | 10.5/ 12.3 |
| TDL-A, 40ns | 10.8/12.7 | 10.9/12.8 | 11/12.8 | 13/15.1 |  |
| CDL-B, 20ns | 13/14.5 | 12.3/12.9 | 13.1/13.8 | 12/12.7 | 12.3/13.2 |
| CDL-B, 50ns | 13.2/14.5 | 13.7/15.5 | 14.7/15.6 | 18/19.7 | 18.1/20.9 |
| 22 | TDL-A, 5ns | 27/ -  \*Note | 20/-  \*Note | 18/33 | 17.8 / 26.8 | 24/-  \*Note |
| TDL-A, 10ns | -/-  \*Note | 25.2/-  \*Note | 19.1/-  \*Note | 18.5/ 33 | -/-  \*Note |
| TDL-A, 20ns | -/-  \*Note | -/-  \*Note | 23.5/-  \*Note | 20/-  \*Note | -/-  \*Note |
| TDL-A, 40ns | -/-  \*Note | -/-  \*Note | 27/-  \*Note | -/-  \*Note |  |
| TDL-A, 40ns (ECP) | -/-  \*Note | -/-  \*Note | 24/-  \*Note | 22.5/-  \*Note |  |
| CDL-B, 20ns | -/-  \*Note | -/-  \*Note | 21.2/25.8 | 17.4/18.4 | 19.3/21.8 |
| CDL-B, 50ns | -/-  \*Note | -/ -  \*Note | -/-  \*Note | -/-  \*Note | -/-  \*Note |
| CDL-B, 50ns (ECP) |  |  | 21.4/26.1 | 19.1/21.4 | 21.4/25.3 |
| Additional report/notes:  CP type: NCP (all), ECP (TDL-A 40ns, CDL-B 50ns)  antenna configuration for CDL model: Configuration 2  (Mg,Ng,M,N,P) = (1,1,4,8,2) BS with (0.5 dv, 0.5 dH)  (Mg,Ng,M,N,P) = (1,1,2,2,2) UE with (0.5 dv, 0.5 dH)  waveform in case of PUSCH: NA  PTRS configuration: L=1, K=4  DMRS configuration: Type 1, front loaded, no data multiplexing  any optional or other assumption/parameters used not as in the baseline  -PN model: Example 2 from 38.803 phase noise model (gNB, UE) scaled to 60 GHz  -CPE compensation  -No TRS, no CSI-RS  \*Note: The values are missing since the required SNR for 10%/1% BLER is either very high or the BLER target is not reachable due to error floor. | | | | | | |

#### B.1.1.9 Source 9 [25]

Table B.1.1.9-1: LLS template: SINR in dB achieving PDSCH BLER of 10% /1%

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 960KHz /400MHz | 960KHz /400MHz (ICI) |
| R1-2008457 / Source 9 | 7 | TDL-A, 5ns | 0/2 | 0/2.25 | 0.25/2.75 | 0.25/2.75 |  |
| TDL-A, 10ns | 0.25/2.25 | 0/2 | 0.25/2 | 0.75/2.75 |  |
| TDL-A, 20ns | 0.5/2.25 | 0.5/2.25 | 0.75/2.5 | 1.25/5 |  |
| 16 | TDL-A, 5ns | 9.25/12 | 8.75/11.25 | 8.25/10.5 | 8.25/10.75 |  |
| TDL-A, 10ns | 9.5/12 | 8.75/11.5 | 9.25/12 | 8.75/11 |  |
| TDL-A, 20ns | 9.5/11.5 | 9.25/11.25 | 9/10.75 | 11/17 |  |
| 22 | TDL-A, 5ns | Inf/Inf | 28/Inf | 15.5/22 | 14.25/16.75 | 14.5/16.75 |
| TDL-A, 10ns | Inf/Inf | Inf/Inf | 16.5/22 | 17/22 | 14.5/17 |
| TDL-A, 20ns | Inf/Inf | 23.5/Inf | 20/[29] | Inf/ Inf | 17/ [24] |
| Additional report/notes:  CP type : Normal  antenna configuration for CDL model : N/A  waveform in case of PDSCH : CP-OFDM  PTRS configuration :  CPE Estimation: (K = 2, L = 1)  ICI Estimation: (K = 2 every 4 RBs, L = 1)  DMRS configuration : 2 DMRS symbols at (2,11)  the higher layer parameter  Antenna Configuration : 2 x 2  Numbers in brackets are extrapolated estimates | | | | | | |

Table B.1.1.9-2: SINR in dB achieving PUSCH BLER of 10% /1%

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 960KHz /400MHz | 960KHz /400MHz (ICI) |
| R1-2008457 / Source 9 | 7 | TDL-A, 5ns | 1.25 / 3.75 | 0.75 / 2.75 | 0.75 / 2.5 | 0.75 / 2.5 |  |
| TDL-A, 10ns | 1.4 / 3.25 | 1 / 3 | 1 / 2.75 | 1.8 / 3 |  |
| TDL-A, 20ns | 1.5 / 4 | 1.25 / 4 | 2 / 4 | 2.5 / 6 |  |
| 16 | TDL-A, 5ns | 9.5 / 12.5 | 8.75 / 11.5 | 8.75 / 11.5 | 8.75 / 11 |  |
| TDL-A, 10ns | 9.75 / 12.25 | 9 / 11.25 | 9.25 / 10.75 | 9.5 / 12.25 |  |
| TDL-A, 20ns | 10 / 12.5 | 9.5 /11.5 | 10 /12.5 | [27] /Inf |  |
| 22 | TDL-A, 5ns | [22.5] / Inf | 14.75 /1 8.25 | 14.5/17.25 | 14/17 |  |
| TDL-A, 10ns | Inf / Inf | 15 / 18.5 | 16 / 18 | 20.5 / 22.5 |  |
| TDL-A, 20ns | 23 / Inf | 15.5 / 19 | 21 / Inf | Inf / Inf |  |
| Additional report/notes:  CP type : Normal  antenna configuration for CDL model : N/A  waveform in case of PDSCH : DFT-S-OFDM  PTRS configuration : DFT-S-OFDM: (Ng = 8, Ns = 4, L = 1)  DMRS configuration : 2 DMRS symbols at (2,11)  the higher layer parameter  Antenna Configuration : 2 x 2  Numbers in brackets are extrapolated estimates | | | | | | |

#### B.1.1.10 Source 10 [67]

Table B.1.1.10-1: SINR in dB achieving PDSCH BLER of 10% /1%

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 960KHz /400MHz | 960KHz /2GHz |
| R1-2008873 / Source 10 | 7 | TDL-A, 5ns | 4.53/6.89 | 4.66/7.24 | 5.75/8.32 | 6.24/8.47 | 2.65/4.08 |
| TDL-A, 10ns | 2.79/5.42 | 2.95/5.76 | 3.99/6.06 | 4.40/6.97 | 2.51/4.27 |
| TDL-A, 20ns | 2.83/4.91 | 3.27/5.49 | 4.01/5.95 | 4.47/6.67 | 3.00/3.88 |
| 16 | TDL-A, 5ns | 11.77/14.46 | 11.09/13.69 | 11.70/13.55 | 12.18/13.90 | 9.85/12.34 |
| TDL-A, 10ns | 11.41/13.08 | 10.18/12.74 | 10.38/12.27 | 10.67/12.55 | 10.13/11.61 |
| TDL-A, 20ns | 10.99/12.40 | 10.10/12.19 | 10.21/12.39 | 11.16/13.19 | 10.24/10.96 |
| 22 | TDL-A, 5ns | 23.44/NaN | 19.39/NaN | 17.81/20.81 | 17.15/21.12 | 15.73/19.37 |
| TDL-A, 10ns | 23.72/NaN | 18.27/NaN | 16.74/19.62 | 16.11/17.74 | 15.87/18.84 |
| TDL-A, 20ns | 24.28/NaN | 18.83/NaN | 16.62/19.39 | 16.41/18.28 | 16.65/19.02 |
| Additional report/notes:  Normal CP  CPE compensation only  PTRS configuration: symbol 3-13, K=4, L=1  DMRS configuration: symbol 2  NaN in the table refers to a large SINR value exceeding the range of interest (i.e., >25 dB) | | | | | | |

Table B.1.1.10-2: SINR in dB achieving PDSCH BLER of 10% /1%

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz  New pattern  No comp | 120KHz /400MHz  New pattern  CPE comp | 120KHz /400MHz  New pattern  ICI comp | 120KHz /400MHz  R15 pattern  CPE comp |
| R1-2008873 / Source 10 | 22 | TDL-A, 5ns | NaN/NaN | 22.71/NaN | 18.79/22.05 | 23.45/NaN |
| TDL-A, 10ns | NaN/NaN | 22.68/NaN | 17.65/21.49 | 23.81/NaN |
| Additional report/notes:  Normal CP  PTRS configuration: Rel-15 pattern: K=4, L=1; new pattern: 1 RB in 50 RB chunk  DMRS configuration: symbol 2  NaN in the table refers to a large SINR value exceeding the range of interest (i.e., >25 dB) | | | | | |

Table B.1.1.10-3: SINR in dB achieving PDSCH BLER of 10% /1%

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 240KHz /400MHz  New pattern  No comp | 240KHz /400MHz  New pattern  CPE comp | 240KHz /400MHz  New pattern  ICI comp | 240KHz /400MHz  R15 pattern  CPE comp |
| R1-2008873 / Source 10 | 22 | TDL-A, 5ns | NaN/NaN | 19.25/NaN | 17.11/19.98 | 19.41/NaN |
| TDL-A, 10ns | NaN/NaN | 18.76/NaN | 16.20/19.16 | 18.29/NaN |
| Additional report/notes:  Normal CP  PTRS configuration: Rel-15 pattern: K=4, L=1; new pattern: 1 RB in 50 RB chunk  DMRS configuration: symbol 2  NaN in the table refers to a large SINR value exceeding the range of interest (i.e., >25 dB) | | | | | |

#### B.1.1.11 Source 11 [27]

Table B.1.1.11-1: SINR in dB achieving PDSCH/PUSCH BLER of 10% /1%

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 960KHz /400MHz | 960KHz /2GHz |
| R1-2008501/ Source 11 | 7 | TDL-A, 5ns | <6.0/6.5 |  |  | 6.0/8.0 |  |
| TDL-A, 10ns | <6.0/<6.0 |  |  | <6.0/7.5 |  |
| TDL-A, 20ns | <6.0/<6.0 |  |  | 6.0/7.5 |  |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| CDL-D, 20ns |  |  |  |  |  |
| CDL-D, 30ns |  |  |  |  |  |
| 16 | TDL-A, 5ns | 14.0/16.5 |  |  | 14.5/17.0 |  |
| TDL-A, 10ns | 13.5/15.5 |  |  | 14.5/16.5 |  |
| TDL-A, 20ns | 13.0/15.0 |  |  | 14.5/16.5 |  |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| CDL-D, 20ns |  |  |  |  |  |
| CDL-D, 30ns |  |  |  |  |  |
| 22 | TDL-A, 5ns | 23.0/29.0 |  |  | 20.0/22.5 |  |
| TDL-A, 10ns | 23.0/29.5 |  |  | 19.5/22.5 |  |
| TDL-A, 20ns | 23.0/30.0 |  |  | 21.5/25.0 |  |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| Additional report/notes:  CP type: Normal  Channel: TDL 2 x 2  PN Model: TR38.803 Example 2 UE profile.  PDSCH SLIV: S=2, L=12  Transmission rank: 1 (wideband, fixed precoding)  PTRS configuration: K=4, L=1  DMRS configuration: single DMRS symbol (front loaded)  Additional Notes:  A 3-tap ICI equalizer is assumed at the receiver side.  The SNR is defined per RX antenna (i.e., pre-combining)  SNR simulation range from 6dB to 30dB | | | | | | |

#### B.1.1.12 Source 12 [5]

Table B.1.1.12-1: SNR in dB achieving PDSCH BLER of 10% or 1% with ICI Compensation

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 960KHz /400MHz | 960KHz /2GHz |
| R1-2007549 / Source 12 | 7 | TDL-A, 5ns | 1.5 / 4.1 | 1.6 / 4.3 | 1.6 / 4.0 | 1.5 / 4.0 | -/- |
| TDL-A, 10ns | 1.0 / 3.2 | 1.0 / 3.2 | 1.2 / 3.4 | 1.2 / 3.3 | -/- |
| TDL-A, 20ns | 0.4 / 2.1 | 0.5 / 2.2 | 1.0 / 1.6 | 1.0 / 1.6 | -/- |
| CDL-B, 20ns | -/- | -/- | -/- | -/- | -/- |
| CDL-B, 50ns | -/- | -/- | -/- | -/- | -/- |
| CDL-D, 20ns | -/- | -/- | -/- | -/- | -/- |
| CDL-D, 30ns | -/- | -/- | -/- | -/- | -/- |
| 16 | TDL-A, 5ns | 10.0/12.2 | 9.9/12.1 | 9.8/12.1 | 9.5/11.9 | -/- |
| TDL-A, 10ns | 9.4/11.6 | 9.3/11.6 | 9.3/11.7 | 9.3/11.7 | -/- |
| TDL-A, 20ns | 9.0/10.8 | 9.1/10.5 | 9.5/11.5 | 10.2/13.2 | 10.2/12.4 |
| TDL-A, 40ns | 8.7/10.0 | 9.5/11.1 | 10.7/12.6 | 9.4/11.0  ECP | -/- |
| CDL-B, 20ns | -/- | -/- | -/- | -/- | -/- |
| CDL-B, 50ns | -/- | -/- | -/- | -/- | -/- |
| CDL-D, 20ns | -/- | -/- | -/- | -/- | -/- |
| CDL-D, 30ns | -/- | -/- | -/- | -/- | -/- |
| 22 | TDL-A, 5ns | 16.2/19.0 | 15.8/18.1 | 15.5/17.8 | 16.0/19.3 | -/- |
| TDL-A, 10ns | 15.7/17.9 | 15.2/17.5 | 15.3/18.2 | 15.5/18.2 | 14.7/15.9 |
| TDL-A, 20ns | 14.6/16.3 | 14.5/16.5 | 14.7/16.7 | 15.2/16.6 ECP | -/- |
| TDL-A, 40ns | 15.0/16.7 | 15.5/17.9 | 15.3/17.1ECP | 15.3/17.1 ECP | -/- |
| CDL-B, 20ns | -/- | -/- | -/- | -/- | -/- |
| CDL-B, 50ns | -9.8/-8.4 | -10/-8.6 | -9.4/-7.9 | -9.5/-8.1 ECP | -/- |
| CDL-D, 20ns | -/- | -/- | -/- | -/- | -/- |
| CDL-D, 30ns | -20.3/-19.0 | -20.5/-19.7 | -20.6/-19.8 | -19.8/-18.6 | -/- |
| Additional report/notes:  CP type: Normal, Extended (ECP)  Antenna configuration for TDL-A model 2x2  Antenna configuration for CDL model  Configuration 2:  - (Mg,Ng,M,N,P) = (1,1,4,8,2) BS with (0.5 dv, 0.5 dH)  - (Mg,Ng,M,N,P) = (1,1,2,2,2) UE with (0.5 dv, 0.5 dH)  Realistic channel estimation  Waveform in case of PUSCH N/A  PTRS configuration: (K = 2, L = 1)  DMRS configuration: 2 Symbols per slot  ICI Compensation with {1,3,5,7} FD filter taps for {960 kHz, 480kHz, 240 kHz, 120 kHz} SCS | | | | | | |

#### B.1.1.13 Source 13 [29]

Table B.1.1.13-1: SINR in dB achieving PDSCH/PUSCH BLER of 10% /1%

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 960KHz /400MHz | 960KHz /2GHz |
| R1-2009062 / Source 13 | 7 | TDL-A, 5ns | -1.23 / 0.97 | -1.26 / 0.55 | -1.15 / 0.70 | NCP:  -0.59 / 1.56  ECP:  -0.58 / 1.21 | NCP:  -1.31 / 0.02  ECP:  -1.43 / 0.00 |
| TDL-A, 10ns | -1.58 / -0.14 | -1.56 / -0.07 | -1.19 / 0.60 | NCP:  -0.52 / 1.33  ECP:  -0.52 / 1.20 | NCP:  -0.94 / 0.03  ECP:  -0.90 / 0.03 |
| TDL-A, 20ns | -1.60 / -0.37 | -1.40 / 0.01 | -0.86 / 0.04 | NCP:  -0.29 / 1.70  ECP:  -0.20 / 1.51 | NCP:  -0.83 / 0.04  ECP:  -0.94 / 0.51 |
| TDL-A, 40ns | -1.44 / -0.13 | -1.00 / 0.03 | -0.29 / 0.06 | NCP:  0.38 / 2.00  ECP:  0.44 / 2.00 | NCP:  0.13 / 1.36  ECP:  0.03 / 1.01 |
| CDL-B, 20ns | -8.55 / -6.40 | -8.71 / -7.00 | -8.67 / -6.80 | NCP:  -8.14 / -6.31  ECP:  -8.03 / -6.06 | NCP:  -8.18 / -6.19  ECP:  -8.26 / -6.05 |
| CDL-B, 50ns | -8.74 / -6.92 | -8.61 / -6.70 | -8.38 / -6.27 | NCP:  -7.67 / -5.36  ECP:  -7.47 / -5.53 | NCP:  -7.48 / -5.32  ECP:  -7.45 / -5.21 |
| CDL-D, 20ns | -23.03 / -22.93 | -23.00 / -22.93 | -23.19 / -22.93 | NCP:  -22.99 / -22.93  ECP:  -22.99 / -22.92 | NCP:  -22.99 / -22.92  ECP:  -22.98 / -22.91 |
| CDL-D, 30ns | -23.00 / -22.93 | -23.00 / -22.93 | -23.19 / -22.94 | NCP:  -22.99 / -23.93  ECP:  -22.99 / -22.92 | NCP:  -22.99 / -23.92  ECP:  -22.98 / -22.91 |
| 16 | TDL-A, 5ns | 6.79 / 8.94 | 6.83 / 8.71 | 7.20 / 9.64 | NCP:  8.13 / 11.09  ECP:  7.52 / 10.50 | NCP:  8.30 / 15.27  ECP:  7.97 / 12.42 |
| TDL-A, 10ns | 6.42 / 8.00 | 6.62 / 8.01 | 7.32 / 9.30 | NCP:  8.18 / 11.15  ECP:  7.74 / 10.00 | NCP:  8.88 / 15.59  ECP:  8.62 / 13.06 |
| TDL-A, 20ns | 6.59 / 8.01 | 6.93 / 8.03 | 7.65 / 9.59 | NCP:  8.40 / 11.32  ECP:  8.02 / 9.91 | NCP:  9.16 / 18.00  ECP:  8.87 / 13.54 |
| TDL-A, 40ns | 6.74 / 8.01 | 7.45 / 9.19 | 8.03 / 10.15 | NCP:  9.35 / 13.20  ECP:  8.58 / 10.89 | NCP:  10.09 / x  ECP:  9.58 / 16.95 |
| CDL-B, 20ns | -0.31 / 1.62 | -0.54 / 1.51 | -0.17 / 2.33 | NCP:  0.19 / 2.66  ECP:  -0.13 / 2.45 | NCP:  1.22 / 9.31  ECP:  0.88 / 5.00 |
| CDL-B, 50ns | -0.20 / 1.68 | -0.38 / 1.84 | 0.12 / 2.28 | NCP:  0.89 / 3.74  ECP:  0.50 / 3.00 | NCP:  1.96 / 15.00  ECP:  1.63 / 6.45 |
| CDL-D, 20ns | -14.97 / -14.90 | -14.97 / -14.90 | -14.97 / -14.90 | NCP:  -14.96 / -14.90  ECP:  -14.96 / -14.90 | NCP:  -14.33 / -13.38  ECP:  -14.27 / -13.29 |
| CDL-D, 30ns | -14.97 / --14.90 | -14.97 / -14.90 | -14.97 / --14.90 | NCP:  -14.96 / -14.90  ECP:  -14.96 / -14.90 | NCP:  -14.26 / -13.23  ECP:  -14.29 / -13.37 |
| 22 | TDL-A, 5ns | 17.38 / x | 18.52 / x | 23.84 / x | NCP:  25.11 / x  ECP:  22.00 / x | NCP:  x / x  ECP:  x / x |
| TDL-A, 10ns | 18.48 / x | 19.66 / x | 30.32 / x | NCP:  30.79 / x  ECP:  26.24 / x | NCP:  x / x  ECP:  x / x |
| TDL-A, 20ns | 18.66 / x | 20.22 / x | x / x | NCP:  x / x  ECP:  x / x | NCP:  x / x  ECP:  x / x |
| TDL-A, 40ns | 19.87 / x | 22.64 / x | x / x | NCP:  x / x  ECP:  x / x | NCP:  x / x  ECP:  x / x |
| CDL-B, 20ns | 12.36 / x | 15.35 / x | 31.00 / x | NCP:  29.32 / x  ECP:  22.31 / x | NCP:  x / x  ECP:  x / x |
| CDL-B, 50ns | 13.74 / x | 15.78 / | x / x | NCP:  x / x  ECP:  40.00 / x | NCP:  x / x  ECP:  x / x |
| CDL-D, 20ns | -6.94 / -0.05 | -7.21 / -1.00 | -7.34 / x | NCP:  -7.34 / x  ECP:  -7.27 / x | NCP:  x / x  ECP:  x / x |
| CDL-D, 30ns | -6.68 / x | -7.32 / -2.40 | -7.24 / x | NCP:  -7.29 / x  ECP:  -7.20 / x | NCP:  x / x  ECP:  x / x |
| Additional report/notes:  CP type:  For 960 kHz, ECP is also investigated in addition to normal CP.  antenna configuration for CDL model  Antenna configuration: (1,1,8,16,2)  PTRS configuration  K = 2, L = 1  DMRS configuration  1 symbol front-loaded DMRS  Note: “x” in the table means the target BLER level cannot be reached. | | | | | | |

#### B.1.1.14 Source 14 [16]

Table B.1.1.14-1: SINR in dB achieving PDSCH BLER of 10% /1%

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 960KHz /400MHz | 960KHz /2GHz |
| R1-2009379 / Source 14 | 7 | TDL-A, 5ns | 3.13 / 5.37 | 2.76 / 5.23 | 2.68 / 4.99 | 2.80 / 5.20 | 2.12 / 3.92 |
| TDL-A, 10ns | 2.56 / 4.55 | 2.23 / 4.26 | 2.20 / 4.24 | 2.42 / 4.56 | 2.04 / 3.56 |
| TDL-A, 20ns | 2.18 / 3.96 | 2.05 / 3.83 | 2.01 / 3.83 | 2.23 / 4.11 | 2.01 / 3.42 |
| CDL-B, 20ns | 15.56/17.65 | 15.17/ 17.36 | 15.01/ 17.11 | 15.20/ 17.32 | 14.85/ 16.60 |
| CDL-B, 50ns | 15.37/ 17.33 | 15.26/ 17.11 | 15.18/ 17.22 | 15.33/ 17.24 | 15.19/ 16.79 |
| CDL-D, 20ns | 4.75/ 5.73 | 4.69/ 5.60 | 4.56/ 5.44 | 4.70/ 5.63 | 4.90/ 5.91 |
| CDL-D, 30ns | 4.75/ 5.74 | 4.70/ 5.62 | 4.60/ 5.46 | 4.75/ 5.67 | 4.93/ 5.95 |
| 16 | TDL-A, 5ns | 11.79 / 14.38 | 11.60 / 14.08 | 11.58 / 14.11 | 11.88 / 14.66 | 10.17 / 12.07 |
| TDL-A, 10ns | 11.32 /13.53 | 11.07 / 13.20 | 11.30 / 13.58 | 11.98 /15.24 | 10.36 / 12.27 |
| TDL-A, 20ns | 11.16 / 13.36 | 10.90 / 12.97 | 11.36 / 14.03 | 13.87 / NA | 12.17 / 16.32 |
| CDL-B, 20ns | 24.71/ 27.26 | 24.52/ 26.91 | 24.60/ 27.56 | 25.23/ 28.47 | 23.46/ 25.64 |
| CDL-B, 50ns | 24.76/ 27.24 | 24.55/ 26.86 | 24.87/ 28.04 | 25.86/29.74 | 24.11/ 26.76 |
| CDL-D, 20ns | 12.94/14.15 | 12.51/ 13.54 | 12.29/ 12.9 | 12.16/ 12.9 | 12.03/ 12.97 |
| CDL-D, 30ns | 12.95/ 14.17 | 12.53/ 13.51 | 12.32/ 13.2 | 12.19/13.1 | 12.08/13.00 |
| 22 | TDL-A, 5ns | NA / NA | NA / NA | 17.90 / 22.80 | 17.49/20.92 | 17.20 / 21.28 |
| TDL-A, 10ns | NA / NA | NA / NA | 18.40 / 23.00 | 19.19 / NA | 19.62 / NA |
| TDL-A, 20ns | NA / NA | NA / NA | 20.95 / NA | NA / NA | NA / NA |
| CDL-B, 20ns | NA/NA | NA/NA | 31.35/ 38.23 | 30.53/34.15 | 30.62/ 36.28 |
| CDL-B, 50ns | NA/NA | NA/NA | 32/NA | 33.27/ NA | 34.84/ NA |
| CDL-D, 20ns | NA/NA | 22.54/ NA | 18.25/ 19.94 | 17.31/ 18.33 | 18.25/ 20.33 |
| CDL-D, 30ns | NA/NA | 22.67/ NA | 18.36/20.07 | 17.46/ 18.47 | 18.44/ 20.38 |
| First and second entry corresponds to SNR required to meet 10% and 1% BLER.  NA refers to PDSCH performance that were not able to achieve 10% or 1% BLER  Additional report/notes:  CP type: Normal CP  antenna configuration for CDL model: Antenna configuration 2  PTRS configuration: (K=4, L=1) PTRS per K number of PRBs, and PTRS every L number of OFDM symbols  DMRS configuration: Type 1 DMRS  any optional or other assumption/parameters used not as in the baseline: For the SNR of CDL models, beamforming gain of Tx and Rx was added, where beamforming gain was computed as ‘10·log10( #elements) [dB] + antenna element beam gain [dBi]’ | | | | | | |

Table B.1.1.14-2: SINR in dB achieving PDSCH BLER of 10% /1% (without DMRS OCC)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 960KHz /400MHz | 960KHz /2GHz |
| R1-2009379 / Source 14 | 7 | TDL-A, 5ns | 3.13 / 5.37 | 2.76 / 5.23 | 2.68 / 4.99 | 2.80 / 5.20 | 2.12 / 3.92 |
| TDL-A, 10ns | 2.56 / 4.55 | 2.23 / 4.26 | 2.20 / 4.24 | 2.42 / 4.56 | 2.04 / 3.56 |
| TDL-A, 20ns | 2.18 / 3.96 | 2.05 / 3.83 | 2.01 / 3.83 | 2.23 / 4.11 | 2.01 / 3.42 |
| CDL-B, 20ns | 5.48 / 7.58 | 5.10 / 7.29 | 4.94 / 7.04 | 5.13 / 7.25 | 4.78 / 6.52 |
| CDL-B, 50ns | 5.30 / 7.26 | 5.19 / 7.04 | 5.11 / 7.15 | 5.26 / 7.17 | 5.12 / 6.72 |
| CDL-D, 20ns | 3.64 / 4.61 | 3.57 / 4.52 | 3.45 / 4.35 | 3.50 / 4.35 | 3.64 / 4.59 |
| CDL-D, 30ns | 3.63 / 4.60 | 3.57 / 4.53 | 3.47 / 4.38 | 3.51 / 4.36 | 3.66 / 4.64 |
| 16 | TDL-A, 5ns | 11.79 / 14.38 | 11.60 / 14.08 | 11.61 / 14.15 | 11.87 / 14.58 | 10.08 / 11.87 |
| TDL-A, 10ns | 11.32 /13.53 | 11.07 / 13.20 | 11.17 / 13.20 | 11.44 / 14.08 | 9.87 / 11.35 |
| TDL-A, 20ns | 11.16 / 13.36 | 10.90 / 12.97 | 10.76 / 12.60 | 11.12 / 13.35 | 9.79 / 11.32 |
| CDL-B, 20ns | 24.71/ 27.26 | 24.52/ 26.91 | 24.70/ 27.99 | 25.25/28.51 | 23.41/ 25.63 |
| CDL-B, 50ns | 24.76/ 27.24 | 24.55/ 26.86 | 24.87/ 27.94 | 25.53/ 29.16 | 23.66/ 25.72 |
| CDL-D, 20ns | 12.94/14.15 | 12.51/ 13.54 | 12.29/ NA | 12.16/ NA | 12.05/12.99 |
| CDL-D, 30ns | 12.95/ 14.17 | 12.53/ 13.51 | 12.24/ NA | 12.12/ NA | 12.01/12.95 |
| 22 | TDL-A, 5ns | NA / NA | NA / NA | 17.75 / 21.81 | 16.93 / 19.65 | 16.54 / 19.66 |
| TDL-A, 10ns | NA / NA | NA / NA | 17.80 / 20.00 | 16.48 / 18.95 | 16.45 / 19.71 |
| TDL-A, 20ns | NA / NA | NA / NA | 17.12 / 21.66 | 16.48 / 18.83 | 16.74 / 20.72 |
| CDL-B, 20ns | NA/NA | NA/NA | 31.35/ 38.83 | 30.20/ 33.41 | 30.2/ 33.4 |
| CDL-B, 50ns | NA/NA | NA/NA | 31.38/ 38.60 | 30.4/34.1 | 30.42/ 34.15 |
| CDL-D, 20ns | NA/NA | 22.54/ NA | 18.33/ 20.10 | 17.39/ 18.40 | 18.33/ 20.10 |
| CDL-D, 30ns | NA/NA | 22.67/ NA | 18.29/19.95 | 17.38/ 18.40 | 18.37/ 20.54 |
| First and second entry corresponds to SNR required to meet 10% and 1% BLER.  NA refers to PDSCH performance that were not able to achieve 10% or 1% BLER  Additional report/notes:  CP type: Normal CP  antenna configuration for CDL model: Antenna configuration 2  PTRS configuration: (K=4, L=1) PTRS per K number of PRBs, and PTRS every L number of OFDM symbols  DMRS configuration: Type 1 DMRS  any optional or other assumption/parameters used not as in the baseline: Frequency domain OCC for DMRS was disabled. For the SNR of CDL models, beamforming gain of Tx and Rx was added, where beamforming gain was computed as ‘10·log10( #elements) [dB] + antenna element beam gain [dBi]’. | | | | | | |

Table B.1.1.14-3: SINR in dB achieving PDSCH BLER of 10% /1% (Rank 2 without DMRS OCC)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 960KHz /400MHz | 960KHz /2GHz |
| R1-2009379 / Source 14 | 7 | TDL-A, 1ns |  |  |  |  |  |
| TDL-A, 5ns |  |  |  |  |  |
| TDL-A, 20ns |  |  |  |  |  |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| CDL-D, 20ns |  |  |  |  |  |
| CDL-D, 30ns |  |  |  |  |  |
| 16 | TDL-A, 1ns | 23.81/ NA | 20.80/ NA | 19.8/25 | 19.5/24.5 |  |
| TDL-A, 5ns | 21.1/NA | 19.35/ NA | 18.5/20.9 | 18.2/20.9 |  |
| TDL-A, 20ns |  |  |  |  |  |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| CDL-D, 20ns | 16.22/17.26 | 16.21/17.47 | 15.54/ 16.54 | 15.50/ 16.52 |  |
| CDL-D, 30ns |  |  |  |  |  |
| 22 | TDL-A, 1ns |  |  |  |  |  |
| TDL-A, 5ns |  |  |  |  |  |
| TDL-A, 20ns |  |  |  |  |  |
| CDL-B, 20ns | NA/NA | NA/NA | 24.73/ NA | 21.75/ 26.46 |  |
| CDL-B, 50ns |  |  |  |  |  |
| CDL-D, 20ns |  |  |  |  |  |
| CDL-D, 30ns |  |  |  |  |  |
| First and second entry corresponds to SNR required to meet 10% and 1% BLER.  NA refers to PDSCH performance that were not able to achieve 10% or 1% BLER  Additional report/notes:  CP type: Normal CP  antenna configuration for CDL model: Antenna configuration 2  PTRS configuration: (K=4, L=1) PTRS per K number of PRBs, and PTRS every L number of OFDM symbols  DMRS configuration: Type 1 DMRS  any optional or other assumption/parameters used not as in the baseline: Frequency domain OCC for DMRS was disabled. For the SNR of CDL models, beamforming gain of Tx and Rx was added, where beamforming gain was computed as ‘10·log10( #elements) [dB] + antenna element beam gain [dBi]’. Transmission Rank 2 was used. | | | | | | |

#### B.1.1.15 Source 15 [71]

Table B.1.1.15-1: SINR in dB achieving PDSCH BLER of 10%

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 960KHz /400MHz | 960KHz /2GHz |
| R1-2009157 / Source 15 | 7 | TDL-A, 5ns | 4.8 | 4.3 | 3.6 | 2.6 | 2.7 |
| TDL-A, 10ns | 4.4 | 4.0 | 3.6 | 3.0 | 2.4 |
| TDL-A, 20ns | 4.0 | 3.7 | 3.4 | 3.1 | 2.9 |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| CDL-D, 20ns |  |  |  |  |  |
| CDL-D, 30ns |  |  |  |  |  |
| 16 | TDL-A, 5ns | 13.3 | 12.6 | 11.4 | 10.7 | 10.6 |
| TDL-A, 10ns | 13.0 | 12.3 | 11.4 | 10.4 | 10.2 |
| TDL-A, 20ns | 12.7 | 12.1 | 11.2 | 11.8 | 11.4 |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| CDL-D, 20ns |  |  |  |  |  |
| CDL-D, 30ns |  |  |  |  |  |
| 22 | TDL-A, 5ns | N/A | N/A | 19.3 | 16.5 | 17.5 |
| TDL-A, 10ns | N/A | N/A | 19.5 | 17.1 | 17.3 |
| TDL-A, 20ns | N/A | N/A | 19.8 | 27.4 | 29.8 |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| Additional report/notes:  Realistic CPE compensation and CE  PT-RS config K = 2, L = 1 | | | | | | |

#### B.1.1.16 Source 16 [61]

Table B.1.1.16-1: SINR in dB achieving PDSCH/PUSCH BLER of 10% /1%

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 960KHz /400MHz | 960KHz /2GHz |
| R1-2007792 / Source 16 | 7 | TDL-A, 5ns | 3.1 /5.2 | 3.3 /4.6 | 3.0 /4.6 | 3.6 /5.3 | 2.1 /2.7 |
| TDL-A, 10ns | 2.6 /4.3 | 2.6 /4.2 | 2.8 /4.5 | 3.1 /4.5 | 2.1 /2.7 |
| TDL-A, 20ns | 2.4 /3.6 | 2.5 /4.1 | 2.6 /4.2 | 3.1 /4.6 | 2.2 /2.7 |
| CDL-B, 20ns | 4.6 /9.5 | 4.4 /10.2 | 4.5 /10.1 | 4.7 /10.4 | 4.3 /10.2 |
| CDL-B, 50ns | 4.6 /9.6 | 4.6 /10.2 | 4.9 /10.9 | 5.2 /11.0 | 4.8 /11.0 |
| CDL-D, 20ns |  |  |  |  |  |
| CDL-D, 30ns |  |  |  |  |  |
| 16 | TDL-A, 5ns | 11.8 /13.9 | 11.4 /13.6 | 11.0 /13.0 | 11.8 /13.8 | 10.1 /11.2 |
| TDL-A, 10ns | 11.2 /12.9 | 11.0 /12.7 | 10.6 /12.2 | 11.0 /12.6 | 10.1 /10.8 |
| TDL-A, 20ns | 10.8 /12.3 | 10.6 /12.1 | 10.3 /11.5 | 10.8 /12.4 | 10.1 /10.7 |
| CDL-B, 20ns | 12.6 /18.4 | 13.2 /18.8 | 12.6 /18.1 | 12.6 /18.2 | 12.8 /18.8 |
| CDL-B, 50ns | 12.6 /18.4 | 13.3 /18.8 | 12.9 /18.5 | 13.2 /22.4 | 13.6 /22.7 |
| CDL-D, 20ns |  |  |  |  |  |
| CDL-D, 30ns |  |  |  |  |  |
| 22 | TDL-A, 5ns | n/a /n/a | 25.6 /n/a | 18.7 /23.3 | 18.0 /20.1 | 17.0 /20.3 |
| TDL-A, 10ns | n/a /n/a | 27.0 /n/a | 18.1 /22.5 | 17.0 /19.0 | 17.0 /20.1 |
| TDL-A, 20ns | n/a /n/a | 27.4 /n/a | 17.8 /22.1 | 17.0 /18.6 | 17.3 /21.2 |
| CDL-B, 20ns | n/a /n/a | 29.5 /n/a | 19.1 /25.8 | 17.5 /23.1 | 18.8 /27.4 |
| CDL-B, 50ns | n/a /n/a | n/a /n/a | 19.5 /n/a | 19.6 /n/a | 21.7 /n/a |
| CDL-D, 20ns |  |  |  |  |  |
| CDL-D, 50ns |  |  |  |  |  |
| - CP type: short CP  - Antenna configuration for CDL model: (Mg,Ng,M,N,P) = (1,1,4,8,2) with (0.5 dv, 0.5 dH) for BS and (Mg,Ng,M,N,P) = (1,1,2,2,2) with (0.5 dv, 0.5 dH) for UE  - PTRS configuration: K = 2, L = 1  - DMRS configuration: Type-1 DM-RS with 1 front-loaded DM-RS and 1 additional DM-RS symbol at (2,11) symbol index | | | | | | |

#### B.1.1.17 Source 17 [19]

Table B.1.1.17-1: SINR in dB achieving PDSCH BLER of 10% /1% with CPE compensation

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 960KHz /400MHz | 960KHz /2GHz |
| R1-2009653 / Source 17 | 7 | TDL-A, 5ns |  |  |  |  |  |
| TDL-A, 10ns |  |  |  |  |  |
| TDL-A, 20ns |  |  |  |  |  |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| CDL-D, 20ns |  |  |  |  |  |
| CDL-D, 30ns |  |  |  |  |  |
| 16 | TDL-A, 5ns |  |  |  |  |  |
| TDL-A, 10ns |  |  |  |  |  |
| TDL-A, 20ns |  |  |  |  |  |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| CDL-D, 20ns |  |  |  |  |  |
| CDL-D, 30ns |  |  |  |  |  |
| 22 | TDL-A, 5ns | 23.3 / 31.6 | 20.9 / 24.9 | 19.7 / 22.7 | 19.3 / 22.2 |  |
| TDL-A, 10ns | 22.9 / 28.6 | 20.7 / 24.4 | 19.3 / 22.1 | 18.7 / 21.3 |  |
| TDL-A, 20ns | 22.6 / 29.2 | 20.4 / 23.7 | 18.9 / 21.3 | 19.5 / 22.7 |  |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| Additional report/notes:  CP type: Normal CP  antenna configuration for CDL model  waveform in case of PUSCH  PTRS configuration: K=2, L=1  DMRS configuration: 1 DMRS symbol (front loaded)  any optional or other assumption/parameters used not as in the baseline  Antenna configuration for TDL: 1x2 | | | | | | |

Table B.1.1.17-2: SINR in dB achieving PDSCH BLER of 10% /1% with ICI compensation

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | MCS | Channel | 120KHz /400MHz | 240KHz /400MHz | 480KHz /400MHz | 960KHz /400MHz | 960KHz /2GHz |
| R1-2009653 / Source 17 | 7 | TDL-A, 5ns |  |  |  |  |  |
| TDL-A, 10ns |  |  |  |  |  |
| TDL-A, 20ns |  |  |  |  |  |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| CDL-D, 20ns |  |  |  |  |  |
| CDL-D, 30ns |  |  |  |  |  |
| 16 | TDL-A, 5ns |  |  |  |  |  |
| TDL-A, 10ns |  |  |  |  |  |
| TDL-A, 20ns |  |  |  |  |  |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| CDL-D, 20ns |  |  |  |  |  |
| CDL-D, 30ns |  |  |  |  |  |
| 22 | TDL-A, 5ns | 21.8 / 25.8 | 20.2 / 23.5 | 19.8 / 22.7 | 20.0 / 22.8 |  |
| TDL-A, 10ns | 21.3 / 25.2 | 19.8 / 22.5 | 19.3 / 22.0 | 19.5 / 22.1 |  |
| TDL-A, 20ns | 20.8 / 24.0 | 19.4 / 21.9 | 18.9 / 21.4 | 20.5 / 24.1 |  |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| CDL-B, 20ns |  |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |  |
| Additional report/notes:  CP type: Normal CP  antenna configuration for CDL model  waveform in case of PUSCH  PTRS configuration: K=2, L=1, ICI compensation with 3 taps  DMRS configuration: 1 DMRS symbol (front loaded)  any optional or other assumption/parameters used not as in the baseline  Antenna configuration for TDL: 1x2 | | | | | | |

### B.1.2 Evaluation results for PSS/SSS

#### B.1.2.1 Source 1 [65]

Table B.1.2.1-1: SINR in dB achieving cell ID detection probability of 90% by one-shot detection from PSS/SSS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Channel | 120KHz | 240KHz | 480KHz | 960KHz |
| R1-2007984 / Source 1 | TDL-A, 5ns | -5.4 | -5.3 | -5.1 | -4.8 |
| TDL-A, 10ns | -5.4 | -5.4 | -4.8 | -4.4 |
| TDL-A, 20ns | -5.4 | -4.9 | -4.3 | -4.3 |
| TDL-A, 40ns | -5.1 | -4.6 | -4.1 | -4.0 |
| CDL-B, 20ns |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |
| CDL-D, 20ns |  |  |  |  |
| CDL-D, 30ns |  |  |  |  |
| Additional report/notes:  frequency offset: 10ppm  the number and granularity of the frequency locations: -x...x, with granularity SCS/2 where x=ceil(freq\_error/SCS)\*SCS for coarse search followed by refinement using hypothesis bi-section  antenna configuration for CDL model: N/A  any optional or other assumption/parameters used not as in the baseline: Medium antenna correlation. Every 4th SSB use one of the following precoders sqrt(1/2) [1 1], [1 j], [1 -1] and [1 -j].  false alarm rate: 1%  criteria for PSS detection success: Correct cell ID and frequency offset estimate error is less than SCS/4.  Simulation duration: 5000 SS/PBCH blocks | | | | |

Table B.1.2.1-2: SINR in dB achieving PBCH BLER of 10%, using 1 transmission.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Channel | 120KHz | 240KHz | 480KHz | 960KHz |
| R1-2007984 / Source 1 | TDL-A, 5ns | -5.0 | -5.3 | -5.2 | -4.7 |
| TDL-A, 10ns | -5.3 | -5.3 | -4.9 | -4.1 |
| TDL-A, 20ns | -5.3 | -5.0 | -4.4 | -4.1 |
| TDL-A, 40ns | -5.0 | -4.5 | -4.3 | -3.9 |
| CDL-B, 20ns |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |
| CDL-D, 20ns |  |  |  |  |
| CDL-D, 30ns |  |  |  |  |
| Additional report/notes:  Single PBCH transmission  Table shows SINR required for 10% PBCH BLER  frequency offset: 10ppm  the number and granularity of the frequency locations: -x...x, with granularity SCS/2 where x=ceil(freq\_error/SCS)\*SCS for coarse search followed by refinement using hypothesis bi-section  antenna configuration for CDL model: N/A  any optional or other assumption/parameters used not as in the baseline: Medium antenna correlation. Every 4th SSB use one of the following precoders sqrt(1/2) [1 1], [1 j], [1 -1] and [1 -j].  false alarm rate: 1%  criteria for PSS detection success: Correct cell ID and frequency offset estimate error is less than SCS/4.  Simulation duration: 5000 SS/PBCH blocks | | | | |

Table B.1.2.1-3: SINR in dB achieving PBCH BLER of 10%, using 4 transmissions.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Channel | 120KHz | 240KHz | 480KHz | 960KHz |
| R1-2007984 / Source 1 | TDL-A, 5ns | -10.4 | -10.4 | -10.2 | -9.8 |
| TDL-A, 10ns | -10.3 | -10.3 | -9.9 | -9.5 |
| TDL-A, 20ns | -10.0 | -10.0 | -9.6 | -8.9 |
| TDL-A, 40ns | -9.9 | -9.6 | -9.0 | -8.3 |
| CDL-B, 20ns |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |
| CDL-D, 20ns |  |  |  |  |
| CDL-D, 30ns |  |  |  |  |
| Additional report/notes:  4 PBCH transmissions  Table shows SINR required for 10% PBCH BLER  frequency offset: 10ppm  the number and granularity of the frequency locations: -x...x, with granularity SCS/2 where x=ceil(freq\_error/SCS)\*SCS for coarse search followed by refinement using hypothesis bi-section  antenna configuration for CDL model: N/A  any optional or other assumption/parameters used not as in the baseline: Medium antenna correlation. Every 4th SSB use one of the following precoders sqrt(1/2) [1 1], [1 j], [1 -1] and [1 -j].  false alarm rate: 1%  criteria for PSS detection success: Correct cell ID and frequency offset estimate error is less than SCS/4.  Simulation duration: 5000 SS/PBCH blocks | | | | |

Table B.1.2.1-4: Link budget for PBCH, 1 transmission, TDL-A 3km/h 20ns, using no FDM with RMSI (SSB/CORESET 0 multiplexing pattern 1)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| R1-2007984 / Source 1 | Number of Tx tries | 1 tx-try | 1 tx-try | 1 tx-try | 1 tx-try |
| Delay Spread [ns] | 20 | 20 | 20 | 20 |
| SCS [kHz] | 120 | 240 | 480 | 960 |
| Bandwidth [MHz] | 28.8 | 57.6 | 115.2 | 230.4 |
| Noise level [dBm] 1) | -89.4 | -86.4 | -83.4 | -80.4 |
| Required SNR [dB] 2) | -5.3 | -5.0 | -4.4 | -4.1 |
| Tx antenna gain [dBi] 3) | 20 | 20 | 20 | 20 |
| Rx antenna gain [dBi] 3) | 6 | 6 | 6 | 6 |
| Max Tx power (according to regulations) [dBm] 4) | 17.6 | 20.0 | 20.0 | 20.0 |
| Transmit Power [dBm] 5) | 17.6 | 20.0 | 20.0 | 20.0 |
| Maximum coupling loss (MCL) [dB] 6) | 112.3 | 111.4 | 107.8 | 104.5 |
| Maximum isotropic loss (MIL) [dB] 7) | 138.3 | 137.4 | 133.8 | 130.5 |
| Table shows link budget for PBCH, 1 transmission, TDL-A 3km/h 20ns, using no FDM with RMSI (SSB/CORESET 0 multiplexing pattern 1)  1) Over used subcarriers, assuming a noise figure of 10 dB and thermal noise spectral density of  -174 dBm/Hz. 2) SNR required to have 10% BLER for 1Tx/Rx x-pol pair. 3) Element gain + beamforming gain. Assumes Antenna Configuration 2 in the link level evaluation assumptions in TR 38.808 for BS and UE. For BS, 20 dBi antenna gain is used: (10\*log10(4x8) + 5 (element gain) = 20. For the UE, 6 dBi gain is used which assumes that the UE uses wider beams during initial access for SSB reception (reduction from 11 dBi). 4) Considering ETSI/FCC EIRP limit of 40 dBm, ETSI BRAN (EIRP) PSD limits of 23 dB/MHz, FCC conducted power limit of 27 dBm above 100 MHz and with proportionally reduced power below 100 MHz. 5) Equals Max Tx power (according to regulations) 6) MCL (Max Tx power) (noise level) (required SNR) 7) MIL MCL (Tx antenna gain) (Rx antenna gain) | | | | |

#### B.1.2.2 Source 3 [30]

Table B.1.2.2-1: CINR in dB achieving PSS detection probability of 90%: one-shot, 5ppm

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Channel | 120KHz | 240KHz | 480KHz | 960KHz |
| R1-2008615 / Source 3 | TDL-A, 5ns | -1.0 | -1.5 | -1.2 | 0.0 |
| TDL-A, 10ns | -0.9 | -1.2 | -0.2 | 0.3 |
| TDL-A, 20ns | -0.5 | -0.9 | 0.7 | 0.6 |
| CDL-B, 20ns (Cfg. 1) | -6.6 | -7.1 | -6.6 | -5.8 |
| CDL-B, 50ns (Cfg. 1) | -6.5 | -6.5 | -6.2 | -5.1 |
| CDL-D, 20ns (Cfg. 1) | -19.9 | -20.1 | -20.3 | -19.9 |
| CDL-D, 30ns (Cfg. 1) | -19.8 | -20.1 | -20.2 | -20.1 |
| CDL-B, 20ns (Cfg. 2) | -0.8 | -0.8 | -0.5 | 0.6 |
| CDL-B, 50ns (Cfg. 2) | -0.5 | -0.5 | 0.5 | 1.7 |
| CDL-D, 20ns (Cfg. 2) | -7.7 | -8.2 | -8.3 | -7.8 |
| CDL-D, 30ns (Cfg. 2) | -7.9 | -8.2 | -8.3 | -7.8 |
| Additional report/notes:  Frequency offset: 5ppm  the number and granularity of the frequency locations:  antenna configuration for CDL model: Config 1 and Config 2  any optional or other assumption/parameters used not as in the baseline  false alarm rate: less than 1%  criteria for PSS detection success: residual timing error within a range of and a residual frequency error within a range of | | | | |

Table B.1.2.2-2: CINR in dB achieving PSS detection probability of 90%: one-shot, 10ppm

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Channel | 120KHz | 240KHz | 480KHz | 960KHz |
| R1-2008615 / Source 3 | TDL-A, 5ns | -1.2 | -1.2 | -1.0 | -0.3 |
| TDL-A, 10ns | -1.3 | -1.0 | 0.0 | -0.2 |
| TDL-A, 20ns | -0.7 | -0.3 | 0.6 | -0.2 |
| CDL-B, 20ns (Cfg. 1) | -7.2 | -6.5 | -6.8 | -6.3 |
| CDL-B, 50ns (Cfg. 1) | -6.8 | -6.1 | -6.0 | -5.4 |
| CDL-D, 20ns (Cfg. 1) | -20.1 | -19.7 | -20.3 | -20.5 |
| CDL-D, 30ns (Cfg. 1) | -20.1 | -19.7 | -20.2 | -20.5 |
| CDL-B, 20ns (Cfg. 2) | -1.2 | -0.5 | -0.3 | 0.2 |
| CDL-B, 50ns (Cfg. 2) | -1.1 | 0.0 | 0.2 | 1.2 |
| CDL-D, 20ns (Cfg. 2) | -7.9 | -7.6 | -8.2 | -8.3 |
| CDL-D, 30ns (Cfg. 2) | -7.9 | -7.8 | -8.2 | -8.2 |
| Additional report/notes:  Frequency offset: 10ppm  the number and granularity of the frequency locations:  antenna configuration for CDL model: Config 1 and Config 2  any optional or other assumption/parameters used not as in the baseline  false alarm rate: less than 1%  criteria for PSS detection success: residual timing error within a range of and a residual frequency error within a range of | | | | |

Table B.1.2.2-3: CINR in dB achieving PBCH BLER of 10% ∕ 1%

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Channel | 120KHz | 240KHz | 480KHz | 960KHz |
| R1-2008615 / Source 3 | TDL-A, 5ns | -6.3/-1.3 | -6.4/-2.3 | -6.1/-2.1 | -6.1/-2.2 |
| TDL-A, 10ns | -6.3/-2.3 | -6.3/-2.1 | -6.1/-2.2 | -6.4/-3.0 |
| TDL-A, 20ns | -6.1/-1.8 | -5.9/-1.9 | -6.4/-3.2 | -6.7/-4.0 |
| CDL-B, 20ns (Cfg. 1) | -12.8/-5.3 | -12.4/-5.5 | -12.2/-5.3 | -12.0/-5.3 |
| CDL-B, 50ns (Cfg. 1) | -12.6/-5.6 | -12.2/-5.4 | -11.7/-4.9 | -11.3/-4.3 |
| CDL-D, 20ns (Cfg. 1) | -25.2/-20.2 | -25.1/-20.2 | -25.2/-20.1 | -25.2/-20.3 |
| CDL-D, 30ns (Cfg. 1) | -25.1/-20.1 | -25.2/-20.3 | -25.2/-20.1 | -25.2/-20.2 |
| CDL-B, 20ns (Cfg. 2) | -7.0/-0.3 | -6.8/-0.5 | -6.5/-0.7 | -6.1/-0.5 |
| CDL-B, 50ns (Cfg. 2) | -6.6/-0.8 | -6.4/-0.9 | -5.7/-0.2 | -4.9/ 0.7 |
| CDL-D, 20ns (Cfg. 2) | -13.0/ -7.9 | -13.2/-7.7 | -12.9/-7.5 | -12.6/-7.1 |
| CDL-D, 30ns (Cfg. 2) | -12.9/-7.9 | -13.0/-7.6 | -12.7/-7.2 | -12.5/-6.5 |
| Additional report/notes:  frequency offset: 5ppm  antenna configuration for CDL model: Config 1 and Config 2  any optional or other assumption/parameters used not as in the baseline: genie PSS/SSS | | | | |

#### B.1.2.3 Source 4 [60]

Table B.1.2.3-1: SINR in dB achieving cell ID detection probability of 90% by one-shot detection from PSS/SSS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Channel | 120KHz | 240KHz | 480KHz | 960KHz |
| R1-2007654 / Source 4 | TDL-A, 5ns | -5.5 | -5.8 | -5.8 | -6.2 |
| TDL-A, 10ns | -5.6 | -5.9 | -5.9 | -5.8 |
| TDL-A, 20ns | -5.6 | -6 | -6 | -5.8 |
| TDL-A, 40ns | -5.4 | -5.4 | -5.4 | -5.8 |
| Additional report/notes:  frequency offset：10ppm  the number and granularity of the frequency locations:  Number (coarse search branch): SCS120:22, SCS240:11, SCS480:6, SCS960:3  Granularity: , where is defined by the number of coarse search branch  CP type: NCP | | | | |

Table B.1.2.3-2: SINR in dB achieving PBCH BLER of 10%, using 1 transmission

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Channel | 120KHz | 240KHz | 480KHz | 960KHz |
| R1-2007654 / Source 4 | TDL-A, 5ns | -4.3 | -5.0 | -5.0 | -5.2 |
| TDL-A, 10ns | -4.0 | -5.0 | -5.0 | -4.0 |
| TDL-A, 20ns | -4.9 | -5.1 | -5.1 | -3.0 |
| TDL-A, 40ns | -5.0 | -4.0 | -4.0 | 0 |
| Additional report/notes:  frequency offset：10ppm  the number and granularity of the frequency locations:  Number (coarse search branch): SCS120:22, SCS240:11, SCS480:6, SCS960:3  Granularity: , where is defined by the number of coarse search branch  CP type: NCP  Single PBCH transmission | | | | |

#### B.1.2.4 Source 6 [68]

Table B.1.2.4-1: SINR in dB achieving cell ID detection probability of 90% by one-shot detection from PSS/SSS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Channel | 120KHz | 240KHz | 480KHz | 960KHz |
| R1-2009615 / Source 6 | TDL-A, 5ns | -3.29/-7.32 | -2.5/-7.42 | -2.45/-7.26 | -4.13/-6.92 |
| TDL-A, 10ns | -3.15/-7.31 | -2.67/-7.26 | -2.25/-6.91 | -4.08/-6.54 |
| TDL-A, 20ns | -3.28/-7.16 | -1.9/-6.89 | -2.21/-6.46 | -3.1/-6.31 |
| Additional report/notes: SINR (x/y) means SINR with 10 ppm/ SINR with 0 ppm  frequency offset: 10ppm/0ppm  carrier frequency: 60GHz  the number and granularity of the frequency locations: -x...x, with granularity SCS/2 where x=frequency offset\*carrier frequency  antenna configuration for CDL model: N/A  false alarm rate: 1%  Criteria for PSS detection success: the PSS detection is regarded as successful if PSS sequence index is detected correctly and the residual timing error is within [-Tcp/2, -Tcp/2] and the residual frequency error is within [-SCS/4, +SCS/4]. The reported results are the performance of PSS+SSS, the criteria for detection success is when the cell ID is corrected detected.  Simulation duration: 2000 SS/PBCH blocks | | | | |

#### B.1.2.5 Source 9 [25]

Table B.1.2.5-1: LLS template: SINR in dB achieving cell ID detection probability of 90% by one-shot detection from PSS/SSS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Channel | 120KHz | 240KHz | 480KHz | 960KHz |
| R1-2008457 / Source 9 | TDL-A, 5ns | -4 | -5.5 | -5.5 | -1 |
| TDL-A, 10ns | -5.5 | -5 | -4 | -1 |
| TDL-A, 20ns | -5.5 | -6.5 | -4 | 0 |
| Additional report/notes:  frequency offset : none  antenna configuration for CDL model : N/A | | | | |

Table B.1.2.5-2: LLS template: SINR in dB achieving PBCH BLER of 10%

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Channel | 120KHz | 240KHz | 480KHz | 960KHz |
| R1-2008457 / Source 9 | TDL-A, 5ns | -6 | -6.5 | -6.5 | -5.9 |
| TDL-A, 10ns | -5 | -6 | -6 | -5.8 |
| TDL-A, 20ns | -7.5 | -8 | -7.5 | -8 |
| Additional report/notes: | | | | |

#### B.1.2.6 Source 13 [29]

Table B.1.2.6-1: SINR in dB achieving cell ID detection probability of 90% by one-shot detection from PSS/SSS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Channel | 120KHz | 240KHz | 480KHz | 960KHz |
| R1-2009062 / Source 13 | TDL-A, 5ns | 4.1 | 2.8 | 1.9 | 2.9 |
| TDL-A, 10ns | 2.4 | 1.9 | 2.4 | 3.8 |
| TDL-A, 20ns | 1.7 | 2.8 | 3.6 | 4.6 |
| CDL-B, 20ns | -6.3 | -7.2 | -6.9 | -4.9 |
| CDL-B, 50ns | -5.8 | -6.0 | -5.3 | -4.1 |
| CDL-D, 20ns | -9.8 | -11.4 | -11.3 | -11.7 |
| CDL-D, 30ns | -9.6 | -10.4 | -10.8 | -12.4 |
| Additional report/notes:  frequency offset: +/- 0.5 ppm at gNB, +/- 5 ppm at UE  the number and granularity of the frequency locations: -1.5\*SCS to 1.5 SCS, with the granularity less than SCS/2 (IFO and FFO are estimated)  antenna configuration for CDL model: N/A  any optional or other assumption/parameters used not as in the baseline  false alarm rate: less than 1 %  criteria for PSS detection success: correct cell ID | | | | |

#### B.1.2.7 Source 14 [16]

Table B.1.2.7-1: LLS template: SINR in dB achieving cell ID detection probability of 90% by one-shot detection from PSS/SSS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Channel | 120KHz | 240KHz | 480KHz | 960KHz |
| R1-2009379/ Source 14 | TDL-A, 5ns | -8.98 / -3.62 | -8.97 / -4.00 | -8.97 / -4.77 | -8.76 / -4.88 |
| TDL-A, 10ns | -8.94 / -3.97 | -8.88 / -4.72 | -8.72 / -4.96 | -8.42 / -4.68 |
| TDL-A, 20ns | -8.83 / -4.72 | -8.68 / -4.84 | -8.39 / -4.63 | -8.30 / -4.81 |
| CDL-B, 20ns | - | - | - | - |
| CDL-B, 50ns | - | - | - | - |
| CDL-D, 20ns | - | - | - | - |
| CDL-D, 30ns | - | - | - | - |
| Values are represented in X / Y, where X and Y corresponds to SNR in dB achieving 90% and 99% detection success, respectively.  Additional report/notes:  frequency offset: initial CFO 5ppm  the number and granularity of the frequency locations: initial frequency offset estimation using PSS based on multiple hypothesis testing in units of ¼ subcarriers.  antenna configuration for CDL model: N/A  any optional or other assumption/parameters used not as in the baseline  false alarm rate: < 0.1% for PSS detection, < 0.1% for SSS detection  criteria for PSS detection success: If SSS was successfully detected with the PSS ID (NID2) and timing obtained from detected PSS, then PSS is declared successful. | | | | |

### B.1.3 Evaluation results for PRACH

#### B.1.3.1 Source 1 [65]

Table B.1.3.1-1: SINR in dB achieving PRACH preamble misdetection probability of 1% and corresponding false alarm probability, for PRACH format A3 (L = 139/571/1151 refers to the PRACH sequence length)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Channel | 120KHz | 240KHz | 480KHz | 960KHz |
| R1-2007984 / Source 1 | TDL-A, 5ns | –7.3 / ≤0.1% (L=139) –14.5 / ≤0.1% (L=571) –17.6 / ≤0.1% (L=1151) |  | –9.4 / ≤0.1% (L=139) –15.4 / ≤0.1% (L=571) | –9.1 / ≤0.1% (L=139) |
| TDL-A, 10ns | –7.9 / ≤0.1% (L=139) –14.6 / ≤0.1% (L=571) –17.5 / ≤0.1% (L=1151) |  | –9.4 / ≤0.1% (L=139) –15.7 / ≤0.1% (L=571) | –8.6 / ≤0.1% (L=139) |
| TDL-A, 20ns | –8.5 / ≤0.1% (L=139) –14.4 / ≤0.1% (L=571) –17.6 / ≤0.1% (L=1151) |  | –8.9 / ≤0.1% (L=139) –15.8 / ≤0.1% (L=571) | –8.4 / ≤0.1% (L=139) |
| TDL-A, 40ns | –8.4 / ≤0.1% (L=139) –14.6 / ≤0.1% (L=571) –17.9 / ≤0.1% (L=1151) |  | –8.5 / ≤0.1% (L=139) –15.3 / ≤0.1% (L=571) | –6.8 / ≤0.1% (L=139) |
| Additional report/notes:  1. PRACH format A3 (L = 139/571/1151 refers to the PRACH sequence length)  2. No cyclic shifts  3. Random propagation round-trip time, uniformly distributed over [0, 380 ns] (corresponding to ISD 100 m).  4. Delay estimation tolerance is ± 0.5 × PUSCH CP (with PUSCH SCS assumed same as PRACH SCS).  5. The receiver structure in R1-1609672 is used, with NNC = 1.  6. The detection threshold was selected to yield a maximum false-alarm probability of 0.1% across all SNRs. | | | | |

Table B.1.3.1-2: SINR in dB achieving PRACH preamble misdetection probability of 1% and corresponding false alarm probability, for PRACH format B4 (L = 139/571/1151 refers to the PRACH sequence length)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Channel | 120KHz | 240KHz | 480KHz | 960KHz |
| R1-2007984 / Source 1 | TDL-A, 5ns | –9.6 / ≤0.1% (L=139) –16.7 / ≤0.1% (L=571) –20.0 / ≤0.1% (L=1151) |  | –11.8 / ≤0.1% (L=139) –17.9 / ≤0.1% (L=571) | –12.0 / ≤0.1% (L=139) |
| TDL-A, 10ns | –10.2 / ≤0.1% (L=139) –16.7 / ≤0.1% (L=571) –19.6 / ≤0.1% (L=1151) |  | –11.8 / ≤0.1% (L=139) –18.1 / ≤0.1% (L=571) | –11.4 / ≤0.1% (L=139) |
| TDL-A, 20ns | –10.8 / ≤0.1% (L=139) –16.3 / ≤0.1% (L=571) –19.7 / ≤0.1% (L=1151) |  | –11.4 / ≤0.1% (L=139) –18.3 / ≤0.1% (L=571) | –11.3 / ≤0.1% (L=139) |
| TDL-A, 40ns | –10.8 / ≤0.1% (L=139) –16.3 / ≤0.1% (L=571) –19.4 / ≤0.1% (L=1151) |  | –11.3 / ≤0.1% (L=139) –17.8 / ≤0.1% (L=571) | –9.2 / ≤0.1% (L=139) |
| Additional report/notes:  1. PRACH format B4 (L = 139/571/1151 refers to the PRACH sequence length)  2. No cyclic shifts  3. Random propagation round-trip time, uniformly distributed over [0, 380 ns] (corresponding to ISD 100 m).  4. Delay estimation tolerance is ± 0.5 × PUSCH CP (with PUSCH SCS assumed same as PRACH SCS).  5. The receiver structure in R1-9609672 is used, with NNC = 1 for all cases except for 120 kHz with L = 571 or L = 1151, where NNC = 2 is used.  6. The detection threshold was selected to yield a maximum false-alarm probability of 0.1% across all SNRs. | | | | |

Table B.1.3.1-3: PRACH link budgets for format B4, delay spread 20 ns, and max RTT 380 ns with UE-specific power limits

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| R1-2007984 / Source 1 | Parameter | Value | | | | | |
| PRACH format | B4 | B4 | B4 | B4 | B4 | B4 |
| SCS [kHz] | 120 | 120 | 120 | 480 | 480 | 960 |
| Sequence length L | 139 | 571 | 1151 | 139 | 571 | 139 |
| Delay spread [ns] | 20 | 20 | 20 | 20 | 20 | 20 |
| Max RTT [ns] | 380 | 380 | 380 | 380 | 380 | 380 |
| Frequency occupancy [MHz] | 16.68 | 68.52 | 138.12 | 66.72 | 274.08 | 133.44 |
| Noise level [dBm] 1) | -94.78 | -88.64 | -85.60 | -88.76 | -82.62 | -85.75 |
| Required SNR [dB] 2) | -10.8 | -16.3 | -19.7 | -11.4 | -18.3 | -11.3 |
| Tx (UE) antenna gain [dBi] 3) | 6 | 6 | 6 | 6 | 6 | 6 |
| Rx (gNB) antenna gain [dBi] 3) | 20 | 20 | 20 | 20 | 20 | 20 |
| Max Tx power according to regulations [dBm] 4) | 19.22 | 25.36 | 27.00 | 25.24 | 27.00 | 27.00 |
| Tx power backoff based on CM [dB] 5) | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 |
| Max UE conducted power (backed off) [dBm] 6) | 18.7 | 18.7 | 18.7 | 18.7 | 18.7 | 18.7 |
| Max Tx power based on UE EIRP [dBm] 7) | 19 | 19 | 19 | 19 | 19 | 19 |
| Tx power [dBm] 8) | 18.7 | 18.7 | 18.7 | 18.7 | 18.7 | 18.7 |
| Maximum coupling loss (MCL) [dB] 9) | 124.3 | 123.6 | 124.0 | 118.9 | 119.6 | 115.7 |
| Maximum isotropic loss (MIL) [dB] 10) | 150.3 | 149.6 | 150.0 | 144.9 | 145.6 | 141.7 |
| Table shows PRACH link budgets for format B4, delay spread 20 ns, and max RTT 380 ns with UE-specific power limits  1) Over used subcarriers, assuming a noise figure of 7 dB and thermal noise spectral density of -174 dBm/Hz. 2) SNR required to have 1% misdetection rate, from Table B.1.3.1-2. 3) Element gain + beamforming gain. Assumes Antenna Configuration 2 in the link level evaluation assumptions in TR 38.808 for BS and UE. For BS, 20 dBi antenna gain is used: (10\*log10(4x8) + 5 (element gain) = 20. For the UE, 6 dBi gain is used which assumes that the UE uses wider beams during initial access for PRACH transmission (reduction from 11 dBi). 4) Considering ETSI/FCC EIRP limit of 40 dBm, ETSI BRAN (EIRP) PSD limits of 23 dB/MHz, FCC conducted power limit of 27 dBm above 100 MHz and with proportionally reduced power below 100 MHz. 5) Backoff from max UE conducted power, based on 95th percentile cubic metric (CM), which according to R1-1912714 is 2.3 dB for all supported Zadoff-Chu sequence lengths (L = 139/571/1151). 6) UE conducted power limit 21 dBm minus Tx power backoff based on CM. 7) UE EIRP limit of 25 dBm minus Tx antenna gain. 8) Minimum of max Tx power according to regulations, max UE conducted power, and max Tx power based on UE EIRP. 9) MCL (Tx power) (noise level) (required SNR) 10) MIL MCL (Tx antenna gain) (Rx antenna gain) | | | | | | |

Table B.1.3.1-4: PRACH link budgets for format B4, delay spread 20 ns, max RTT 380 ns, without UE-specific power limits

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| R1-2007984 / Source 1 | Parameter | Value | | | | | |
| PRACH format | B4 | B4 | B4 | B4 | B4 | B4 |
| SCS [kHz] | 120 | 120 | 120 | 480 | 480 | 960 |
| Sequence length L | 139 | 571 | 1151 | 139 | 571 | 139 |
| Delay spread [ns] | 20 | 20 | 20 | 20 | 20 | 20 |
| Max RTT [ns] | 380 | 380 | 380 | 380 | 380 | 380 |
| Frequency occupancy [MHz] | 16.68 | 68.52 | 138.12 | 66.72 | 274.08 | 133.44 |
| Noise level [dBm] 1) | -94.78 | -88.64 | -85.60 | -88.76 | -82.62 | -85.75 |
| Required SNR [dB] 2) | -10.8 | -16.3 | -19.7 | -11.4 | -18.3 | -11.3 |
| Tx (UE) antenna gain [dBi] 3) | 6 | 6 | 6 | 6 | 6 | 6 |
| Rx (gNB) antenna gain [dBi] 3) | 20 | 20 | 20 | 20 | 20 | 20 |
| Max Tx power according to regulations [dBm] 4) | 19.22 | 25.36 | 27.00 | 25.24 | 27.00 | 27.00 |
| Tx power [dBm] 5) | 19.22 | 25.36 | 27.00 | 25.24 | 27.00 | 27.00 |
| Maximum coupling loss (MCL) [dB] 6) | 124.8 | 130.3 | 132.3 | 125.4 | 127.9 | 124.0 |
| Maximum isotropic loss (MIL) [dB] 7) | 150.8 | 156.3 | 158.3 | 151.4 | 153.9 | 150.0 |
| Table shows PRACH link budgets for format B4, delay spread 20 ns, max RTT 380 ns, without UE-specific power limits  1) Over used subcarriers, assuming a noise figure of 7 dB and thermal noise spectral density of -174 dBm/Hz. 2) SNR required to have 1% misdetection rate, from B.1.3.1-2. 3) Element gain + beamforming gain, same value as for SSB. Assumes Antenna Configuration 2 in the link level evaluation assumptions in TR 38.808 for BS and UE. For BS, 20 dBi antenna gain is used: (10\*log10(4x8) + 5 (element gain) = 20. For the UE, 6 dBi gain is used which assumes that the UE uses wider beams during initial access for PRACH transmission (reduction from 11 dBi). 4) Considering ETSI/FCC EIRP limit of 40 dBm, ETSI BRAN (EIRP) PSD limits of 23 dB/MHz, FCC conducted power limit of 27 dBm above 100 MHz and with proportionally reduced power below 100 MHz. 5) Equals max Tx power according to regulations. Assumes UE is not limited by 21 dBm conducted power or 25 dBm EIRP. 6) MCL (Tx power) (noise level) (required SNR) 7) MIL MCL (Tx antenna gain) (Rx antenna gain) | | | | | | |

#### B.1.3.2 Source 2 [72]

Table B.1.3.2-1: SINR in dB achieving PRACH preamble misdetection probability of 1% and corresponding false alarm probability 1‰

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Format | Channel | 120 kHz | 240 kHz | 480 kHz | 960 kHz |
| R1-2009610 / Source 2 | A1 | CDL-B, 20ns | -6.920/1‰ | -7.820/1‰ | -7.829/1‰ | -8.234/1‰ |
| CDL-B, 50ns | -7.842/1‰ | -8.258/1‰ | -8.652/1‰ | -8.917/1‰ |
| CDL-D, 20ns | -6.740/1‰ | -6.740/1‰ | -6.740/1‰ | -6.728/1‰ |
| CDL-D, 30ns | -6.740/1‰ | -6.740/1‰ | -6.740/1‰ | -6.728/1‰ |
| A2 | CDL-B, 20ns | -9.836/1‰ | -10.860/1‰ | -10.739/1‰ | -11.030/1‰ |
| CDL-B, 50ns | -10.777/1‰ | -11.079/1‰ | -11.558/1‰ | -11.955/1‰ |
| CDL-D, 20ns | -9.529/1‰ | -9.523/1‰ | -9.526/1‰ | -9.526/1‰ |
| CDL-D, 30ns | -9.529/1‰ | -9.523/1‰ | -9.526/1‰ | -9.526/1‰ |
| Additional report/notes:  1. PRACH format: A1/A2  2. values of : 137  3. antenna configuration for CDL model:  (Mg,Ng,M,N,P) = (1,1,4,8,2) BS with (0.5 dv, 0.5 dH)  (Mg,Ng,M,N,P) = (1,1,2,2,2) UE with (0.5 dv, 0.5 dH)  4. any optional or other assumption/parameters used not as in the baseline  PN model: Example 2 phase noise model scaling to 60 GHz in 38.803 | | | | | |

#### B.1.3.3 Source 3 [30]

Table B.1.3.3-1: CINR in dB achieving PRACH preamble misdetection probability of 1% ∕ false alarm:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Channel | 120KHz | 240KHz | 480KHz | 960KHz |
| R1-2008615 / Source 3 | TDL-A, 5ns | -5.00|<0.1% | -5.52|<0.1% | -6.34|<0.1% | -6.15|<0.1% |
| TDL-A, 10ns | -6.00|<0.1% | -6.01|<0.1% | -6.28|<0.1% | -6.00|<0.1% |
| TDL-A, 20ns | -6.13|<0.1% | -6.00|<0.1% | -6.00|<0.1% | -6.00|<0.1% |
| CDL-B, 20ns (Cfg. 1) | -5.23|<0.1% | -5.45|<0.1% | -5.68|<0.1% | -6.12|<0.1% |
| CDL-B, 50ns (Cfg. 1) | -5.76|<0.1% | -6.06|<0.1% | -6.22|<0.1% | -5.87|<0.1% |
| CDL-D, 20ns (Cfg. 1) | -22.78|<0.1% | -22.97|<0.1% | -22.87|<0.1% | -22.96|<0.1% |
| CDL-D, 30ns (Cfg. 1) | -22.82|<0.1% | -22.93|<0.1% | -22.86|<0.1% | -22.97|<0.1% |
| CDL-B, 20ns (Cfg. 2) | -0.65|<0.1% | -0.45|<0.1% | -0.33|<0.1% | 0.00|<0.1% |
| CDL-B, 50ns (Cfg. 2) | 0.03|<0.1% | 0.42|<0.1% | -0.18|<0.1% | 1.22|<0.1% |
| CDL-D, 20ns (Cfg. 2) | -10.70|<0.1% | -10.64|<0.1% | -10.67|<0.1% | -10.58|<0.1% |
| CDL-D, 30ns (Cfg. 2) | -10.68|<0.1% | -10.62|<0.1% | -10.48|<0.1% | -10.64|<0.1% |
| Additional report/notes:  PRACH format: A3,  value of : 46 (zeroCorrelationZoneConfig = 14) for CDL, 19 (zeroCorrelationZoneConfig = 10) for TDL  antenna configuration for CDL model: Config 1 and Config 2  any optional or other assumption/parameters used not as in the baseline | | | | |

Table B.1.3.3-2: CINR in dB achieving PRACH preamble misdetection probability of 1% ∕ false alarm

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Channel | 120KHz | 240KHz | 480KHz | 960KHz |
| R1-2008615 / Source 3 | TDL-A, 5ns | -12.47|<0.1% | -12.50|<0.1% | -12.29|<0.1% | -12.55|<0.1% |
| TDL-A, 10ns | -12.56|<0.1% | -12.22|<0.1% | -12.54|<0.1% | -12.93|<0.1% |
| TDL-A, 20ns | -12.12|<0.1% | -12.35|<0.1% | -13.02|<0.1% | -12.33|<0.1% |
| CDL-B, 20ns (Cfg. 1) | -12.06|<0.1% | -12.33|<0.1% | -12.64|<0.1% | -11.07|<0.1% |
| CDL-B, 50ns (Cfg. 1) | -11.43|<0.1% | -11.45|<0.1% | -10.70|<0.1% | -10.28|<0.1% |
| CDL-D, 20ns (Cfg. 1) | -28.05|<0.1% | -28.08|<0.1% | -28.05|<0.1% | -28.03|<0.1% |
| CDL-D, 30ns (Cfg. 1) | -28.05|<0.1% | -28.08|<0.1% | -28.06|<0.1% | -28.03|<0.1% |
| CDL-B, 20ns (Cfg. 2) | -5.64|<0.1% | -5.46|<0.1% | -5.42|<0.1% | -5.00|<0.1% |
| CDL-B, 50ns (Cfg. 2) | -5.45|<0.1% | -5.28|<0.1% | -4.60|<0.1% | -3.47|<0.1% |
| CDL-D, 20ns (Cfg. 2) | -15.81|<0.1% | -15.85|<0.1% | -15.93|<0.1% | -15.76|<0.1% |
| CDL-D, 30ns (Cfg. 2) | -15.82|<0.1% | -15.88|<0.1% | -15.95|<0.1% | -15.77|<0.1% |
| Additional report/notes:  PRACH format: A3,  value of : 190 (zeroCorrelationZoneConfig = 14) for CDL, 51 (zeroCorrelationZoneConfig = 10) for TDL  antenna configuration for CDL model: Config 1 and Config 2  any optional or other assumption/parameters used not as in the baseline | | | | |

#### B.1.3.4 Source 4 [60]

Table B.1.3.4-1: SINR in dB achieving PRACH preamble misdetection probability of 1% and corresponding false alarm probability

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Channel | 120KHz | 240KHz | 480KHz | 960KHz |
| R1-2007654 / Source 4 | TDL-A, 5ns | -2.9/0.0071 | -3.5/0.0038 | -3.7/0.0026 | -3.2/0.0020 |
| TDL-A, 10ns | -3.5/0.0071 | -4.2/0.0038 | -3.8/0.0026 | -2.9/0.0020 |
| TDL-A, 20ns | -4.4/0.0071 | -4.4/0.0038 | -3.5/0.0026 | -2.7/0.0020 |
| TDL-A, 40ns | -4.7/0.0071 | -3.9/0.0038 | -3.2/0.0026 | -1.8/0.0020 |
| Additional report/notes:  1. PRACH format：A1  2. values of ：  SCS 120KHz:8, SCS 240KHz:15, SCS 480KHz:34, SCS 960KHz:69  3.Time advance：  SCS 120KHz: random in 0-82, SCS 240KHz: random in 0-163, SCS 480KHz: random in 0-325, SCS 960KHz: random in 0-649. | | | | |

#### B.1.3.5 Source 5 [64]

Table B.1.3.5-1: LLS template: SINR in dB achieving PRACH preamble misdetection probability of 1% and corresponding false alarm probability

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Channel | 120KHz | 240KHz | 480KHz | 960KHz |
| R1-2009450/ Source 5 | TDL-A, 5ns | -3.9/≤0.1% | -4.9/≤0.1% | -5.4/≤0.1% | -5.4/≤0.1% |
| TDL-A, 10ns | -5.0/≤0.1% | -5.2/≤0.1% | -5.2/≤0.1% | -5.0/≤0.1% |
| TDL-A, 20ns | -5.3/≤0.1% | -5.3/≤0.1% | -5.0/≤0.1% | -5.1/≤0.1% |
| Additional report/notes:  1. PRACH format:A1  2. L\_RA=139 | | | | |

#### B.1.3.6 Source 6 [68]

Table B.1.3.6-1: SINR in dB achieving PRACH preamble misdetection probability of 1% and corresponding false alarm probability, for PRACH format A1 (L = 139 refers to the PRACH sequence length)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Channel | 60KHz | 120KHz | 240KHz | 480KHz | 960KHz |
| R1-2009615/ Source 6 | TDL-A, 5ns | -4.7/0.5‰ | -5/0.47‰ | -5.8/0.52‰ | -6.4/0.35‰ | -6.4/0.14‰ |
| TDL-A, 10ns | -5/ 0.49‰ | -5.86/0.44‰ | -6.5/0.55‰ | -6.1/0.53‰ | -5.6/0.14‰ |
| TDL-A, 20ns | -5.2/0.51‰ | -6.1/0.49‰ | -6.4/0.58‰ | -5.1/0.47‰ | Inf(note) |
| CDL-B, 20ns | -17.2/0.33‰ | -16.2/0.54‰ | -16.7/0.36‰ | -17.6/0.53‰ | -19.1/0.14‰ |
| CDL-B, 50ns | -16.6/0.41‰ | -16.5/0.68‰ | -17.9/0.38‰ | -19.6/0.47‰ | -20.2/0.14‰ |
| Additional report/notes:  1. PRACH format A1 (L = 139 refers to the PRACH sequence length)  2. No cyclic shifts  4. Delay estimation tolerance is ± 0.5 × PUSCH CP (with PUSCH SCS assumed same as PRACH SCS).  5. The detection threshold was selected to yield a maximum false-alarm probability of 0.1% across all SNRs and the actual false-alarm rate is reported in the table.  Note: infinity SNR is observed when the above mentioned detection criteria; while -6.2 dB SNR is observed if the criteria does not take into account timing error. See Figure B.1.3.6-1. | | | | | |

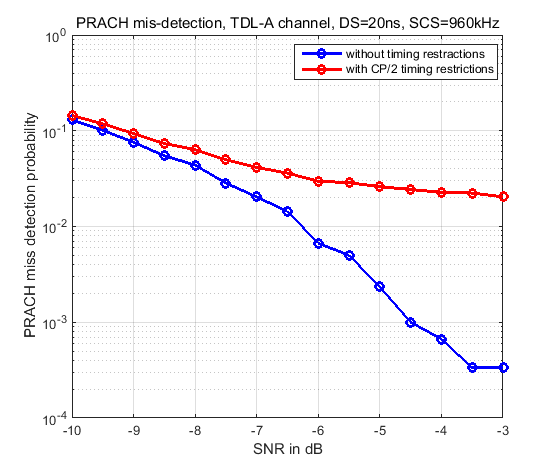


Figure B.1.3.6-1: PRACH miss-detection for 960 kHz with and without timing restriction

#### B.1.3.7 Source 7 [62]

Table B.1.3.7-1: SINR in dB achieving PRACH preamble misdetection probability of 1% and corresponding false alarm probability

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Channel | 120KHz | 240KHz | 480KHz | 960KHz |
| R1-2007928 / Source 7 | TDL-A, 5ns | -9.6 | -9.5 | -9.4 | -9.9 |
| TDL-A, 10ns | -10.3 | -10.1 | -9.8 | -9.8 |
| TDL-A, 20ns | -9.5 | -8.9 | -8.8 | -9.5 |
| CDL-B, 20ns |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |
| CDL-D, 20ns |  |  |  |  |
| CDL-D, 30ns |  |  |  |  |
| Additional report/notes:  1. PRACH format A3, L=139  2. Ncs={13,13,69,69} for each SCS, TDL-A,20ns with 240kHz also with Ncs=69.  3. antenna configuration for CDL model  4. Agreed PN model used in TX and RX side. Time offset assumption of 0-0.385us corresponding to ISD of 0-100m. False alarm probability of 0.1%. | | | | |

#### B.1.3.8 Source 13 [29]

Table B.1.3.8-1: LLS template: SINR in dB achieving PRACH preamble misdetection probability of 1% and corresponding false alarm probability

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Channel | 120KHz | 240KHz | 480KHz | 960KHz |
| R1-2009062 / Source 13 | TDL-A, 5ns | 1.1/<0.001 | 0.4/<0.001 | 0.2/<0.001 | -0.3/<0.001 |
| TDL-A, 10ns | 0.8/<0.001 | 0.8/<0.001 | -0.4/<0.001 | -1.2/<0.001 |
| TDL-A, 20ns | 1.4/<0.001 | 0.3/<0.001 | -0.8/<0.001 | -0.2/<0.001 |
| CDL-B, 20ns |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |
| CDL-D, 20ns |  |  |  |  |
| CDL-D, 30ns |  |  |  |  |
| Additional report/notes:  1. PRACH format: A1  2. values of : No cyclic shift  3. antenna configuration for CDL model: N/A  4. any optional or other assumption/parameters used not as in the baseline  - #loops for each combination of SCS and DS: 1000 | | | | |

#### B.1.3.9 Source 14 [16]

Table B.1.3.9-1: SINR in dB achieving PRACH preamble misdetection probability of 1% and corresponding false alarm probability

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Channel | 120KHz | 240KHz | 480KHz | 960KHz |
| R1-2009379/ Source 14 | TDL-A, 5ns | -8.27 dB  / <0.1% FA | -8.57 dB  / <0.1% FA | -9.12 dB  / <0.1% FA | -8.42 dB  / <0.1% FA |
| TDL-A, 10ns | -8.66 dB  / <0.1% FA | -9.15 dB  / <0.1% FA | -8.66 dB  / <0.1% FA | -7.19 dB  / <0.1% FA |
| TDL-A, 20ns | -8.92 dB  / <0.1% FA | -8.37 dB  / <0.1% FA | -7.25 dB  / <0.1% FA | -8.74 dB  / <0.1% FA |
| CDL-B, 20ns | - | - | - | - |
| CDL-B, 50ns | - | - | - | - |
| CDL-D, 20ns | - | - | - | - |
| CDL-D, 30ns | - | - | - | - |
| Additional report/notes:  1. PRACH format: A2 with sequence length 139  2. values of : Ncs = {34, 69, 0, 0} for {120, 240, 480, 960 kHz}  3. antenna configuration for CDL model: N/A  4. any optional or other assumption/parameters used not as in the baseline | | | | |

Table B.1.3.9-2: SINR in dB achieving PRACH preamble misdetection probability of 1% and corresponding false alarm probability

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Channel | 120KHz | 240KHz | 480KHz | 960KHz |
| R1-2009379/ Source 14 | TDL-A, 5ns | -3.99 dB  / <0.1% FA | -6.40 dB  / <0.1% FA | -9.17 dB  / <0.1% FA | -10.48 dB  / <0.1% FA |
| TDL-A, 10ns | -4.46 dB  / <0.1% FA | -7.10 dB  / <0.1% FA | -8.73 dB  / <0.1% FA | -9.39 dB  / <0.1% FA |
| TDL-A, 20ns | -4.90 dB  / <0.1% FA | -6.47 dB  / <0.1% FA | -7.55 dB  / <0.1% FA | -10.65 dB  / <0.1% FA |
| CDL-B, 20ns | - | - | - | - |
| CDL-B, 50ns | - | - | - | - |
| CDL-D, 20ns | - | - | - | - |
| CDL-D, 30ns | - | - | - | - |
| Additional report/notes:  1. PRACH format: sequence length 139, symbol repetition {1,2,4,8} for {120, 240, 480, 960 kHz}, Tested with fixed 1.96 GHz bandwidth.  2. values of : Ncs = {34, 69, 0, 0} for {120, 240, 480, 960 kHz}  3. antenna configuration for CDL model: N/A  4. any optional or other assumption/parameters used not as in the baseline | | | | |

Table B.1.3.9-3: SINR in dB achieving PRACH preamble misdetection probability of 1% and corresponding false alarm probability

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Channel | 120KHz | 240KHz | 480KHz | 960KHz |
| R1-2009379/ Source 14 | TDL-A, 5ns | -15.12 / <0.1% FA | -14.74 / <0.1% FA | -14.48 / <0.1% FA | -15.28 / <0.1% FA |
| TDL-A, 10ns | -14.80 / <0.1% FA | -14.59 / <0.1% FA | -15.30 / <0.1% FA | -15.25 / <0.1% FA |
| TDL-A, 20ns | -14.49 / <0.1% FA | -15.20 / <0.1% FA | -15.35 / <0.1% FA | -15.16 / <0.1% FA |
| CDL-B, 20ns | - | - | - | - |
| CDL-B, 50ns | - | - | - | - |
| CDL-D, 20ns | - | - | - | - |
| CDL-D, 30ns | - | - | - | - |
| Additional report/notes:  1. PRACH format: A2 with sequence length 571  2. values of : Ncs = {114, 285, 0, 0} for {120, 240, 480, 960 kHz}  3. antenna configuration for CDL model: N/A  4. any optional or other assumption/parameters used not as in the baseline | | | | |

Table B.1.3.9-4: SINR in dB achieving PRACH preamble misdetection probability of 1% and corresponding false alarm probability

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Channel | 120KHz | 240KHz | 480KHz | 960KHz |
| R1-2008805 / Source 14 | TDL-A, 5ns | -17.69 / <0.1% FA | -17.39/ <0.1% FA | -17.98 / <0.1% FA | -18.19 / <0.1% FA |
| TDL-A, 10ns | -17.56 / <0.1% FA | -18.14 / <0.1% FA | -18.03 / <0.1% FA | -17.58 / <0.1% FA |
| TDL-A, 20ns | -18.15 / <0.1% FA | -18.24 / <0.1% FA | -18.69 / <0.1% FA | -17.97 / <0.1% FA |
| CDL-B, 20ns |  |  |  |  |
| CDL-B, 50ns |  |  |  |  |
| CDL-D, 20ns |  |  |  |  |
| CDL-D, 30ns |  |  |  |  |
| Additional report/notes:  1. PRACH format: A2 with sequence length 1151  2. values of : Ncs = {230, 575, 0, 0} for {120, 240, 480, 960 kHz}  3. antenna configuration for CDL model: N/A  4. any optional or other assumption/parameters used not as in the baseline | | | | |

## B.2 System level evaluation results

### B.2.1 RSRP distribution

#### B.2.1.1 Source 1 [65]

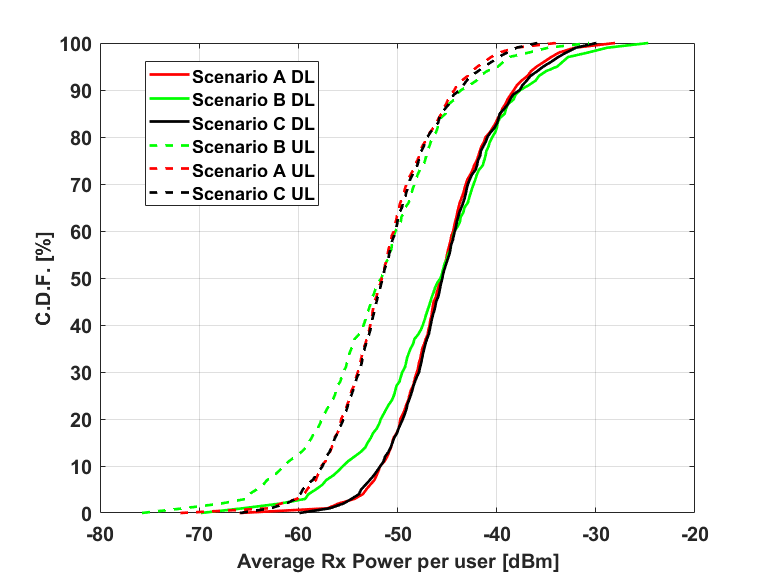
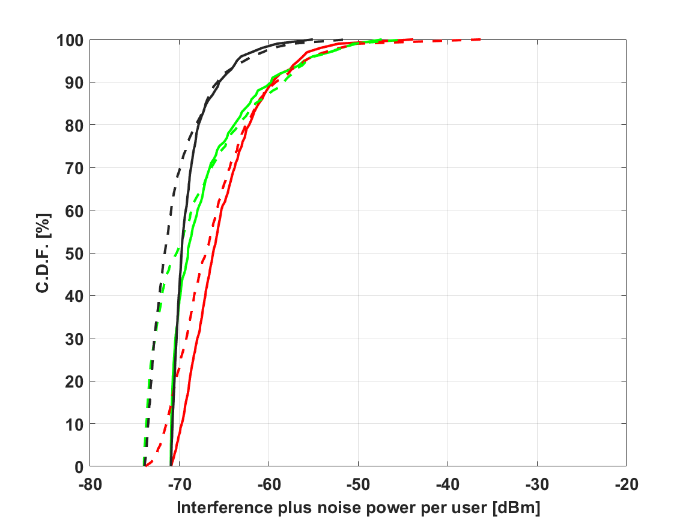


Figure B.2.1.1-1. (a) Received Power (serving BS to UE link) and (b) interference per User in indoor Scenario A, B, and C when buffer occupancy is high (~55%).

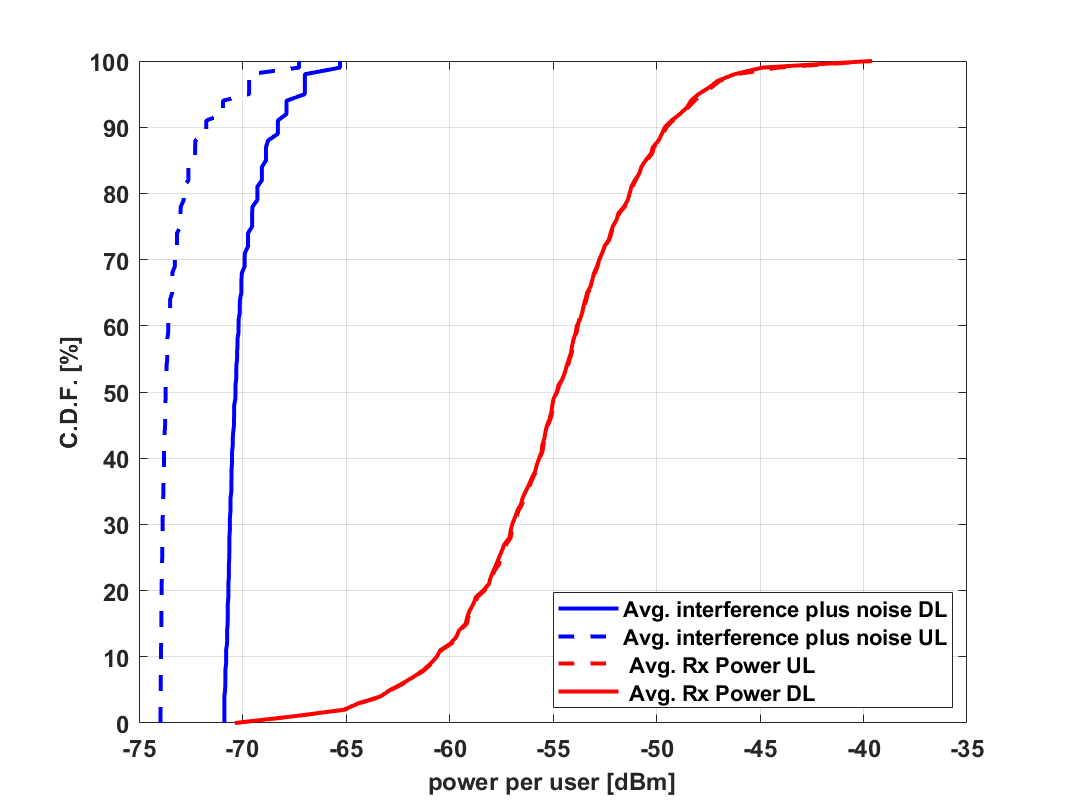


Figure B.2.1.1-2. Received Power (serving BS to UE link) and interference per user in outdoor scenario B (1 Site) when buffer occupancy is high.

#### B.2.1.2 Source 2 [72]

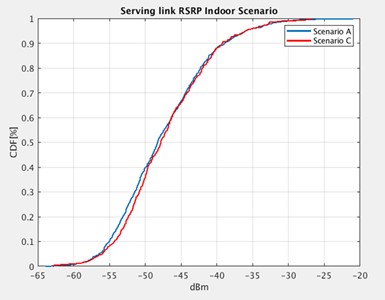


Figure B.2.1.2-1. Serving link RSRP of Indoor scenario-A/C

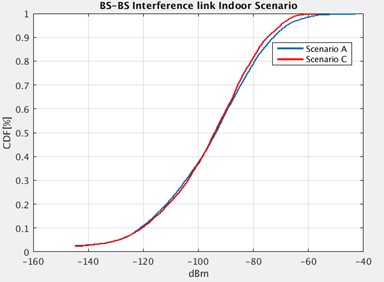


Figure B.2.1.2-2. BS-to-BS interference link RSRP of Indoor scenario-A/C

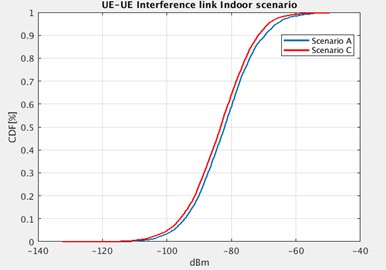


Figure B.2.1.2-3. UE-to-UE interference link RSRP of Indoor scenario-A/C

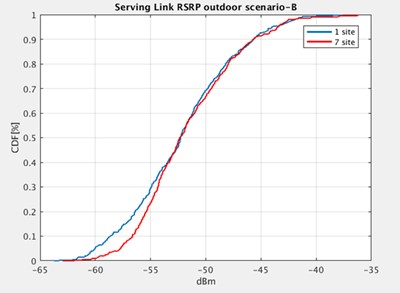


Figure B.2.1.2-4. Serving link RSRP of outdoor scenario-B

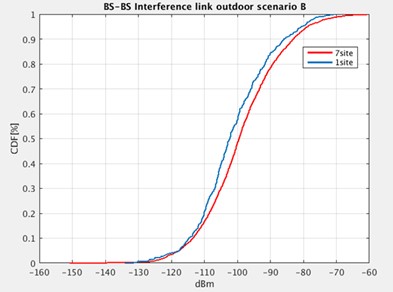


Figure B.2.1.2-5. BS-to-BS interference link RSRP of Indoor scenario-B

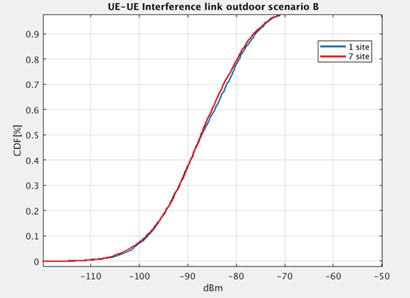


Figure B.2.1.2-6. UE-to-UE interference link RSRP of Indoor scenario-B

#### B.2.1.3 Source 3 [56]



Figure B.2.1.3-1. Downlink serving Cell RSRP Distributions for Indoor scenarios

#### B.2.1.4 Source 4 [37]

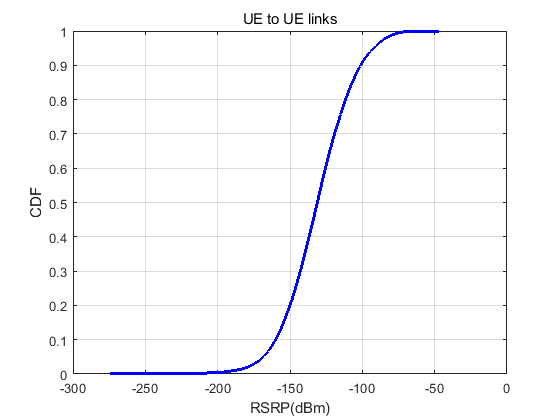
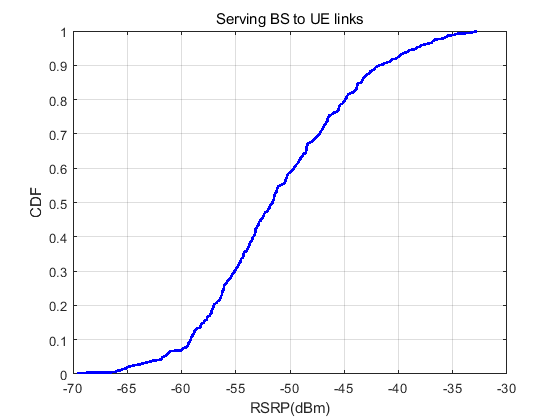
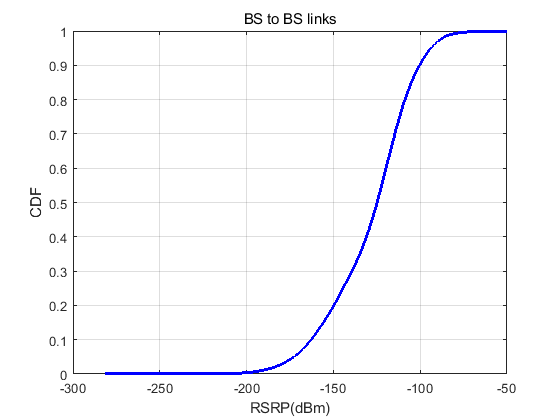
**

Figure B.2.1.4-1 RSRP CDF

#### B.2.1.5 Source 5 [64]



Figure B.2.1.5-1. RSRP distribution for Indoor Scenario A

#### B.2.1.6 Source 6 [68]

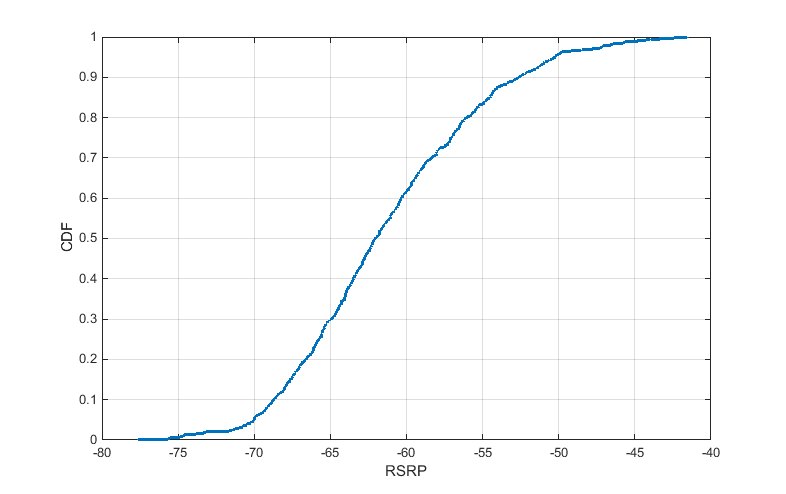


Figure B.2.1.6-1. RSRP distribution

#### B.2.1.7 Source 10 [67]



Figure B.2.1.7-1. RSRP CDF

#### B.2.1.8 Source 14 [43]



Figure B.2.1.8-1. DL Geometry of Indoor A scenario



Figure B.2.1.8-2. RSRP of BS to BS links and (non-serving) BS to UE links for Indoor A scenario

Figure B.2.1.8-3. RSRP of (serving or non-serving) BS to UE link for Indoor A scenario



Figure B.2.1.8-4. Accumulative RSRP of (non-serving) BS to UE links for Indoor A scenario



Figure B.2.1.8-5. RSRP of UE to (serving) BS for Indoor A scenario



Figure B.2.1.8-6. RSRP of UE to (non-serving) BS links for Indoor A scenario. The BS is using regular beamforming intended to receive signals from its own UEs (denoted as Dir CCA), or omnidirectional beamforming (denoted as Omni CCA)



Figure B.2.1.8-7. RSRP of UE to UE links for Indoor A scenario. The UE is using regular beamforming intended to receive signals from its own BS (denoted as Dir CCA), or omnidirectional beamforming (denoted as Omni CCA)



Figure B.2.1.8-8. DL Geometry of Indoor A scenario with non-ceiling mounted BS



Figure B.2.1.8-9. RSRP of BS to BS links and (non-serving) BS to UE links for Indoor A scenario with non-ceiling mounted BS



Figure B.2.1.8-10. RSRP of (serving or non-serving) BS to UE link for Indoor A scenario with non-ceiling mounted BS



Figure B.2.1.8-11. Accumulative RSRP of (non-serving) BS to UE links for Indoor A scenario with non-ceiling mounted BS



Figure B.2.1.8-12. RSRP of UE to (serving) BS for Indoor A scenario with non-ceiling mounted BS



Figure B.2.1.8-13. RSRP of UE to (non-serving) BS links for Indoor A scenario with non-ceiling mounted BS. The BS is using regular beamforming intended to receive signals from its own UEs (denoted as Dir CCA), or omnidirectional beamforming (denoted as Omni CCA)

Figure B.2.1.8-14. RSRP of UE to UE links for Indoor A scenario with non-ceiling mounted BS. The UE is using regular beamforming intended to receive signals from its own BS (denoted as Dir CCA), or omnidirectional beamforming (denoted as Omni CCA)

### B.2.2 Indoor scenario A

#### B.2.2.1 Source 1 [65]

Table B.2.2.1-1. System level evaluation results for scenario A, with/without LBT

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /Source | Cases | | Case 1: no LBT | | | Case 2: ED -47dBm | | | Case 3: ED-68 dBm | | |
| R1-2007984 / Source 1 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 5566 | 3889 | 2448 | 5451 | 3518 | 2310 | 5201 | 3250 | 2007 |
| 50%ile | 9244 | 7380 | 5670 | 8851 | 7057 | 5356 | 8840 | 6583 | 4813 |
| 95%ile | 11219 | 10363 | 9247 | 10778 | 9882 | 8542 | 10739 | 9543 | 7780 |
| mean | 9002 | 7358 | 5877 | 8627 | 7019 | 5473 | 8595 | 6618 | 4929 |
| DL delay (s) | 5%ile | 0.019 | 0.020 | 0.023 | 0.020 | 0.021 | 0.025 | 0.020 | 0.022 | 0.028 |
| 50%ile | 0.024 | 0.032 | 0.042 | 0.025 | 0.033 | 0.045 | 0.025 | 0.036 | 0.050 |
| 95%ile | 0.038 | 0.058 | 0.090 | 0.039 | 0.063 | 0.097 | 0.040 | 0.066 | 0.112 |
| mean | 0.026 | 0.036 | 0.049 | 0.027 | 0.038 | 0.053 | 0.027 | 0.040 | 0.059 |
| UL UPT (Mbps) | 5%ile | 1869 | 1139 | 493 | 1718 | 960 | 487 | 1727 | 836 | 342 |
| 50%ile | 3409 | 2570 | 1835 | 3197 | 2361 | 1667 | 3130 | 1994 | 1236 |
| 95%ile | 4741 | 4199 | 3592 | 4419 | 3856 | 3314 | 4337 | 3444 | 2727 |
| mean | 3392 | 2659 | 1968 | 3183 | 2426 | 1810 | 3120 | 2088 | 1375 |
| UL delay (s) | 5%ile | 0.045 | 0.050 | 0.059 | 0.048 | 0.055 | 0.063 | 0.049 | 0.062 | 0.077 |
| 50%ile | 0.064 | 0.090 | 0.130 | 0.069 | 0.098 | 0.142 | 0.071 | 0.123 | 0.197 |
| 95%ile | 0.113 | 0.202 | 0.405 | 0.121 | 0.231 | 0.415 | 0.122 | 0.273 | 0.602 |
| mean | 0.072 | 0.107 | 0.179 | 0.076 | 0.119 | 0.188 | 0.078 | 0.146 | 0.261 |
| Arrival rate (files/s) | | 0.47 | 1.53 | 2.45 | 0.46 | 1.57 | 2.48 | 0.46 | 1.57 | 2.48 |
| 𝜌DL | | 1.00 | 1.00 | 0.99 | 1.00 | 1.00 | 0.99 | 1.00 | 1.00 | 0.99 |
| 𝜌UL | | 1.00 | 0.99 | 0.96 | 1.00 | 0.99 | 0.96 | 1.00 | 0.99 | 0.94 |
| BO | | 0.10 | 0.34 | 0.54 | 0.11 | 0.37 | 0.57 | 0.11 | 0.41 | 0.62 |
| Additional report/notes:  1. LBT procedure and parameters: LBT based on ETSI EN 302 567 v2.1.20, ED thresholds -47dBm or -68dBm, CWS: CW\_min = CW\_max = 3  2. any assumptions/parameters used not as in the agreed baseline: no  3. Details of case: 2 operators (scenario A) with the same settings, report only for OP A; case 1: no-LBT, case 2: LBT with ED = -47dBm, case 3: LBT with ED = -68dBm  5. Details of COT sharing if used in evaluation: 0.5ms COT for DL, 0.25ms COT for UL, DL COT sharing when traffic in both directions.  6. Other parameters: Frequency 60GHz, BW = 2GHz, SCS = 960kHz. | | | | | | | | | | |

Table B.2.2.1-2. System level evaluation results for scenario A with Receiver assisted LBT

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /Source | Cases | | Case 1: no LBT | | | Case 2: RAL ED -47dBm | | | Case 3: RAL ED-68 dBm | | |
| R1-2007984 / Source 1 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 5574 | 3830 | 2396 | 5426 | 3561 | 2385 | 5415 | 3573 | 2227 |
| 50%ile | 9250 | 7319 | 5607 | 8845 | 6971 | 5317 | 8880 | 6678 | 4936 |
| 95%ile | 11220 | 10326 | 9205 | 10776 | 9827 | 8674 | 10748 | 9417 | 8209 |
| mean | 9008 | 7303 | 5822 | 8629 | 6951 | 5484 | 8630 | 6660 | 5146 |
| DL delay (s) | 5%ile | 0.019 | 0.020 | 0.023 | 0.020 | 0.021 | 0.025 | 0.020 | 0.022 | 0.026 |
| 50%ile | 0.024 | 0.032 | 0.042 | 0.025 | 0.033 | 0.045 | 0.025 | 0.035 | 0.049 |
| 95%ile | 0.038 | 0.059 | 0.091 | 0.039 | 0.063 | 0.096 | 0.039 | 0.066 | 0.103 |
| mean | 0.026 | 0.036 | 0.050 | 0.027 | 0.038 | 0.053 | 0.027 | 0.040 | 0.056 |
| UL UPT (Mbps) | 5%ile | 1871 | 1116 | 469 | 1741 | 1016 | 527 | 1664 | 888 | 329 |
| 50%ile | 3413 | 2541 | 1808 | 3194 | 2362 | 1697 | 3175 | 2064 | 1287 |
| 95%ile | 4742 | 4181 | 3569 | 4411 | 3881 | 3364 | 4363 | 3513 | 2839 |
| mean | 3395 | 2635 | 1943 | 3182 | 2437 | 1839 | 3144 | 2150 | 1441 |
| UL delay (s) | 5%ile | 0.045 | 0.050 | 0.060 | 0.048 | 0.055 | 0.062 | 0.048 | 0.061 | 0.074 |
| 50%ile | 0.064 | 0.091 | 0.132 | 0.069 | 0.097 | 0.140 | 0.069 | 0.119 | 0.195 |
| 95%ile | 0.112 | 0.206 | 0.413 | 0.120 | 0.225 | 0.410 | 0.121 | 0.255 | 0.591 |
| mean | 0.072 | 0.109 | 0.181 | 0.076 | 0.118 | 0.186 | 0.078 | 0.140 | 0.256 |
| Arrival rate (files/s) | | 0.46 | 1.57 | 2.48 | 0.46 | 1.57 | 2.48 | 0.46 | 1.57 | 2.48 |
| 𝜌DL | | 1.00 | 1.00 | 0.99 | 1.00 | 1.00 | 0.99 | 1.00 | 1.00 | 0.99 |
| 𝜌UL | | 1.00 | 0.99 | 0.96 | 1.00 | 0.99 | 0.96 | 1.00 | 0.98 | 0.94 |
| BO | | 0.10 | 0.35 | 0.55 | 0.11 | 0.37 | 0.57 | 0.11 | 0.40 | 0.62 |
| Additional report/notes:  1. LBT procedure and parameters: LBT based on ETSI EN 302 567 v2.1.20, ED thresholds -47dBm or -68dBm, CWS: CW\_min = CW\_max = 3  2. any assumptions/parameters used not as in the agreed baseline: no  3. Details of case: 2 operators (scenario A) with the same settings, report only for OP A; case 1: no-LBT, case 2: receiver assisted LBT with ED = -47dBm, case 3: receiver assisted LBT with ED = -68dBm  Receiver assisted LBT: the LBT procedure is evaluated at the receiver instead of transmitter. The LBT result is assumed to be available instantly at the transmitter without accounting any overhead for exchanging this information between the transmitter and the receiver (refer to section 2.1.4 in R1-2007983 for more details).  5. Details of COT sharing if used in evaluation: 0.5ms COT for DL, 0.25ms COT for UL, DLCOT sharing when traffic in both directions  6. Other parameters: Frequency 60GHz, BW = 2GHz, SCS = 960kHz. | | | | | | | | | | |

Table B.2.2.1-3. System level evaluation results for scenario A with Dynamic LBT

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | Case 1: no LBT | | | Case 2: Dynamic LBT ED -47dBm | | | Case 3: Dynamic LBT ED-68 dBm | | | |
| R1-2007984 / Source 1 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 5574 | 3830 | 2396 | 5644 | 3743 | 2522 | 5542 | 3713 | 2141 |
| 50%ile | 9250 | 7319 | 5607 | 9228 | 7295 | 5705 | 9166 | 7079 | 5371 |
| 95%ile | 11220 | 10326 | 9205 | 11223 | 10314 | 9083 | 11221 | 10192 | 8835 |
| mean | 9008 | 7303 | 5822 | 8997 | 7301 | 5831 | 8960 | 7108 | 5518 |
| DL delay (s) | 5%ile | 0.019 | 0.020 | 0.023 | 0.019 | 0.020 | 0.024 | 0.019 | 0.020 | 0.024 |
| 50%ile | 0.024 | 0.032 | 0.042 | 0.024 | 0.032 | 0.042 | 0.024 | 0.034 | 0.046 |
| 95%ile | 0.038 | 0.059 | 0.091 | 0.037 | 0.060 | 0.091 | 0.039 | 0.065 | 0.103 |
| mean | 0.026 | 0.036 | 0.050 | 0.026 | 0.036 | 0.049 | 0.026 | 0.038 | 0.054 |
| UL UPT (Mbps) | 5%ile | 1871 | 1116 | 469 | 1863 | 1134 | 581 | 1860 | 1066 | 434 |
| 50%ile | 3413 | 2541 | 1808 | 3432 | 2564 | 1900 | 3387 | 2398 | 1618 |
| 95%ile | 4742 | 4181 | 3569 | 4724 | 4191 | 3643 | 4670 | 3944 | 3212 |
| mean | 3395 | 2635 | 1943 | 3408 | 2646 | 2026 | 3369 | 2487 | 1727 |
| UL delay (s) | 5%ile | 0.045 | 0.050 | 0.060 | 0.045 | 0.050 | 0.058 | 0.045 | 0.054 | 0.066 |
| 50%ile | 0.064 | 0.091 | 0.132 | 0.064 | 0.091 | 0.124 | 0.065 | 0.098 | 0.152 |
| 95%ile | 0.112 | 0.206 | 0.413 | 0.112 | 0.194 | 0.349 | 0.114 | 0.213 | 0.468 |
| mean | 0.072 | 0.109 | 0.181 | 0.071 | 0.108 | 0.165 | 0.072 | 0.116 | 0.205 |
| Arrival rate (files/s) | | 0.46 | 1.57 | 2.48 | 0.46 | 1.57 | 2.48 | 0.46 | 1.57 | 2.48 |
| 𝜌DL | | 1.00 | 1.00 | 0.99 | 1.00 | 1.00 | 0.99 | 1.00 | 1.00 | 0.99 |
| 𝜌UL | | 1.00 | 0.99 | 0.96 | 1.00 | 0.99 | 0.97 | 1.00 | 0.99 | 0.95 |
| BO | | 0.10 | 0.35 | 0.55 | 0.10 | 0.35 | 0.55 | 0.10 | 0.36 | 0.58 |
| Additional report/notes:  1. LBT procedure and parameters: LBT based on ETSI EN 302 567 v2.1.20, ED thresholds -47dBm or -68dBm, CWS: CW\_min = CW\_max = 3  2. any assumptions/parameters used not as in the agreed baseline: no  3. Details of case: 2 operators (scenario A) with the same settings, report only for OP A; case 1: no-LBT, case 2: Dynamic LBT with ED = -47dBm, case 3: Dynamic LBT with ED = -68dBm  Dynamic LBT: a node operates without LBT unless the receiver experiences a failure in reception due to a drop in SINR, which reflects a presence of interferer. Only then, the node switches to LBT. Besides, when the LBT is switched on, the RAL described in section 2.1.4 of R1-2007983 is used  5. Details of COT sharing if used in evaluation: 0.5ms COT for DL, 0.25ms COT for UL, DL COT sharing when traffic in both directions.  6. Other parameters: Frequency 60GHz, BW = 2GHz, SCS = 960kHz. | | | | | | | | | | | |

Table B.2.2.1-4. System level evaluation results for scenario A with directional LBT

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | Case 1: no LBT | | | Case 2: directional LBT ED -47dBm | | | Case 3: directional LBT ED-47+X dBm | | |
| R1-2007984 / Source 1 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 5574 | 3830 | 2396 | 5294 | 3497 | 2365 | 5321 | 3537 | 2274 |
| 50%ile | 9250 | 7319 | 5607 | 8849 | 6924 | 5256 | 8836 | 6948 | 5337 |
| 95%ile | 11220 | 10326 | 9205 | 10780 | 9816 | 8494 | 10768 | 9867 | 8609 |
| mean | 9008 | 7303 | 5822 | 8638 | 6914 | 5449 | 8613 | 6925 | 5461 |
| DL delay (s) | 5%ile | 0.019 | 0.020 | 0.023 | 0.020 | 0.021 | 0.025 | 0.020 | 0.021 | 0.025 |
| 50%ile | 0.024 | 0.032 | 0.042 | 0.025 | 0.034 | 0.046 | 0.025 | 0.034 | 0.045 |
| 95%ile | 0.038 | 0.059 | 0.091 | 0.040 | 0.064 | 0.097 | 0.040 | 0.066 | 0.098 |
| mean | 0.026 | 0.036 | 0.050 | 0.027 | 0.038 | 0.053 | 0.027 | 0.038 | 0.053 |
| UL UPT (Mbps) | 5%ile | 1871 | 1116 | 469 | 1733 | 1008 | 529 | 1716 | 1028 | 481 |
| 50%ile | 3413 | 2541 | 1808 | 3206 | 2342 | 1674 | 3225 | 2360 | 1683 |
| 95%ile | 4742 | 4181 | 3569 | 4453 | 3881 | 3370 | 4447 | 3841 | 3342 |
| mean | 3395 | 2635 | 1943 | 3193 | 2435 | 1813 | 3194 | 2427 | 1811 |
| UL delay (s) | 5%ile | 0.045 | 0.050 | 0.060 | 0.048 | 0.054 | 0.063 | 0.048 | 0.055 | 0.065 |
| 50%ile | 0.064 | 0.091 | 0.132 | 0.068 | 0.099 | 0.143 | 0.068 | 0.099 | 0.142 |
| 95%ile | 0.112 | 0.206 | 0.413 | 0.119 | 0.218 | 0.409 | 0.119 | 0.219 | 0.424 |
| mean | 0.072 | 0.109 | 0.181 | 0.076 | 0.118 | 0.185 | 0.076 | 0.118 | 0.188 |
| Arrival rate (files/s) | | 0.46 | 1.57 | 2.48 | 0.46 | 1.57 | 2.48 | 0.46 | 1.57 | 2.48 |
| 𝜌DL | | 1.00 | 1.00 | 0.99 | 1.00 | 1.00 | 0.99 | 1.00 | 1.00 | 0.99 |
| 𝜌UL | | 1.00 | 0.99 | 0.96 | 1.00 | 0.99 | 0.97 | 1.00 | 0.99 | 0.96 |
| BO | | 0.10 | 0.35 | 0.55 | 0.11 | 0.37 | 0.57 | 0.11 | 0.37 | 0.58 |
| Additional report/notes:  1. LBT procedure and parameters: directional LBT, CWS: CW\_min = CW\_max = 3  2. any assumptions/parameters used not as in the agreed baseline: no  3. Details of case: 2 operators (scenario A) with the same settings, report only for OP A; case 1: no-LBT, case 2: directional LBT with ED = -47dBm, case 3: directional LBT with ED = -47+x dBm (i.e., -47+15dBm at gNB, -47+6dBm at UE)  5. Details of COT sharing if used in evaluation: 0.5ms COT for DL, 0.25ms COT for UL, DLCOT sharing when traffic in both directions  6. Other parameters: Frequency 60GHz, BW = 2GHz, SCS = 960kHz. | | | | | | | | | | |

Table B.2.2.1-5. System level evaluation results for scenario A, with mixed LBT configuration

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | Case 1: no LBT  (OpA ) | | | Case 2: ED -47dBm  (OpB) | | | Case 3: mixed configuration | | | | | | |
| (Op A , no LBT ) | | | (Op B, -47dBm ) | | | |
| R1-2007984 / Source 1 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 5574 | 3830 | 2396 | 5072 | 3434 | 2204 | 5662 | 3761 | 2455 | 5106 | 3552 | 2219 |
| 50%ile | 9250 | 7319 | 5607 | 8787 | 6893 | 5292 | 9218 | 7378 | 5574 | 8796 | 6929 | 5238 |
| 95%ile | 11220 | 10326 | 9205 | 10793 | 9829 | 8587 | 11222 | 10295 | 9071 | 10774 | 9845 | 8585 |
| mean | 9008 | 7303 | 5822 | 8562 | 6869 | 5435 | 9009 | 7324 | 5780 | 8553 | 6900 | 5427 |
| DL delay (s) | 5%ile | 0.019 | 0.020 | 0.023 | 0.020 | 0.021 | 0.025 | 0.019 | 0.020 | 0.023 | 0.020 | 0.021 | 0.025 |
| 50%ile | 0.024 | 0.032 | 0.042 | 0.025 | 0.034 | 0.045 | 0.024 | 0.032 | 0.043 | 0.025 | 0.034 | 0.046 |
| 95%ile | 0.038 | 0.059 | 0.091 | 0.041 | 0.065 | 0.102 | 0.037 | 0.058 | 0.090 | 0.041 | 0.064 | 0.101 |
| mean | 0.026 | 0.036 | 0.050 | 0.027 | 0.038 | 0.053 | 0.026 | 0.036 | 0.050 | 0.027 | 0.038 | 0.053 |
| UL UPT (Mbps) | 5%ile | 1871 | 1116 | 469 | 1641 | 961 | 414 | 1901 | 1081 | 526 | 1673 | 999 | 477 |
| 50%ile | 3413 | 2541 | 1808 | 3186 | 2326 | 1638 | 3409 | 2546 | 1827 | 3198 | 2365 | 1683 |
| 95%ile | 4742 | 4181 | 3569 | 4399 | 3844 | 3338 | 4732 | 4171 | 3661 | 4382 | 3895 | 3404 |
| mean | 3395 | 2635 | 1943 | 3151 | 2406 | 1778 | 3397 | 2631 | 1962 | 3161 | 2439 | 1832 |
| UL delay (s) | 5%ile | 0.045 | 0.050 | 0.060 | 0.048 | 0.054 | 0.063 | 0.045 | 0.050 | 0.057 | 0.048 | 0.053 | 0.062 |
| 50%ile | 0.064 | 0.091 | 0.132 | 0.069 | 0.100 | 0.146 | 0.064 | 0.091 | 0.132 | 0.069 | 0.099 | 0.139 |
| 95%ile | 0.112 | 0.206 | 0.413 | 0.124 | 0.231 | 0.458 | 0.111 | 0.205 | 0.389 | 0.123 | 0.221 | 0.411 |
| mean | 0.072 | 0.109 | 0.181 | 0.077 | 0.120 | 0.201 | 0.071 | 0.108 | 0.174 | 0.077 | 0.119 | 0.187 |
| Arrival rate (files/s) | | 0.46 | 1.57 | 2.48 | 0.46 | 1.57 | 2.48 | 0.46 | 1.57 | 2.48 | 0.46 | 1.57 | 2.48 |
| 𝜌DL | | 1.00 | 1.00 | 0.99 | 1.00 | 1.00 | 0.99 | 1.00 | 1.00 | 0.99 | 1.00 | 1.00 | 0.99 |
| 𝜌UL | | 1.00 | 0.99 | 0.96 | 1.00 | 0.99 | 0.96 | 1.00 | 0.99 | 0.96 | 1.00 | 0.99 | 0.96 |
| BO | | 0.10 | 0.35 | 0.55 | 0.11 | 0.37 | 0.57 | 0.10 | 0.35 | 0.55 | 0.11 | 0.37 | 0.58 |
| Additional report/notes:  1. LBT procedure and parameters: LBT based on ETSI EN 302 567 v2.1.20, ED thresholds -47dBm, CWS: CW\_min = CW\_max = 3  2. any assumptions/parameters used not as in the agreed baseline: no  3. Details of case: 2 operators (scenario A); case 1: no-LBT for both OPs, case 2: LBT with ED = -47dBm for both OPs, case 3: no LBT for OP A, LBT with ED = -47dBm for OP B  4. Other metric(s) and definition if reported: no  5. Details of COT sharing if used in evaluation: 0.5ms COT for DL, 0.25ms COT for UL, DL COT sharing when traffic in both directions.  6. Other parameters: Frequency 60GHz, BW = 2GHz, SCS = 960kHz. | | | | | | | | | | | | | | |

#### B.2.2.2 Source 2 [72]

Table B.2.2.2-1. System level evaluation results for indoor scenario A (no-LBT and omni-directional LBT)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | no-LBT | | | omni-directional LBT | | |
| Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| R1-2009610 / Source 2 | DL UPT (Mbps) | 5%ile | 2690.3 | 1015.6 | 222.3 | 2527.9 | 881.7 | 158.8 |
| 50%ile | 6635.8 | 4431.6 | 3385.4 | 6137.7 | 4068.8 | 3062.5 |
| 95%ile | 9477.6 | 9469.3 | 9404.3 | 8949.0 | 8837.5 | 8628.6 |
| mean | 6381.8 | 4819.0 | 3818.9 | 5943.5 | 4404.3 | 3439.1 |
| DL delay (s) | 5%ile | 0.0228 | 0.0228 | 0.0229 | 0.0241 | 0.0244 | 0.0250 |
| 50%ile | 0.0325 | 0.0485 | 0.0634 | 0.0352 | 0.0530 | 0.0698 |
| 95%ile | 0.0801 | 0.2059 | 0.7516 | 0.0867 | 0.2492 | 1.0180 |
| mean | 0.0396 | 0.0743 | 0.1751 | 0.0430 | 0.0882 | 0.2161 |
| UL UPT (Mbps) | 5%ile | 2817.4 | 1027.9 | 304.2 | 2606.0 | 839.2 | 185.6 |
| 50%ile | 6949.9 | 4798 | 3802.7 | 6527.9 | 4358.4 | 3372.2 |
| 95%ile | 10637 | 10118 | 9111.1 | 9982.3 | 9243.3 | 8536.7 |
| mean | 6771.0 | 5046.4 | 4165.3 | 6320.3 | 4602.4 | 3726.3 |
| UL delay (s) | 5%ile | 0.0203 | 0.0211 | 0.0236 | 0.0216 | 0.0225 | 0.0251 |
| 50%ile | 0.0311 | 0.0448 | 0.0564 | 0.0331 | 0.0493 | 0.0634 |
| 95%ile | 0.0764 | 0.2034 | 0.5975 | 0.0837 | 0.2500 | 0.8877 |
| mean | 0.0375 | 0.0728 | 0.1613 | 0.0410 | 0.0867 | 0.2029 |
| Arrival rate (files/s) | | 0.4 | 1.2 | 1.6 | 0.4 | 1.2 | 1.6 |
| 𝜌DL | | 99.64% | 99.49% | 97.37% | 99.69% | 99.44% | 96.69% |
| 𝜌UL | | 99.68% | 99.45% | 97.89% | 99.65% | 99.32% | 96.91% |
| BO | | 12.94% | 42.34% | 57.72% | 13.81% | 45.13% | 60.60% |
| Additional report/notes:  1. LBT procedure and parameters: LBT based on ETSI EN 302 567 v2.1.20, ED thresholds -47dBm for BBU, -32dBm for UE, CWS: CW\_min = CW\_max = 127  2. Details of case: 2 operators (scenario A) with the same settings, case1: No LBT; case 2: omni-directional LBT  3. Details of COT sharing if used in evaluation: MCOT = 5ms, No COT sharing for DL/UL data transmission.  4. Other parameters: Frequency 60GHz, BW = 2GHz, SCS = 960kHz. Rank 1 transmission. BS to UE: InH open office channel, ftp3 file size = 27Mbyte. | | | | | | | |

Table B.2.2.2-2. System level evaluation results for indoor scenario A (directional LBT and receiver assisted LBT)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | directional LBT | | | receiver-assisted LBT | | |
| Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| R1-2009610 / Source 2 | DL UPT (Mbps) | 5%ile | 2507.1 | 874.7 | 154.7 | 2587.9 | 994.5 | 242.7 |
| 50%ile | 6129.2 | 4038.4 | 3031.0 | 6170.7 | 4181.1 | 3187.9 |
| 95%ile | 8956.3 | 8827.5 | 8625.3 | 8959.2 | 8852.4 | 8690.1 |
| mean | 5931.7 | 4382.4 | 3432.0 | 5991.0 | 4516.8 | 3582.2 |
| DL delay (s) | 5%ile | 0.0241 | 0.0244 | 0.0250 | 0.0241 | 0.0244 | 0.0248 |
| 50%ile | 0.0351 | 0.0530 | 0.0707 | 0.0352 | 0.0515 | 0.0673 |
| 95%ile | 0.0858 | 0.2411 | 0.9853 | 0.0838 | 0.2237 | 0.7022 |
| mean | 0.0427 | 0.0857 | 0.2087 | 0.0424 | 0.0819 | 0.1971 |
| UL UPT (Mbps) | 5%ile | 2606.0 | 836.3 | 181.8 | 2698.8 | 938.8 | 275.2 |
| 50%ile | 6528.8 | 4351.0 | 3369.3 | 6621.1 | 4490.5 | 3537.3 |
| 95%ile | 9985.1 | 9250.1 | 8531.0 | 9990.1 | 9469.4 | 8631.4 |
| mean | 6317.1 | 4594.3 | 3724.6 | 6396.9 | 4750.6 | 3868.7 |
| UL delay (s) | 5%ile | 0.0216 | 0.0230 | 0.0252 | 0.0216 | 0.0224 | 0.0248 |
| 50%ile | 0.0330 | 0.0494 | 0.0634 | 0.0329 | 0.0481 | 0.0605 |
| 95%ile | 0.0824 | 0.2490 | 0.8331 | 0.0815 | 0.2332 | 0.7032 |
| mean | 0.0405 | 0.0880 | 0.1989 | 0.0402 | 0.0808 | 0.1831 |
| Arrival rate (files/s) | | 0.4 | 1.2 | 1.6 | 0.4 | 1.2 | 1.6 |
| 𝜌DL | | 99.62% | 99.41% | 96.81% | 99.69% | 99.47% | 96.90% |
| 𝜌UL | | 99.66% | 99.33% | 96.98% | 99.66% | 99.34% | 97.21% |
| BO | | 13.82% | 45.20% | 60.57% | 13.81% | 44.89% | 60.35% |
| Additional report/notes:  1. LBT procedure and parameters: LBT based on ETSI EN 302 567 v2.1.20, ED thresholds -47dBm for BBU, -32dBm for UE, CWS: CW\_min = CW\_max = 127  2. Details of case: 2 operators (scenario A) with the same settings, case1: directional LBT; case 2: receiver-assisted LBT  3. Details of COT sharing if used in evaluation: MCOT = 5ms, No COT sharing for DL/UL data transmission.  4. Other parameters: Frequency 60GHz, BW = 2GHz, SCS = 960kHz. Rank 1 transmission. BS to UE: InH open office channel, ftp3 file size = 27Mbyte. | | | | | | | |

Table B.2.2.2-3. System level evaluation results for indoor scenario A (receiver-only directional LBT)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | receiver-only directional LBT | | |
| Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| R1-2009610 / Source 2 | DL UPT (Mbps) | 5%ile | 2809.9 | 1206.1 | 370.2 |
| 50%ile | 6586.1 | 4563.2 | 3591.4 |
| 95%ile | 9481.1 | 9475.2 | 9441.4 |
| mean | 6431.9 | 4943.0 | 3982.5 |
| DL delay (s) | 5%ile | 0.0228 | 0.0228 | 0.0229 |
| 50%ile | 0.0330 | 0.0471 | 0.0598 |
| 95%ile | 0.0783 | 0.1827 | 0.5443 |
| mean | 0.0395 | 0.0698 | 0.1610 |
| UL UPT (Mbps) | 5%ile | 2932.9 | 1139.2 | 356.9 |
| 50%ile | 7009.0 | 4947.9 | 3901.2 |
| 95%ile | 10621 | 10276 | 9203.9 |
| mean | 6838.1 | 5198.1 | 4277.9 |
| UL delay (s) | 5%ile | 0.0203 | 0.0207 | 0.0231 |
| 50%ile | 0.0310 | 0.0435 | 0.0549 |
| 95%ile | 0.0748 | 0.1881 | 0.5590 |
| mean | 0.0374 | 0.0685 | 0.1530 |
| Arrival rate (files/s) | | 0.4 | 1.2 | 1.6 |
| 𝜌DL | | 99.71% | 99.54% | 97.55% |
| 𝜌UL | | 99.68% | 99.47% | 97.95% |
| BO | | 12.96% | 42.14% | 57.46% |
| Additional report/notes:  1. LBT procedure and parameters: LBT based on ETSI EN 302 567 v2.1.20, ED thresholds -47dBm for BBU, -32dBm for UE, CWS: CW\_min = CW\_max = 127  2. Details of case: 2 operators (scenario A) with the same settings, case1: receiver-only directional LBT(No random back off before dl/ul data grant);  3. Details of COT sharing if used in evaluation: MCOT = 5ms, No COT sharing for DL/UL data transmission.  4. Other parameters: Frequency 60GHz, BW = 2GHz, SCS = 960kHz. Rank 1 transmission. BS to UE: InH open office channel, ftp3 file size = 27Mbyte. | | | | |

Table B.2.2.2-4. System level evaluation results for indoor scenario A (InH mixed, no-LBT and omni-directional LBT)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | no-LBT | | | omni-directional LBT | | |
| Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| R1-2009610 / Source 2 | DL UPT (Mbps) | 5%ile | 346.9 | 150.2 | 62.9 | 339.6 | 145.6 | 60.7 |
| 50%ile | 1141.5 | 764.6 | 597.5 | 1077.0 | 726.0 | 578.8 |
| 95%ile | 1851.6 | 1848.6 | 1841.6 | 1786.7 | 1768.5 | 1751.1 |
| mean | 1105.3 | 846.8 | 701.5 | 1057.6 | 805.6 | 669.1 |
| DL delay (s) | 5%ile | 0.0346 | 0.0353 | 0.0404 | 0.0361 | 0.0371 | 0.0421 |
| 50%ile | 0.0543 | 0.0811 | 0.1034 | 0.0574 | 0.0858 | 0.1080 |
| 95%ile | 0.2901 | 0.7812 | 1.7303 | 0.3024 | 0.8198 | 1.7773 |
| mean | 0.1062 | 0.2269 | 0.3583 | 0.1086 | 0.2320 | 0.3627 |
| UL UPT (Mbps) | 5%ile | 279.7 | 123.7 | 46.8 | 271.3 | 108.8 | 37.5 |
| 50%ile | 1071.6 | 753.1 | 590.5 | 1018 | 697.7 | 554.5 |
| 95%ile | 1973.5 | 1969.3 | 1943.5 | 1886.5 | 1865.4 | 1825.6 |
| mean | 1076.8 | 846.3 | 701.9 | 1021.9 | 792.7 | 659.9 |
| UL delay (s) | 5%ile | 0.0325 | 0.0346 | 0.0391 | 0.0342 | 0.0366 | 0.0415 |
| 50%ile | 0.0573 | 0.0823 | 0.1054 | 0.0603 | 0.0897 | 0.1121 |
| 95%ile | 0.4021 | 1.1329 | 2.2083 | 0.4133 | 1.2521 | 2.4032 |
| mean | 0.1378 | 0.2777 | 0.4186 | 0.1446 | 0.2981 | 0.4457 |
| Arrival rate (files/s) | | 0.25 | 0.6 | 0.8 | 0.25 | 0.6 | 0.8 |
| 𝜌DL | | 99.37% | 97.46% | 94.91% | 99.33% | 97.43% | 94.77% |
| 𝜌UL | | 98.15% | 96.48% | 93.69% | 98.11% | 96.23% | 93.12% |
| BO | | 20.19% | 45.88% | 58.88% | 21.01% | 47.36% | 59.9% |
| Additional report/notes:  1. LBT procedure and parameters: LBT based on ETSI EN 302 567 v2.1.20, ED thresholds -47dBm for BBU, -32dBm for UE, CWS: CW\_min = CW\_max = 127  2. Details of case: 2 operators (scenario A) with the same settings, case1: no-LBT; case 2: omni-directional LBT  3. Details of COT sharing if used in evaluation: MCOT = 5ms, No COT sharing for DL/UL data transmission.  4. Other parameters: Frequency 60GHz, BW = 400MHz, SCS = 120kHz. Rank 1 transmission. BS to UE: InH mixed office channel, ftp3 file size = 8Mbyte. | | | | | | | |

Table B.2.2.2-5. System level evaluation results for indoor scenario A (InH mixed, directional LBT and receiver assisted LBT)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | directional LBT | | | receiver-assisted LBT | | |
| Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| R1-2009610 / Source 2 | DL UPT (Mbps) | 5%ile | 332.5 | 145.6 | 59.7 | 350.1 | 165.6 | 76.05 |
| 50%ile | 1072.7 | 729.1 | 573.7 | 1067.2 | 753.9 | 624.6 |
| 95%ile | 1787.5 | 1770.5 | 1751.1 | 1784.7 | 1770.2 | 1759.3 |
| mean | 1056.1 | 805.5 | 668.31 | 1057.5 | 821.0 | 699.1 |
| DL delay (s) | 5%ile | 0.0361 | 0.0370 | 0.0421 | 0.0361 | 0.0369 | 0.0406 |
| 50%ile | 0.0576 | 0.0856 | 0.1078 | 0.0583 | 0.0814 | 0.1000 |
| 95%ile | 0.3016 | 0.8349 | 1.7601 | 0.2941 | 0.6925 | 1.4098 |
| mean | 0.1104 | 0.2334 | 0.3629 | 0.1045 | 0.2196 | 0.3192 |
| UL UPT (Mbps) | 5%ile | 261.1 | 108.7 | 38.2 | 273.7 | 114.2 | 44.23 |
| 50%ile | 1016.5 | 699.4 | 557.0 | 1025.8 | 723.6 | 594.1 |
| 95%ile | 1885.7 | 1862.6 | 1819.1 | 1887.3 | 1867.5 | 1843.5 |
| mean | 1021.7 | 790.9 | 659.8 | 1032.6 | 810.4 | 684.9 |
| UL delay (s) | 5%ile | 0.0343 | 0.0367 | 0.0416 | 0.0342 | 0.0361 | 0.0404 |
| 50%ile | 0.0605 | 0.0890 | 0.1118 | 0.0599 | 0.0855 | 0.1039 |
| 95%ile | 0.4228 | 1.2325 | 2.3873 | 0.4007 | 1.0162 | 2.0620 |
| mean | 0.1452 | 0.2970 | 0.4438 | 0.1371 | 0.2713 | 0.4056 |
| Arrival rate (files/s) | | 0.25 | 0.6 | 0.8 | 0.25 | 0.6 | 0.8 |
| 𝜌DL | | 99.33% | 97.43% | 94.81% | 99.38% | 97.44% | 95.35% |
| 𝜌UL | | 98.11% | 96.32% | 93.18% | 98.25% | 96.54% | 93.70% |
| BO | | 21.04% | 47.4% | 59.8% | 21.24% | 47.41% | 59.83% |
| Additional report/notes:  1. LBT procedure and parameters: LBT based on ETSI EN 302 567 v2.1.20, ED thresholds -47dBm for BBU, -32dBm for UE, CWS: CW\_min = CW\_max = 127  2. Details of case: 2 operators (scenario A) with the same settings, case1: directional LBT; case 2: receiver-assisted LBT  3. Details of COT sharing if used in evaluation: MCOT = 5ms, No COT sharing for DL/UL data transmission.  4. Other parameters: Frequency 60GHz, BW = 400MHz, SCS = 120kHz. Rank 1 transmission. BS to UE: InH mixed office channel, ftp3 file size = 8Mbyte. | | | | | | | |

Table B.2.2.2-6. System level evaluation results for indoor scenario A (InH Mixed, receiver-only directional LBT)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | receiver-only directional LBT | | |
| Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| R1-2009610 / Source 2 | DL UPT (Mbps) | 5%ile | 375.9 | 188.5 | 97.9 |
| 50%ile | 1146.4 | 822.5 | 677.0 |
| 95%ile | 1892.6 | 1890.1 | 1885.8 |
| mean | 1134.2 | 894.7 | 759.0 |
| DL delay (s) | 5%ile | 0.0339 | 0.0341 | 0.0380 |
| 50%ile | 0.0544 | 0.0750 | 0.0912 |
| 95%ile | 0.2647 | 0.5887 | 1.1616 |
| mean | 0.0975 | 0.1950 | 0.2849 |
| UL UPT (Mbps) | 5%ile | 289.3 | 130.9 | 53.9 |
| 50%ile | 1059.6 | 733.6 | 640.8 |
| 95%ile | 1973.2 | 1968.8 | 1957.5 |
| mean | 1090.8 | 863.8 | 733.9 |
| UL delay (s) | 5%ile | 0.0325 | 0.0340 | 0.0380 |
| 50%ile | 0.0558 | 0.0795 | 0.0960 |
| 95%ile | 0.3791 | 0.9621 | 1.8669 |
| mean | 0.1295 | 0.2605 | 0.3765 |
| Arrival rate (files/s) | | 0.25 | 0.6 | 0.8 |
| 𝜌DL | | 99.41% | 97.80% | 96.02% |
| 𝜌UL | | 98.34% | 96.62% | 94.30% |
| BO | | 20.3% | 45.43% | 58.06% |
| Additional report/notes:  1. LBT procedure and parameters: LBT based on ETSI EN 302 567 v2.1.20, ED thresholds -47dBm for BBU, -32dBm for UE, CWS: CW\_min = CW\_max = 127  2. Details of case: 2 operators (scenario A) with the same settings, case1: receiver-only directional LBT(No random back off before dl/ul data grant);  3. Details of COT sharing if used in evaluation: MCOT = 5ms, No COT sharing for DL/UL data transmission.  4. Other parameters: Frequency 60GHz, BW = 400MHz, SCS = 120kHz. Rank 1 transmission. BS to UE: InH mixed office channel, ftp3 file size = 8Mbyte. | | | | |

#### B.2.2.3 Source 3 [56]

Table B.2.2.3-1. System level evaluation results for indoor scenario A

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | Case 1: -47dBM@gNB, Dynamic TDD  (Mg,Ng,M,N,P) = (1,1,4,8,2) with (0.5 dv, 0.5 dH), 2Mbytes, 2 Operators, | | | Case 2: -67dBM@gNB,  (Mg,Ng,M,N,P) = (1,1,4,8,2) with (0.5 dv, 0.5 dH), 2Mbytes, 2 Operators  Omni Listening | | |
| R1-2009362 / Source 3 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 6381 | 3753 | 758 | 6176 | 3738 | 781 |
| 50%ile | 11297 | 8593 | 4511 | 11335 | 8607 | 4841 |
| 95%ile | 13685 | 12550 | 10440 | 13661 | 12503 | 10659 |
| mean | 10738 | 8387 | 4992 | 10734 | 8420 | 5170 |
| DL delay (s) | 5%ile | 1.22 | 1.428 | 1.919 | 1.226 | 1.422 | 1.87 |
| 50%ile | 1.712 | 2.525 | 5.854 | 1.712 | 2.48 | 5.472 |
| 95%ile | 3.406 | 6.704 | 83.257 | 3.362 | 6.698 | 47.683 |
| mean | 1.942 | 3.172 | 24.875 | 1.944 | 3.111 | 20.491 |
| UL UPT (Mbps) | 5%ile | 4997 | 3438 | 935 | 4921 | 3506 | 972 |
| 50%ile | 8755 | 6996 | 4086 | 8731 | 7023 | 4281 |
| 95%ile | 10395 | 9591 | 8161 | 10372 | 9575 | 8316 |
| mean | 8407 | 6826 | 4300 | 8397 | 6841 | 4450 |
| UL delay (s) | 5%ile | 1.597 | 1.791 | 2.357 | 1.604 | 1.806 | 2.287 |
| 50%ile | 2.091 | 2.921 | 6.543 | 2.099 | 2.881 | 6.041 |
| 95%ile | 3.822 | 6.702 | 37.443 | 3.872 | 6.7 | 36.987 |
| mean | 2.292 | 3.418 | 12.621 | 2.299 | 3.394 | 11.065 |
| Arrival rate (files/s) | | 10 | 15 | 20 | 10 | 15 | 20 |
| 𝜌DL | | 0.999 | 0.999 | 0.984 | 0.999 | 0.999 | 0.985 |
| 𝜌UL | | 0.999 | 0.999 | 0.994 | 0.999 | 0.999 | 0.995 |
| BO | | 0.18 | 0.33 | 0.508 | 0.18 | 0.326 | 0.502 |
| Additional report/notes: Case 1 and Case 2:  LBT procedure and parameters: Baseline LBT Procedure at gNB: 8us+(1-3)\*5us, at the gNB. Only gNBs perform extended CCA.  All Results with 2 operator Indoor scenario. Main assumptions provided in Column header and Table 1. Omni Directional LBT with specified thresholds.  No COT sharing from UL to DL.  Common: DL-UL Traffic:50:50, FTP Model 3, 2MB file.{SCS,BW=960Khz,2GHz},{[k1,k2,k3]=[12,0,32] NR slots}, COT duration 0.25ms, Multi-user scheduling -1 user per COT with beam persistence. | | | | | | | |

Table B.2.2.3-2. System level evaluation results for indoor scenario A

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | Case 3: -67dBM@gNB, Rx Assist  (Mg,Ng,M,N,P) = (1,1,4,8,2) with (0.5 dv, 0.5 dH), 2Mbytes, 2 Operators, Omni Listening | | | Case 4: -72dBM@gNB, Rx Assist  (Mg,Ng,M,N,P) = (1,1,4,8,2) with (0.5 dv, 0.5 dH), 2Mbytes, 2 Operators Omni Listening | | |
| R1-2009362 / Source 3 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 6275 | 3713 | 851 | 6368 | 3855 | 1146 |
| 50%ile | 11237 | 8686 | 5063 | 11235 | 8751 | 5497 |
| 95%ile | 13473 | 12340 | 10634 | 13480 | 12444 | 10730 |
| mean | 10631 | 8364 | 5340 | 10670 | 8492 | 5719 |
| DL delay (s) | 5%ile | 1.239 | 1.442 | 1.844 | 1.231 | 1.425 | 1.799 |
| 50%ile | 1.719 | 2.464 | 5.203 | 1.69 | 2.429 | 4.489 |
| 95%ile | 3.355 | 6.728 | 43.559 | 3.326 | 6.33 | 26.962 |
| mean | 1.948 | 3.153 | 19.907 | 1.931 | 3.054 | 12.928 |
| UL UPT (Mbps) | 5%ile | 5023 | 3443 | 1132 | 5066 | 3521 | 1343 |
| 50%ile | 8740 | 7035 | 4438 | 8724 | 7142 | 4726 |
| 95%ile | 10362 | 9580 | 8331 | 10328 | 9614 | 8390 |
| mean | 8408 | 6850 | 4593 | 8405 | 6881 | 4796 |
| UL delay (s) | 5%ile | 1.603 | 1.8 | 2.272 | 1.609 | 1.8 | 2.245 |
| 50%ile | 2.084 | 2.862 | 5.932 | 2.093 | 2.838 | 5.189 |
| 95%ile | 3.861 | 6.806 | 30.388 | 3.773 | 6.608 | 21.325 |
| mean | 2.29 | 3.368 | 9.494 | 2.292 | 3.316 | 7.919 |
| Arrival rate (files/s) | | 10 | 15 | 20 | 10 | 15 | 20 |
| 𝜌DL | | 0.999 | 0.999 | 0.987 | 0.999 | 0.999 | 0.993 |
| 𝜌UL | | 0.999 | 0.999 | 0.996 | 0.999 | 0.999 | 0.997 |
| BO | | 0.18 | 0.331 | 0.5 | 0.179 | 0.325 | 0.504 |
| Additional report/notes: Case 3 and Case 4:  LBT procedure and parameters: ECCA based Contention at gNB: 8us+(1-3)\*5us, at the gNB.  Rx-Assistance: Silencing signals sent by gNB and UE after winning the medium. Only gNBs perform extended CCA.  All results are for 2 operator Indoor office scenarios. Main Setup described in the column header and Table 1.  Only gNBs perform extended CCA. No COT sharing from UL to DL.  Common: DL-UL Traffic:50:50, FTP Model 3, 2MB file.{SCS,BW=960Khz,2GHz},{[k1,k2,k3]=[12,0,32] NR slots}, COT duration 0.25ms, Multi-user scheduling 1 user.COT with beam persistence | | | | | | | |

Table B.2.2.3-3. System level evaluation results for indoor scenario A

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | Case 5: -67dBM@gNB, Tx Sensing  (Mg,Ng,M,N,P) = (1,1,4,8,2) with (0.5 dv, 0.5 dH), 2Mbytes, 2 Operators, Directional Sensing | | | Case 6: -72dBM@gNB, Tx Sensing  (Mg,Ng,M,N,P) = (1,1,4,8,2) with (0.5 dv, 0.5 dH), 2Mbytes, 2 Operators Directional Sensing | | |
| R1-2009362 / Source 3 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 6133 | 3698 | 791 | 6212 | 3710 | 874 |
| 50%ile | 11328 | 8385 | 4730 | 11344 | 8503 | 4888 |
| 95%ile | 13610 | 12535 | 10512 | 13632 | 12465 | 10476 |
| mean | 10725 | 8301 | 5038 | 10722 | 8347 | 5143 |
| DL delay (s) | 5%ile | 1.23 | 1.436 | 1.944 | 1.237 | 1.445 | 1.889 |
| 50%ile | 1.715 | 2.547 | 5.659 | 1.718 | 2.595 | 5.524 |
| 95%ile | 3.452 | 6.646 | 81.718 | 3.393 | 6.992 | 52.664 |
| mean | 1.949 | 3.21 | 22.175 | 1.946 | 3.205 | 21.199 |
| UL UPT (Mbps) | 5%ile | 4999 | 3466 | 1001 | 5030 | 3454 | 996 |
| 50%ile | 8726 | 6979 | 4169 | 8779 | 6989 | 4296 |
| 95%ile | 10363 | 9573 | 8298 | 10373 | 9575 | 8255 |
| mean | 8397 | 6809 | 4357 | 8409 | 6798 | 4411 |
| UL delay (s) | 5%ile | 1.606 | 1.812 | 2.292 | 1.602 | 1.806 | 2.312 |
| 50%ile | 2.082 | 2.912 | 6.481 | 2.071 | 2.89 | 6.168 |
| 95%ile | 3.881 | 6.662 | 36.804 | 3.858 | 6.578 | 33.331 |
| mean | 2.301 | 3.412 | 11.291 | 2.287 | 3.407 | 10.714 |
| Arrival rate (files/s) | | 10 | 15 | 20 | 10 | 15 | 20 |
| 𝜌DL | | 0.999 | 0.999 | 0.986 | 0.999 | 0.999 | 0.986 |
| 𝜌UL | | 0.999 | 0.999 | 0.995 | 0.999 | 0.999 | 0.995 |
| BO | | 0.18 | 0.334 | 0.518 | 0.18 | 0.333 | 0.496 |
| Additional report/notes: Case 5 and Case 6:  LBT procedure and parameters: Baseline LBT Procedure at gNB: 8us+(1-3)\*5us, at the gNB. Only gNBs perform extended CCA  All Results with 2 operator Indoor scenario. Main assumptions provided in Column header and Table 1. Directional LBT – Energy Detection in the direction of UE to serve, with same beam as the transmission beam.  Only gNBs perform extended CCA. No COT sharing from UL to DL.  Common: DL-UL Traffic:50:50, FTP Model 3, 2MB file.{SCS,BW=960Khz,2GHz},{[k1,k2,k3]=[12,0,32] NR slots}, COT duration 0.25ms, Multi-user scheduling -1 user per COT with beam persistence. | | | | | | | |

Table B.2.2.3-4. System level evaluation results for indoor scenario A

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | Case 7: -67dBM@gNB, Rx Assistance  (Mg,Ng,M,N,P) = (1,1,4,8,2) with (0.5 dv, 0.5 dH), 2Mbytes, 2 Operators, Directional Sensing | | | Case 8: -72dBM@gNB, , Rx Assistance  (Mg,Ng,M,N,P) = (1,1,4,8,2) with (0.5 dv, 0.5 dH), 2Mbytes, 2 Operators Directional Sensing | | |
| R1-2009362 / Source 3 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 6136 | 3692 | 874 | 6139 | 3809 | 1148 |
| 50%ile | 11231 | 8642 | 4954 | 11270 | 8782 | 5675 |
| 95%ile | 13448 | 12371 | 10582 | 13498 | 12450 | 10806 |
| mean | 10605 | 8346 | 5312 | 10687 | 8510 | 5783 |
| DL delay (s) | 5%ile | 1.24 | 1.43 | 1.859 | 1.238 | 1.448 | 1.819 |
| 50%ile | 1.729 | 2.478 | 5.159 | 1.692 | 2.434 | 4.455 |
| 95%ile | 3.463 | 6.799 | 52.919 | 3.466 | 6.218 | 29.454 |
| mean | 1.957 | 3.174 | 18.912 | 1.93 | 3.016 | 13.05 |
| UL UPT (Mbps) | 5%ile | 4990 | 3485 | 1206 | 5088 | 3556 | 1335 |
| 50%ile | 8758 | 7055 | 4383 | 8765 | 7116 | 4783 |
| 95%ile | 10351 | 9612 | 8236 | 10350 | 9620 | 8455 |
| mean | 8405 | 6836 | 4566 | 8399 | 6916 | 4860 |
| UL delay (s) | 5%ile | 1.602 | 1.792 | 2.338 | 1.608 | 1.799 | 2.223 |
| 50%ile | 2.079 | 2.867 | 5.735 | 2.08 | 2.802 | 4.957 |
| 95%ile | 3.906 | 6.877 | 30.671 | 3.766 | 6.4 | 23.645 |
| mean | 2.295 | 3.384 | 9.428 | 2.299 | 3.261 | 8.354 |
| Arrival rate (files/s) | | 10 | 15 | 20 | 10 | 15 | 20 |
| 𝜌DL | | 0.999 | 0.999 | 0.988 | 0.999 | 0.999 | 0.994 |
| 𝜌UL | | 0.999 | 0.999 | 0.996 | 0.999 | 0.999 | 0.997 |
| BO | | 0.18 | 0.329 | 0.495 | 0.179 | 0.326 | 0.497 |
| Additional report/notes: Case 7 and Case 8:  LBT procedure and parameters: ECCA based Contention at gNB: 8us+(1-3)\*5us, at the gNB.  Rx-Assistance: Silencing signals sent by gNB and UE after winning the medium. Only gNBs perform extended CCA.  Directional LBT – Sensing done at gNB in the direction of the intended UE, with same beam as the transmission beam. All results are for 2 operator Indoor office scenarios. Main Setup described in the column header and Table 1.  Only gNBs perform extended CCA. No COT sharing from UL to DL.  Common: DL-UL Traffic:50:50, FTP Model 3, 2MB file.{SCS,BW=960Khz,2GHz},{[k1,k2,k3]=[12,0,32] NR slots}, COT duration 0.25ms, Multi-user scheduling -1 user per COT with beam persistence. | | | | | | | |

Table B.2.2.3-5. System level evaluation results for indoor scenario A

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Cases | | Case 9: -47dBM@gNB, Tx Sensing  (Mg,Ng,M,N,P) = (1,1,8,16,2) with (0.5 dv, 0.5 dH), 2Mbytes, 2 Operators, Omni Sensing | | | Case10: -67dBM@gNB, , Tx Sensing  (Mg,Ng,M,N,P) = (1,1,8,16,2) with (0.5 dv, 0.5 dH), 2Mbytes, 2 Operators Omni Sensing | | |
| R1-2009362 / Source 3 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 6576 | 4888 | 1848 | 6635 | 4929 | 1997 |
| 50%ile | 11495 | 10028 | 5942 | 11428 | 10011 | 6094 |
| 95%ile | 13400 | 12560 | 10568 | 13382 | 12576 | 10522 |
| mean | 10892 | 9474 | 6139 | 10860 | 9467 | 6178 |
| DL delay (s) | 5%ile | 1.258 | 1.394 | 1.875 | 1.261 | 1.394 | 1.853 |
| 50%ile | 1.627 | 2.006 | 3.9 | 1.635 | 2.022 | 3.859 |
| 95%ile | 3.1 | 4.438 | 15.855 | 3.229 | 4.351 | 14.397 |
| mean | 1.853 | 2.352 | 6.46 | 1.857 | 2.353 | 6.204 |
| UL UPT (Mbps) | 5%ile | 7106 | 5859 | 2909 | 7040 | 5796 | 2915 |
| 50%ile | 9406 | 8610 | 6309 | 9416 | 8613 | 6369 |
| 95%ile | 10297 | 9812 | 8582 | 10281 | 9838 | 8533 |
| mean | 9126 | 8344 | 6125 | 9124 | 8340 | 6151 |
| UL delay (s) | 5%ile | 1.615 | 1.734 | 2.129 | 1.613 | 1.725 | 2.149 |
| 50%ile | 1.86 | 2.141 | 3.439 | 1.861 | 2.141 | 3.443 |
| 95%ile | 2.733 | 3.569 | 10.374 | 2.739 | 3.556 | 9.89 |
| mean | 1.985 | 2.32 | 4.523 | 1.984 | 2.32 | 4.389 |
| Arrival rate (files/s) | | 15 | 20 | 30 | 15 | 20 | 30 |
| 𝜌DL | | 0.999 | 1 | 0.997 | 0.999 | 1 | 0.998 |
| 𝜌UL | | 0.999 | 0.999 | 0.999 | 0.999 | 0.999 | 0.999 |
| BO | | 0.232 | 0.338 | 0.56 | 0.231 | 0.338 | 0.569 |
| Additional report/notes: Case 9 and Case 10:  LBT procedure and parameters: Baseline LBT Procedure at gNB: 8us+(1-3)\*5us, at the gNB. Only gNBs perform extended CCA.  All Results with 2 operator Indoor scenario. Main assumptions provided in Column header and Table 1. Omni Directional LBT with specified thresholds.  No COT sharing from UL to DL.  Common: DL-UL Traffic:50:50, FTP Model 3, 2MB file.{SCS,BW=960Khz,2GHz},{[k1,k2,k3]=[12,0,32] NR slots}, COT duration 0.25ms, Multi-user scheduling -1 user per COT with beam persistence. | | | | | | | |

Table B.2.2.3-6. System level evaluation results for indoor scenario A

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Cases | | Case 11 -67dBM@gNB, Tx Sensing  (Mg,Ng,M,N,P) = (1,1,8,16,2) with (0.5 dv, 0.5 dH), 2Mbytes, 2 Operators, Directional Sensing | | | Case12: -72dBM@gNB, Tx Sensing  (Mg,Ng,M,N,P) = (1,1,8,16,2) with (0.5 dv, 0.5 dH), 2Mbytes, 2 Operators Directional Sensing | | |
| R1-2009362 / Source 3 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 6369 | 4880 | 1971 | 6644 | 4834 | 2003 |
| 50%ile | 11443 | 10011 | 6033 | 11446 | 9933 | 6041 |
| 95%ile | 13377 | 12579 | 10475 | 13341 | 12519 | 10518 |
| mean | 10853 | 9468 | 6156 | 10841 | 9414 | 6152 |
| DL delay (s) | 5%ile | 1.264 | 1.392 | 1.843 | 1.27 | 1.397 | 1.903 |
| 50%ile | 1.632 | 2.014 | 3.932 | 1.64 | 2.041 | 3.897 |
| 95%ile | 3.179 | 4.328 | 14.559 | 3.164 | 4.359 | 14.482 |
| mean | 1.859 | 2.348 | 6.579 | 1.864 | 2.372 | 6.193 |
| UL UPT (Mbps) | 5%ile | 7070 | 5837 | 2947 | 7146 | 5716 | 2900 |
| 50%ile | 9422 | 8604 | 6272 | 9409 | 8582 | 6296 |
| 95%ile | 10286 | 9818 | 8570 | 10280 | 9815 | 8573 |
| mean | 9126 | 8337 | 6133 | 9122 | 8321 | 6152 |
| UL delay (s) | 5%ile | 1.615 | 1.73 | 2.157 | 1.618 | 1.73 | 2.162 |
| 50%ile | 1.859 | 2.144 | 3.493 | 1.861 | 2.137 | 3.491 |
| 95%ile | 2.81 | 3.495 | 9.853 | 2.764 | 3.72 | 9.7 |
| mean | 1.984 | 2.326 | 4.435 | 1.984 | 2.332 | 4.332 |
| Arrival rate (files/s) | | 15 | 20 | 30 | 15 | 20 | 30 |
| 𝜌DL | | 0.999 | 1 | 0.997 | 0.999 | 1 | 0.997 |
| 𝜌UL | | 0.999 | 0.999 | 0.999 | 0.999 | 0.999 | 0.999 |
| BO | | 0.232 | 0.337 | 0.565 | 0.231 | 0.338 | 0.554 |
| Additional report/notes: Case 11 and Case 12:  LBT procedure and parameters: Baseline LBT Procedure at gNB: 8us+(1-3)\*5us, at the gNB. Only gNBs perform extended CCA  All Results with 2 operator Indoor scenario. Main assumptions provided in Column header and Table 1. Directional LBT – Energy Detection in the direction of UE to serve, with same beam as the transmission beam.  Only gNBs perform extended CCA. No COT sharing from UL to DL.  Common: DL-UL Traffic:50:50, FTP Model 3, 2MB file.{SCS,BW=960Khz,2GHz},{[k1,k2,k3]=[12,0,32] NR slots}, COT duration 0.25ms, Multi-user scheduling -1 user per COT with beam persistence. | | | | | | | |

Table B.2.2.3-7. System level evaluation results for indoor scenario A

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Cases | | Case 13: -67dBM@gNB, Rx Assistance  (Mg,Ng,M,N,P) = (1,1,8,16,2) with (0.5 dv, 0.5 dH), 2Mbytes, 2 Operators, Omni Sensing | | | Case14: -72dBM@gNB, Rx Assistance  (Mg,Ng,M,N,P) = (1,1,8,16,2) with (0.5 dv, 0.5 dH), 2Mbytes, 2 Operators Omni Sensing | | |
| R1-2009362 / Source 3 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 6526 | 4771 | 2133 | 6523 | 5001 | 2347 |
| 50%ile | 11384 | 9959 | 6366 | 11381 | 10040 | 6746 |
| 95%ile | 13214 | 12429 | 10545 | 13169 | 12359 | 10641 |
| mean | 10755 | 9429 | 6362 | 10764 | 9491 | 6675 |
| DL delay (s) | 5%ile | 1.272 | 1.409 | 1.833 | 1.286 | 1.416 | 1.799 |
| 50%ile | 1.628 | 2.002 | 3.63 | 1.623 | 1.966 | 3.312 |
| 95%ile | 3.208 | 4.331 | 12.167 | 3.153 | 4.227 | 11.129 |
| mean | 1.866 | 2.33 | 5.678 | 1.856 | 2.302 | 5.038 |
| UL UPT (Mbps) | 5%ile | 7036 | 5738 | 2997 | 7092 | 5748 | 3242 |
| 50%ile | 9414 | 8592 | 6479 | 9396 | 8616 | 6591 |
| 95%ile | 10283 | 9853 | 8648 | 10265 | 9813 | 8634 |
| mean | 9132 | 8358 | 6283 | 9121 | 8344 | 6408 |
| UL delay (s) | 5%ile | 1.615 | 1.724 | 2.105 | 1.618 | 1.733 | 2.107 |
| 50%ile | 1.853 | 2.141 | 3.262 | 1.865 | 2.12 | 3.184 |
| 95%ile | 2.76 | 3.572 | 9.22 | 2.735 | 3.507 | 7.599 |
| mean | 1.98 | 2.306 | 4.126 | 1.979 | 2.309 | 3.851 |
| Arrival rate (files/s) | | 15 | 20 | 30 | 15 | 20 | 30 |
| 𝜌DL | | 0.999 | 1 | 0.998 | 0.999 | 1 | 0.998 |
| 𝜌UL | | 0.999 | 0.999 | 0.999 | 0.999 | 0.999 | 0.999 |
| BO | | 0.231 | 0.338 | 0.564 | 0.232 | 0.334 | 0.553 |
| Additional report/notes: Case 13 and Case 14:  LBT procedure and parameters: ECCA based Contention at gNB: 8us+(1-3)\*5us, at the gNB.  Rx-Assistance: Silencing signals sent by gNB and UE after winning the medium. Only gNBs perform extended CCA.  All results are for 2 operator Indoor office scenarios. Main Setup described in the column header and Table 1.  Only gNBs perform extended CCA. No COT sharing from UL to DL.  Common: DL-UL Traffic:50:50, FTP Model 3, 2MB file.{SCS,BW=960Khz,2GHz},{[k1,k2,k3]=[12,0,32] NR slots}, COT duration 0.25ms, Multi-user scheduling -1 user per COT with beam persistence. | | | | | | | |

Table B.2.2.3-8. System level evaluation results for indoor scenario A

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Cases | | Case 15: -67dBM@gNB, Rx Assistance  (Mg,Ng,M,N,P) = (1,1,8,16,2) with (0.5 dv, 0.5 dH), 2Mbytes, 2 Operators, Directional Sensing | | | Case 16: -72dBM@gNB, Rx Assistance  (Mg,Ng,M,N,P) = (1,1,8,16,2) with (0.5 dv, 0.5 dH), 2Mbytes, 2 Operators Directional Sensing | | |
| R1-2009362 / Source 3 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 6443 | 4782 | 2134 | 6752 | 5076 | 2408 |
| 50%ile | 11399 | 10083 | 6367 | 11400 | 10152 | 6836 |
| 95%ile | 13200 | 12406 | 10584 | 13162 | 12364 | 10668 |
| mean | 10759 | 9443 | 6378 | 10807 | 9514 | 6704 |
| DL delay (s) | 5%ile | 1.276 | 1.394 | 1.829 | 1.284 | 1.412 | 1.8 |
| 50%ile | 1.62 | 1.991 | 3.594 | 1.618 | 1.945 | 3.275 |
| 95%ile | 3.179 | 4.415 | 12.388 | 3.093 | 4.215 | 10.824 |
| mean | 1.861 | 2.328 | 5.809 | 1.844 | 2.29 | 4.734 |
| UL UPT (Mbps) | 5%ile | 7010 | 5810 | 3013 | 7098 | 5882 | 3220 |
| 50%ile | 9411 | 8625 | 6454 | 9419 | 8644 | 6648 |
| 95%ile | 10290 | 9838 | 8654 | 10260 | 9838 | 8644 |
| mean | 9134 | 8363 | 6282 | 9122 | 8370 | 6444 |
| UL delay (s) | 5%ile | 1.613 | 1.733 | 2.112 | 1.615 | 1.729 | 2.095 |
| 50%ile | 1.86 | 2.132 | 3.286 | 1.857 | 2.119 | 3.143 |
| 95%ile | 2.739 | 3.577 | 9.195 | 2.704 | 3.499 | 7.806 |
| mean | 1.975 | 2.302 | 4.15 | 1.976 | 2.293 | 3.819 |
| Arrival rate (files/s) | | 15 | 20 | 30 | 15 | 20 | 30 |
| 𝜌DL | | 0.999 | 1 | 0.998 | 0.999 | 1 | 0.999 |
| 𝜌UL | | 0.999 | 0.999 | 0.999 | 0.999 | 0.999 | 0.999 |
| BO | | 0.23 | 0.336 | 0.571 | 0.228 | 0.335 | 0.551 |
| Additional report/notes: Case 15 and Case 16:  LBT procedure and parameters: ECCA based Contention at gNB: 8us+(1-3)\*5us, at the gNB.  Rx-Assistance: Silencing signals sent by gNB and UE after winning the medium. Only gNBs perform extended CCA.  Directional LBT – Sensing done at gNB in the direction of the intended UE, with same beam as the transmission beam. All results are for 2 operator Indoor office scenarios. Main Setup described in the column header and Table 1.  Only gNBs perform extended CCA. No COT sharing from UL to DL.  Common: DL-UL Traffic:50:50, FTP Model 3, 2MB file.{SCS,BW=960Khz,2GHz},{[k1,k2,k3]=[12,0,32] NR slots}, COT duration 0.25ms, Multi-user scheduling -1 user per COT with beam persistence. | | | | | | | |

#### B.2.2.4 Source 4 [37]

Table B.2.2.4-1. System level evaluation results for indoor scenario A

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases (scenario A) | | no LBT | | | omni-directional LBT | | | directional LBT | | |
| R1-2007653 / Source 4 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 2855.02 | 1781.36 | 314.07 | 2852.51 | 1915.01 | 489.35 | 2283.13 | 1606.05 | 414.88 |
| 50%ile | 9403.74 | 7295.97 | 3215.40 | 9261.99 | 7443.08 | 3722.77 | 8917.87 | 6844.76 | 3601.45 |
| 95%ile | 15368.94 | 13972.57 | 10753.71 | 15796.49 | 13935.58 | 10900.44 | 15813.50 | 13931.07 | 10892.34 |
| mean | 9533.10 | 7691.84 | 4148.07 | 9539.51 | 7744.95 | 4485.14 | 9372.87 | 7444.27 | 4442.28 |
| DL delay (s) | 5%ile | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| 50%ile | 0.02 | 0.03 | 0.08 | 0.02 | 0.03 | 0.08 | 0.02 | 0.03 | 0.07 |
| 95%ile | 0.12 | 0.22 | 0.76 | 0.13 | 0.21 | 0.67 | 0.13 | 0.22 | 0.62 |
| mean | 0.04 | 0.06 | 0.19 | 0.04 | 0.06 | 0.18 | 0.04 | 0.06 | 0.17 |
| UL UPT (Mbps) | 5%ile | 1154.55 | 743.61 | 174.68 | 953.56 | 683.63 | 219.10 | 986.52 | 583.05 | 181.54 |
| 50%ile | 5533.82 | 4394.30 | 2467.35 | 5297.09 | 4041.75 | 2142.84 | 4985.30 | 3782.74 | 2062.24 |
| 95%ile | 14673.77 | 12899.08 | 9980.28 | 14754.13 | 12027.72 | 9256.56 | 14280.57 | 12204.77 | 9029.75 |
| mean | 6629.05 | 5401.71 | 3392.04 | 6308.31 | 5007.02 | 3123.04 | 6070.00 | 4927.91 | 3022.04 |
| UL delay (s) | 5%ile | 0.01 | 0.01 | 0.02 | 0.01 | 0.01 | 0.02 | 0.01 | 0.01 | 0.02 |
| 50%ile | 0.01 | 0.02 | 0.02 | 0.01 | 0.02 | 0.03 | 0.01 | 0.02 | 0.03 |
| 95%ile | 0.17 | 0.26 | 0.69 | 0.32 | 0.36 | 0.66 | 0.33 | 0.37 | 0.66 |
| mean | 0.06 | 0.08 | 0.18 | 0.08 | 0.11 | 0.19 | 0.09 | 0.10 | 0.19 |
| Arrival rate (files/s) | | 0.60 | 1.00 | 1.80 | 0.60 | 1.00 | 1.80 | 0.60 | 1.00 | 1.80 |
| 𝜌DL | | 1.00 | 0.99 | 0.94 | 1.00 | 1.00 | 0.96 | 0.98 | 0.96 | 0.92 |
| 𝜌UL | | 0.93 | 0.89 | 0.84 | 0.93 | 0.89 | 0.83 | 0.92 | 0.86 | 0.80 |
| BO | | 0.22 | 0.40 | 0.73 | 0.27 | 0.45 | 0.75 | 0.29 | 0.46 | 0.76 |
| Additional report/notes:  1. LBT procedure and parameters  The LBT procedure is based on the draft v2.1.20 of EN 302 567, generating a random back off counter that is decreasing upon CCA succeeds and channel is considered as available when the counter becomes 0. The difference lies in that only one category is defined for 60GHz band here instead of 4 categories in 5GHz.  ED threshold: -47 dBm, CCA slot length: 5 us, Maximum Channel Occupancy Time: 2ms, Contention Window Size: [0,3], mp = 1, Td = 8 us.  2. any assumptions/parameters used not as in the agreed baseline  3. Details of case: e.g., single or two operators; no-LBT, omni-directional LBT, directional LBT schemes etc.  no LBT: without LBT scheme  omni-directional LBT: A transmission node listens to the channel using an omni-directional antenna and then performs transmission in any direction to the reception node(s).  directional LBT: A transmission node listens to the channel using an directional antenna and then performs transmission in this direction to the reception node(s).  4. Other metric(s) and definition if reported  5. Details of COT sharing if used in evaluation  UE can share gNB’s initiated COT without LBT gap and transmit uplink signals. | | | | | | | | | | |

Table B.2.2.4-2. System level evaluation results for indoor scenario A

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases (scenario A) | | receiver-assisted omni-directional LBT | | | receiver-assisted directional LBT | | |
| R1-2007653 / Source 4 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 2821.80 | 1901.38 | 439.18 | 2681.82 | 1700.56 | 271.17 |
| 50%ile | 9257.08 | 7343.11 | 3761.23 | 9028.41 | 7077.76 | 3635.26 |
| 95%ile | 15801.13 | 14102.28 | 11123.56 | 15532.99 | 14000.36 | 11180.96 |
| mean | 9548.47 | 7762.27 | 4504.13 | 9384.98 | 7619.36 | 4489.52 |
| DL delay (s) | 5%ile | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| 50%ile | 0.02 | 0.03 | 0.08 | 0.02 | 0.03 | 0.07 |
| 95%ile | 0.13 | 0.22 | 0.63 | 0.12 | 0.22 | 0.67 |
| mean | 0.04 | 0.06 | 0.17 | 0.04 | 0.06 | 0.17 |
| UL UPT (Mbps) | 5%ile | 956.07 | 694.68 | 239.10 | 925.43 | 671.77 | 179.49 |
| 50%ile | 5228.97 | 4261.81 | 2413.70 | 5179.68 | 3879.64 | 2088.79 |
| 95%ile | 14238.00 | 12111.56 | 9187.09 | 14444.61 | 11873.55 | 8891.43 |
| mean | 6181.77 | 5029.66 | 3151.09 | 6120.56 | 4926.70 | 3076.43 |
| UL delay (s) | 5%ile | 0.01 | 0.01 | 0.02 | 0.01 | 0.01 | 0.02 |
| 50%ile | 0.01 | 0.02 | 0.03 | 0.01 | 0.02 | 0.02 |
| 95%ile | 0.33 | 0.37 | 0.67 | 0.32 | 0.40 | 0.65 |
| mean | 0.09 | 0.10 | 0.19 | 0.09 | 0.11 | 0.18 |
| Arrival rate (files/s) | | 0.60 | 1.00 | 1.80 | 0.60 | 1.00 | 1.80 |
| 𝜌DL | | 1.00 | 1.00 | 0.96 | 0.98 | 0.97 | 0.90 |
| 𝜌UL | | 0.93 | 0.89 | 0.83 | 0.91 | 0.88 | 0.79 |
| BO | | 0.27 | 0.44 | 0.75 | 0.28 | 0.45 | 0.76 |
| Additional report/notes:  1. LBT procedure and parameters  The LBT procedure is based on the draft v2.1.20 of EN 302 567, generating a random back off counter that is decreasing upon CCA succeeds and channel is considered as available when the counter becomes 0. The difference lies in that only one category is defined for 60GHz band here instead of 4 categories in 5GHz.  ED threshold: -47 dBm, CCA slot length: 5 us, Maximum Channel Occupancy Time: 2ms, Contention Window Size: [0,3], mp = 1, Td = 8 us.  2. any assumptions/parameters used not as in the agreed baseline  3. Details of case: e.g., single or two operators; no-LBT, omni-directional LBT, directional LBT schemes etc.  receiver-assisted omni-directional LBT: A transmission node listens to the channel using an omni-directional antenna, and then send out RTS in omni-direction, and then performs transmission in the directions to the reception node(s) which send out CTS.  receiver-assisted directional LBT: A transmission node listens to the channel using an directional antenna, and then send out RTS in this dirction, and then performs transmission in the direction to the reception node(s) which send out CTS.  4. Other metric(s) and definition if reported  5. Details of COT sharing if used in evaluation  UE can share gNB’s initiated COT without LBT gap and transmit uplink signals. | | | | | | | |

#### B.2.2.5 Source 5 [64]

Table B.2.2.5-1. System level evaluation results for coexistence interference analysis with CCA=-68dBm

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | Case 1：Omni vs Omni | | Case2:Omni vs Directional | |
| Operator1 | Operator2 | Operator1 | Operator2 |
| R1-2009450/ Source 5 | Traffic load  Metrics | | medium load  35%~50% BO | | medium load  35%~50% BO | |
| DL UPT (Mbps) | 5%ile | 3033.1213 | 2287.0171 | 2828.5513 | 3060.1575 |
| 50%ile | 9441.7471 | 8566.0156 | 9444.8320 | 10166.2471 |
| 95%ile | 16029.5293 | 14801.7207 | 16146.0420 | 17572.2949 |
| mean | 10065.5078 | 8785.5869 | 10001.9004 | 10481.0479 |
| DL delay (s) | 5%ile | 0.010 | 0.011 | 0.010 | 0.010 |
| 50%ile | 0.024 | 0.029 | 0.024 | 0.021 |
| 95%ile | 0.175 | 0.181 | 0.184 | 0.117 |
| mean | 0.050 | 0.055 | 0.052 | 0.038 |
| Arrival rate (files/s) | | 2 | 2 | 2 | 2 |
| 𝜌DL | | 100% | 100% | 100% | 100% |
| BO | | 30.253% | 35.013% | 31.050% | 28.234% |
| Additional report/notes:  LBT procedure and parameters  Refer to Section A.2 in R1-2009450. Subcarrier spacing is 960KHz;  LBT procedure align with v2.1.20 of EN 302 567;  CWmax=10;  any assumptions/parameters used not as in the agreed baseline  3. Details of case: two operators; omni-directional LBT, directional LBT schemes; Indoor Scenario A  Case1：. two operators,Omni(Operator1) vs Omni(Operator2);  Case2：. two operators,Omni(Operator1) vs Directional(Operator2)  4. Other metric(s) and definition if reported  5. Details of COT sharing if used in evaluation:DL Only,No COT sharing | | | | | |

Table B.2.2.5-2. performance of different LBT mode of various traffic load with CCA=-62dBm

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | LBT mode | | omni | | | directional | | |
| R1-2009450/ Source 5 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 3546.6826 | 3033.7112 | 975.4548 | 3547.0242 | 3110.3704 | 1207.0940 |
| 50%ile | 11305.6396 | 10783.6074 | 7088.4458 | 11371.8018 | 10765.0527 | 8245.8027 |
| 95%ile | 18089.7539 | 18282.6270 | 15489.9375 | 18654.7754 | 18886.9160 | 16380.3154 |
| mean | 11196.8545 | 10566.7207 | 8016.2710 | 11427.4307 | 10969.6787 | 8994.2236 |
| DL delay (s) | 5%ile | 0.010 | 0.010 | 0.011 | 0.010 | 0.010 | 0.011 |
| 50%ile | 0.020 | 0.021 | 0.032 | 0.020 | 0.020 | 0.027 |
| 95%ile | 0.072 | 0.109 | 0.589 | 0.070 | 0.099 | 0.429 |
| mean | 0.028 | 0.036 | 0.122 | 0.027 | 0.033 | 0.109 |
| Arrival rate (files/s) | | 1.25 | 2 | 3.5 | 1.25 | 2 | 3.5 |
| 𝜌DL | | 100% | 100% | 100% | 100% | 100% | 100% |
| BO | | 14.746% | 25.491% | 56.031% | 14.312% | 24.300% | 50.851 % |
| Additional report/notes:  1.LBT procedure and parameters  Refer to Section A.2 in R1-2007967. Subcarrier spacing is 960KHz;  LBT procedure align with v2.1.20 of EN 302 567;  CWmax=10;  2.any assumptions/parameters used not as in the agreed baseline  3. Details of case: two operators; omni-directional LBT, directional LBT schemes; Indoor Scenario A  4. Other metric(s) and definition if reported  5. Details of COT sharing if used in evaluation:DL Only,No COT sharing | | | | | | | |

Table B.2.2.5-3. performance of different LBT mode of various traffic load with CCA=-68dBm

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | LBT mode | | omni | | | directional | | |
| R1-2009450/ Source 5 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 3100.9858 | 1712.3741 | 245.2404 | 3312.4214 | 2718.2942 | 723.0867 |
| 50%ile | 10191.9561 | 8506.4385 | 4438.5952 | 11147.1846 | 9503.4453 | 5792.6738 |
| 95%ile | 16638.7871 | 14970.9316 | 12214.0654 | 17476.5605 | 16888.0996 | 13832.0059 |
| mean | 10046.3867 | 8758.2285 | 5320.7637 | 10966.8721 | 9989.6123 | 6762.5283 |
| DL delay (s) | 5%ile | 0.010 | 0.011 | 0.013 | 0.010 | 0.011 | 0.012 |
| 50%ile | 0.023 | 0.028 | 0.061 | 0.020 | 0.023 | 0.042 |
| 95%ile | 0103 | 0.206 | 1.667 | 0.078 | 0.125 | 1.009 |
| mean | 0.035 | 0.061 | 0.330 | 0.029 | 0.040 | 0.205 |
| Arrival rate (files/s) | | 1.25 | 2 | 3.5 | 1.25 | 2 | 3.5 |
| 𝜌DL | | 100% | 100% | 100% | 100% | 100% | 99.89% |
| BO | | 17.327% | 33.466 % | 70.039% | 15.260% | 27.308% | 63.559 % |
| Additional report/notes:  1.LBT procedure and parameters  Refer to Section A.2 in R1-2009450. Subcarrier spacing is 960KHz;  LBT procedure align with v2.1.20 of EN 302 567;  CWmax=10;  2.any assumptions/parameters used not as in the agreed baseline  3. Details of case: two operators; omni-directional LBT, directional LBT schemes; Indoor Scenario A  4. Other metric(s) and definition if reported  5. Details of COT sharing if used in evaluation: DL Only,No COT sharing | | | | | | | |

Table B.2.2.5-4. performance of different LBT mode of various traffic load with CCA=-62dBm

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Tdoc / Source | Cases | | Omni | Direc |
| R1-2009450/ Source 5 | load  Metrics | | High load  above 55% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 787.1970 | 963.5551 |
| 50%ile | 3211.0288 | 3474.2285 |
| 95%ile | 5875.3906 | 5062.0288 |
| mean | 3295.7209 | 3390.7334 |
| DL delay (s) | 5%ile | 0.011 | 0.011 |
| 50%ile | 0.023 | 0.020 |
| 95%ile | 0.214 | 0.150 |
| mean | 0.074 | 0.046 |
| UL UPT (Mbps) | 5%ile | 36.0758 | 38.0263 |
| 50%ile | 505.9953 | 660.0948 |
| 95%ile | 3232.8450 | 3326.7085 |
| mean | 898.5682 | 1108.8021 |
| UL delay (s) | 5%ile | 0.014 | 0.014 |
| 50%ile | 0.075 | 0.065 |
| 95%ile | 1.479 | 1.444 |
| mean | 0.280 | 0.249 |
| Arrival rate(files/s) | | 9 | 9 |
| 𝜌DL | | 100% | 100% |
| 𝜌UL | | 94.51% | 94.38% |
| BO | | 70.97% | 67.34% |
| Additional report/notes:  1.LBT procedure and parameters  Refer to Section A.2 in R1-2007967. Subcarrier spacing is 960KHz;  LBT procedure align with v2.1.20 of EN 302 567;  CWmax=10;  2.any assumptions/parameters used not as in the agreed baseline  File size = 8M Bytes  3. Details of case: two operators; omni-directional LBT, directional LBT schemes; Indoor Scenario A  4. Other metric(s) and definition if reported  5. Details of COT sharing if used in evaluation  No COT sharing | | | |

Table B.2.2.5-5. performance of different LBT mode of various traffic load with CCA=-68dBm

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | Omni | Direc |
| R1-2009450/ Source 5 | load  Metrics | | High load  above 55% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 497.3786 | 939.2247 |
| 50%ile | 2311.2671 | 3370.9375 |
| 95%ile | 5017.5645 | 6728.2817 |
| mean | 2579.0989 | 3340.2598 |
| DL delay (s) | 5%ile | 0.010 | 0.007 |
| 50%ile | 0.039 | 0.023 |
| 95%ile | 0.444 | 0.175 |
| mean | 0.109 | 0.052 |
| UL UPT (Mbps) | 5%ile | 32.0786 | 36.4840 |
| 50%ile | 454.0096 | 581.5397 |
| 95%ile | 2869.6545 | 3244.2061 |
| mean | 896.6053 | 1040.3958 |
| UL delay (s) | 5%ile | 0.016 | 0.014 |
| 50%ile | 0.094 | 0.090 |
| 95%ile | 1.661 | 1.653 |
| mean | 0.478 | 0.490 |
| Arrival rate(files/s) | | 9 | 9 |
| 𝜌DL | | 100% | 100% |
| 𝜌UL | | 93.89% | 94.61% |
| BO | | 78.63% | 71.22% |
| Additional report/notes:  1.LBT procedure and parameters  Refer to Section A.2 in R1-2009450. Subcarrier spacing is 960KHz;  LBT procedure align with v2.1.20 of EN 302 567;  CWmax=10;  2.any assumptions/parameters used not as in the agreed baseline  File size = 8M Bytes  3. Details of case: two operators; omni-directional LBT, directional LBT schemes; Indoor Scenario A  4. Other metric(s) and definition if reported  5. Details of COT sharing if used in evaluation  No COT sharing | | | |

Table B.2.2.5-6. Different bandwidth performance of different LBT mode of various traffic load with CCA=-62dBm

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Channel bandwidth | | 400 MHz | | | | | |
| LBT scheme | | omni | | | Directional | | |
| R1-2009450/ Source 5 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 1300.0225 | 1059.2625 | 168.9819 | 1308.3411 | 1121.9795 | 256.5734 |
| 50%ile | 3168.2114 | 2788.5532 | 1287.3207 | 3255.4275 | 2917.9692 | 1516.7057 |
| 95%ile | 4915.9663 | 4500.5015 | 3472.9429 | 4915.9663 | 4731.4634 | 3670.7224 |
| mean | 3225.4819 | 2822.2759 | 1521.6208 | 3303.8604 | 2985.5891 | 1784.7135 |
| DL delay (s) | 5%ile | 0.042 | 0.042 | 0.051 | 0.042 | 0.040 | 0.048 |
| 50%ile | 0.072 | 0.083 | 0.176 | 0.084 | 0.077 | 0.145 |
| 95%ile | 0.190 | 0.347 | 3.177 | 0.176 | 0.292 | 2.434 |
| mean | 0.087 | 0.125 | 0.677 | 0.084 | 0.111 | 0.523 |
| Arrival rate (files/s) | | 0.3125 | 0.625 | 1.25 | 0.3125 | 0.625 | 1.25 |
| 𝜌DL | | 100% | 100% | 99.68% | 100% | 100% | 99.60% |
| BO | | 12.014% | 28.063% | 73.959% | 11.580% | 26.050% | 69.711% |
| Additional report/notes:  1.LBT procedure and parameters  Refer to Section A.2 in R1-2009450.  Subcarrier spacing is 960KHz for 2GHz bandwidth  Subcarrier spacing is 120KHz for 400MHz bandwidth  LBT procedure align with v2.1.20 of EN 302 567;  CWmax=10;  2.any assumptions/parameters used not as in the agreed baseline  3. Details of case: two operators; omni-directional LBT, directional LBT schemes; Indoor Scenario A  4. Other metric(s) and definition if reported  5. Details of COT sharing if used in evaluation:DL Only, No COT sharing | | | | | | | |

Table B.2.2.5-7. Different bandwidth performance of different LBT mode of various traffic load with CCA=-62dBm

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Channel bandwidth | | 2000 MHz | | | | | |
| LBT scheme | | omni | | | Directional | | |
| R1-2009450/ Source 5 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 3546.6826 | 3033.7112 | 975.4548 | 3547.0242 | 3110.3704 | 1207.0940 |
| 50%ile | 11305.6396 | 10783.6074 | 7088.4458 | 11371.8018 | 10765.0527 | 8245.8027 |
| 95%ile | 18089.7539 | 18282.6270 | 15489.9375 | 18654.7754 | 18886.9160 | 16380.3154 |
| mean | 11196.8545 | 10566.7207 | 8016.2710 | 11427.4307 | 10969.6787 | 8994.2236 |
| DL delay (s) | 5%ile | 0.010 | 0.010 | 0.011 | 0.010 | 0.010 | 0.011 |
| 50%ile | 0.020 | 0.021 | 0.032 | 0.020 | 0.020 | 0.027 |
| 95%ile | 0.072 | 0.109 | 0.589 | 0.070 | 0.099 | 0.429 |
| mean | 0.028 | 0.036 | 0.122 | 0.027 | 0.033 | 0.109 |
| Arrival rate (files/s) | | 1.25 | 2 | 3.5 | 1.25 | 2 | 3.5 |
| 𝜌DL | | 100% | 100% | 100% | 100% | 100% | 100% |
| BO | | 14.746% | 25.491% | 56.031% | 14.312% | 24.300% | 50.851 % |
| Additional report/notes:  1.LBT procedure and parameters  Refer to Section A.2 in R1-2009450.  Subcarrier spacing is 960KHz for 2GHz bandwidth  Subcarrier spacing is 120KHz for 400MHz bandwidth  LBT procedure align with v2.1.20 of EN 302 567;  CWmax=10;  2.any assumptions/parameters used not as in the agreed baseline  3. Details of case: two operators; omni-directional LBT, directional LBT schemes; Indoor Scenario A  4. Other metric(s) and definition if reported  5. Details of COT sharing if used in evaluation:DL Only, No COT sharing | | | | | | | |

Table B.2.2.5-8. Different bandwidth performance of different LBT mode of various traffic load with CCA=-68dBm

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Channel bandwidth | | 400 MHz | | | | | |
| LBT Scheme | | omni | | | Directional | | |
| R1-2009450/ Source 5 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 1286.4290 | 890.3098 | 117.3812 | 1315.3109 | 1081.5392 | 170.7861 |
| 50%ile | 2783.8201 | 2449.9802 | 905.8357 | 3156.8037 | 2763.4055 | 1337.1993 |
| 95%ile | 4840.3359 | 4338.0054 | 3084.9612 | 5019.1318 | 4531.5996 | 3379.1458 |
| mean | 3013.2285 | 2488.6345 | 1211.7831 | 3192.3352 | 2785.3354 | 1497.6672 |
| DL delay (s) | 5%ile | 0.042 | 0.042 | 0.050 | 0.042 | 0.042 | 0.052 |
| 50%ile | 0.078 | 0.097 | 0.255 | 0.072 | 0.084 | 0.173 |
| 95%ile | 0.221 | 0.459 | 4.668 | 0.197 | 0.344 | 3.096 |
| mean | 0.097 | 0.156 | 0.981 | 0.089 | 0.124 | 0.626 |
| Arrival rate (files/s) | | 0.3125 | 0.625 | 1.25 | 0.3125 | 0.625 | 1.25 |
| 𝜌DL | | 100% | 100% | 99.95% | 100% | 100% | 99.83% |
| BO | | 13.128% | 32.639% | 80.403% | 12.282% | 28.292% | 73.553% |
| Additional report/notes:  1.LBT procedure and parameters  Refer to Section A.2 in R1-2009450.  Subcarrier spacing is 960KHz for 2GHz bandwidth  Subcarrier spacing is 120KHz for 400MHz bandwidth  LBT procedure align with v2.1.20 of EN 302 567;  CWmax=10;  2.any assumptions/parameters used not as in the agreed baseline  3. Details of case: two operators; omni-directional LBT, directional LBT schemes; Indoor Scenario A  4. Other metric(s) and definition if reported  5. Details of COT sharing if used in evaluation:DL Only, No COT sharing | | | | | | | |

Table B.2.2.5-9. Different bandwidth performance of different LBT mode of various traffic load with CCA=-68dBm

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Channel bandwidth | | 2000 MHz | | | | | |
| LBT Scheme | | omni | | | Directional | | |
| R1-2009450/ Source 5 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 3100.9858 | 1712.3741 | 245.2404 | 3312.4214 | 2718.2942 | 723.0867 |
| 50%ile | 10191.9561 | 8506.4385 | 4438.5952 | 11147.1846 | 9503.4453 | 5792.6738 |
| 95%ile | 16638.7871 | 14970.9316 | 12214.0654 | 17476.5605 | 16888.0996 | 13832.0059 |
| mean | 10046.3867 | 8758.2285 | 5320.7637 | 10966.8721 | 9989.6123 | 6762.5283 |
| DL delay (s) | 5%ile | 0.010 | 0.011 | 0.013 | 0.010 | 0.011 | 0.012 |
| 50%ile | 0.023 | 0.028 | 0.061 | 0.020 | 0.023 | 0.042 |
| 95%ile | 0103 | 0.206 | 1.667 | 0.078 | 0.125 | 1.009 |
| mean | 0.035 | 0.061 | 0.330 | 0.029 | 0.040 | 0.205 |
| Arrival rate (files/s) | | 1.25 | 2 | 3.5 | 1.25 | 2 | 3.5 |
| 𝜌DL | | 100% | 100% | 100% | 100% | 100% | 99.89% |
| BO | | 17.327% | 33.466 % | 70.039% | 15.260% | 27.308% | 63.559 % |
| Additional report/notes:  1.LBT procedure and parameters  Refer to Section A.2 in R1-2009450.  Subcarrier spacing is 960KHz for 2GHz bandwidth  Subcarrier spacing is 120KHz for 400MHz bandwidth  LBT procedure align with v2.1.20 of EN 302 567;  CWmax=10;  2.any assumptions/parameters used not as in the agreed baseline  3. Details of case: two operators; omni-directional LBT, directional LBT schemes; Indoor Scenario A  4. Other metric(s) and definition if reported  5. Details of COT sharing if used in evaluation:DL Only, No COT sharing | | | | | | | |

#### B.2.2.6 Source 7 [62]

Table B.2.2.6-1. System level evaluation results for indoor scenario A

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | Case 1  (DL:UL 50:50, No-LBT) | | | Case 2  (DL:UL 50:50, Omni-LBT) | | |
| R1-2007928 / Source 7 | Traffic load  Metrics | | Low load | Medium load | High load | Low load | Medium load | High load |
| DL UPT (Mbps) | 5%ile | 2362 | 1187 | 631 | 2344 | 987 | 490 |
| 50%ile | 9137 | 5266 | 3083 | 8720 | 4391 | 2313 |
| 95%ile | 19548 | 16680 | 13333 | 18462 | 14979 | 11405 |
| mean | 9857 | 6843 | 4444 | 9280 | 5767 | 3544 |
| DL delay (ms) | 5%ile | 11 | 13 | 16 | 12 | 14 | 19 |
| 50%ile | 24 | 41 | 70 | 25 | 49 | 93 |
| 95%ile | 91 | 181 | 341 | 92 | 219 | 440 |
| mean | 34 | 61 | 111 | 35 | 74 | 143 |
| UL UPT (Mbps) | 5%ile | 1528 | 870 | 508 | 1484 | 682 | 342 |
| 50%ile | 4080 | 3198 | 2246 | 4041 | 2723 | 1721 |
| 95%ile | 7654 | 6968 | 6175 | 9643 | 6704 | 5456 |
| mean | 4297 | 3527 | 2723 | 4207 | 3107 | 2218 |
| UL delay (ms) | 5%ile | 28 | 31 | 35 | 22 | 32 | 40 |
| 50%ile | 53 | 68 | 96 | 53 | 79 | 125 |
| 95%ile | 141 | 247 | 424 | 144 | 317 | 630 |
| mean | 65 | 94 | 146 | 66 | 112 | 189 |
| Arrival rate (files/s) | | 1.5 | 2.75 | 4 | 1.5 | 2.75 | 4 |
| BO | | 25% | 54% | 78% | 25% | 58% | 82% |
| Additional report/notes:  LBT Procedures: No-LBT, Omni-LBT and Directional LBT  Cases:  Case 1: No-LBT, DL:UL 50:50  Case 2: Omni-LBT, DL:UL 50:50 | | | | | | | |

Table B.2.2.6-2. System level evaluation results for indoor scenario A

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | Case 3  (No-LBT, DL:UL 100:0) | | | Case 4  (Omni-LBT, DL:UL 100:0) | | | Case 5  (Directional-LBT,  DL:UL 100:0) | | |
| R1-2007928 / Source 7 | Traffic load  Metrics | | Low load | Medium Load | High Load | Low Load | Medium Load | High Load | Low Load | Medium Load | High Load |
| DL UPT (Mbps) | 5%ile | 2627 | 902 | 412 | 2388 | 861 | 350 | 2748 | 1050 | 395 |
| 50%ile | 9630 | 5859 | 3022 | 8675 | 4954 | 2466 | 9122 | 5352 | 2669 |
| 95%ile | 19548 | 17116 | 13723 | 17575 | 15021 | 11576 | 17955 | 15201 | 12067 |
| mean | 10204 | 7072 | 4455 | 9178 | 6076 | 3669 | 9596 | 6441 | 3930 |
| DL delay (ms) | 5%ile | 11 | 13 | 16 | 12 | 14 | 19 | 12 | 14 | 18 |
| 50%ile | 22 | 37 | 72 | 25 | 44 | 88 | 24 | 40 | 81 |
| 95%ile | 82 | 239 | 524 | 90 | 251 | 617 | 78 | 205 | 546 |
| mean | 31 | 69 | 139 | 35 | 77 | 166 | 31 | 65 | 151 |
| Arrival rate (files/s) | | 2.0 | 3.5 | 5.0 | 2.0 | 3.5 | 5.0 | 2.0 | 3.5 | 5.0 |
| BO | | 23.4% | 56% | 84.4% | 26.2% | 57.5% | 89.3% | 24.1% | 58 | 92.2% |
| Additional report/notes:  LBT Procedures: No-LBT, Omni-LBT and Directional LBT  Cases:  Case 1: No-LBT, DL:UL 100:0  Case 2: Omni-LBT, DL:UL 100:0  Case 3: Directional-LBT, DL:UL 100:0 | | | | | | | | | | |

#### B.2.2.7 Source 10 [67]

Table B.2.2.7-1: System level evaluation results for scenario Indoor-A

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | Case 1: no LBT | | | Case 2: omni-directional LBT | | | Case 3: directional LBT | | |
| R1-2008873 / Source 10 | Traffic  load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 3693.6 | 2131.4 | 1387.1 | 3420.3 | 1903.6 | 1288.3 | 3606.2 | 2184.3 | 1639.7 |
| 50%ile | 7720.5 | 6641.6 | 4006.2 | 7462.8 | 6370.2 | 3822.1 | 7646.8 | 6801.9 | 4579.4 |
| 95%ile | 14264.1 | 14208.3 | 14031.9 | 13595.5 | 13472.0 | 13039.9 | 14196.5 | 14355.6 | 14156.4 |
| mean | 8002.7 | 7161.2 | 5248.9 | 7643.7 | 6897.7 | 4573.9 | 7894.3 | 7197.6 | 5431.5 |
| DL delay (s) | 5%ile | 0.015 | 0.017 | 0.019 | 0.015 | 0.017 | 0.020 | 0.015 | 0.017 | 0.018 |
| 50%ile | 0.030 | 0.038 | 0.050 | 0.033 | 0.042 | 0.053 | 0.030 | 0.037 | 0.046 |
| 95%ile | 0.063 | 0.078 | 0.095 | 0.064 | 0.080 | 0.097 | 0.064 | 0.076 | 0.090 |
| mean | 0.033 | 0.040 | 0.051 | 0.036 | 0.044 | 0.055 | 0.034 | 0.038 | 0.047 |
| UL UPT (Mbps) | 5%ile | 1189.4 | 465.8 | 277.2 | 1125.1 | 401.5 | 246.0 | 1135.4 | 485.4 | 295.3 |
| 50%ile | 2850.8 | 1748.4 | 927.7 | 2413.5 | 1687.9 | 882.6 | 2813.2 | 1791.0 | 977.9 |
| 95%ile | 5698.3 | 5466.0 | 5125.8 | 5537.3 | 5348.2 | 5011.1 | 5613.9 | 5495.2 | 5213.8 |
| mean | 2436.7 | 1734.0 | 1029.5 | 2297.6 | 1627.7 | 922.6 | 2404.5 | 1783.4 | 1174.2 |
| UL delay (s) | 5%ile | 0.032 | 0.041 | 0.054 | 0.032 | 0.042 | 0.055 | 0.032 | 0.041 | 0.051 |
| 50%ile | 0.068 | 0.102 | 0.143 | 0.070 | 0.107 | 0.146 | 0.069 | 0.100 | 0.141 |
| 95%ile | 0.150 | 0.205 | 0.296 | 0.152 | 0.209 | 0.301 | 0.150 | 0.202 | 0.291 |
| mean | 0.089 | 0.117 | 0.152 | 0.091 | 0.120 | 0.158 | 0.090 | 0.114 | 0.146 |
| Arrival rate (files/s) | | 0.4 | 0.8 | 1.2 | 0.4 | 0.8 | 1.2 | 0.4 | 0.8 | 1.2 |
| 𝜌DL | | 0.99 | 0.99 | 0.98 | 0.99 | 0.98 | 0.98 | 0.99 | 0.99 | 0.98 |
| 𝜌UL | | 0.98 | 0.97 | 0.97 | 0.98 | 0.96 | 0.96 | 0.99 | 0.98 | 0.98 |
| BO | | 0.15 | 0.44 | 0.74 | 0.17 | 0.48 | 0.80 | 0.15 | 0.43 | 0.71 |
| Additional report/notes:  1. LBT procedure and parameters are following ETSI 302 567 v2.1.20  2. Details of cases:  Case 1: Indoor-A with two operators, no-LBT  Case 2: Indoor-A with two operators, omni-directional LBT  Case 3: Indoor-A with two operators, directional LBT  3. No COT sharing  4. Other parameters to report:  Carrier frequency: 60 GHz  Carrier bandwidth: 2 GHz  Numerology: 960 kHz SCS with NCP | | | | | | | | | | |

#### B.2.2.8 Source 14 [43]

Table B.2.2.8-1. System level evaluation results for scenario A – ceiling mounted BS with UE antenna configuration 1

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | Case 1 – No LBT | | | Case 2- Omnidirectional LBT | | | Case 3 – Directional LBT | | |
| R1-2009380 / Source 14 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 1845.98 | 145.03 | 11.19 | 1777.43 | 306.52 | 22.50 | 1805.80 | 303.72 | 24.20 |
| 50%ile | 3948.45 | 1046.90 | 139.50 | 3726.00 | 1436.33 | 271.95 | 3734.81 | 1458.00 | 279.46 |
| 95%ile | 5515.98 | 3324.67 | 1266.04 | 5232.62 | 3489.01 | 2019.97 | 5245.49 | 3509.15 | 2114.95 |
| mean | 3825.71 | 1318.04 | 312.44 | 3645.17 | 1583.18 | 534.07 | 3654.78 | 1610.66 | 555.41 |
| DL delay (s) | 5%ile | 2.44 | 3.52 | 8.23 | 2.55 | 3.31 | 5.42 | 2.55 | 3.25 | 5.27 |
| 50%ile | 4.16 | 20.56 | 107.48 | 4.42 | 14.97 | 80.12 | 4.39 | 14.64 | 78.31 |
| 95%ile | 23.72 | 261.08 | 914.64 | 24.56 | 207.20 | 633.62 | 28.31 | 201.36 | 618.27 |
| mean | 14.51 | 64.95 | 229.45 | 14.67 | 48.13 | 157.72 | 14.90 | 46.88 | 153.69 |
| UL UPT (Mbps) | 5%ile | 1707.51 | 753.06 | 259.23 | 1575.48 | 641.62 | 110.19 | 1580.44 | 634.25 | 111.42 |
| 50%ile | 3335.97 | 2276.75 | 1206.79 | 3238.31 | 2057.99 | 1036.17 | 3242.91 | 2068.98 | 1038.76 |
| 95%ile | 4927.06 | 4101.46 | 3196.89 | 4799.78 | 3905.39 | 3085.83 | 4794.81 | 3926.98 | 2996.54 |
| mean | 3335.50 | 2309.04 | 1386.55 | 3256.26 | 2108.08 | 1243.09 | 3256.74 | 2120.66 | 1235.71 |
| UL delay (s) | 5%ile | 2.83 | 3.14 | 4.00 | 2.88 | 3.27 | 4.08 | 2.88 | 3.25 | 4.09 |
| 50%ile | 4.75 | 7.25 | 15.66 | 4.84 | 8.22 | 18.16 | 4.84 | 8.19 | 18.27 |
| 95%ile | 15.58 | 129.83 | 142.22 | 20.56 | 142.59 | 180.02 | 18.75 | 142.39 | 179.56 |
| mean | 13.08 | 25.21 | 36.37 | 14.17 | 28.67 | 46.34 | 13.88 | 28.40 | 46.56 |
| Arrival rate (files/s) | | 5 | 10 | 15 | 5 | 10 | 15 | 5 | 10 | 15 |
| 𝜌DL | | 0.99 | 0.96 | 0.75 | 0.99 | 0.98 | 0.86 | 0.99 | 0.98 | 0.87 |
| 𝜌UL | | 1 | 1 | 0.99 | 1 | 1 | 0.98 | 1 | 1 | 0.98 |
| BO | | 35 | 67 | 84 | 35 | 67 | 84 | 35 | 67 | 84 |
| Additional report/notes:  1. LBT procedure and parameters: LBT based on ETSI EN 302 567 v2.1.20, ED threshold= - 48 dBm, CWS=15.  2. Details of case: 2 operators (scenario A) with ceiling mounted gNB and same setting, case1: No LBT, case2: Omni-directional LBT, case3: directional LBT.  3. Details of COT sharing if used in evaluation: MCOT=5ms, No COT sharing used.  4. Other parameters: Frequency 60 GHz, BW = 2GHz, SCS=960 KHz, UE Antenna Configuration 1 (Mg,Ng,M,N,P) = (1,2,2,2,2), ftp3 file size=2Mbytes. | | | | | | | | | | |

Table B.2.2.8-2. System level evaluation results for scenario A –ceiling mounted BS with UE antenna configuration 2

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | Case 1 – No LBT | | | Case 2- Omnidirectional LBT | | | Case 3 – Directional LBT | | |
| R1-2009380 / Source 14 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 2410.86 | 950.39 | 76.70 | 2216.86 | 986.97 | 129.99 | 2381.97 | 932.67 | 135.56 |
| 50%ile | 4988.44 | 3117.29 | 881.57 | 4767.26 | 2913.59 | 1069.25 | 4774.78 | 2978.08 | 1101.74 |
| 95%ile | 5909.11 | 5045.98 | 3211.02 | 5674.06 | 4849.88 | 3432.80 | 5688.90 | 4871.51 | 3485.26 |
| mean | 4715.32 | 3071.41 | 1175.69 | 4497.91 | 2911.48 | 1351.03 | 4525.39 | 2933.17 | 1371.26 |
| DL delay (s) | 5%ile | 2.36 | 2.48 | 3.25 | 2.44 | 2.61 | 3.03 | 2.42 | 2.61 | 3.03 |
| 50%ile | 2.91 | 5.47 | 31.73 | 3.03 | 5.77 | 27.61 | 3.03 | 5.69 | 27.27 |
| 95%ile | 41.19 | 143.09 | 295.42 | 44.83 | 144.17 | 239.44 | 35.55 | 143.33 | 231.83 |
| mean | 14.64 | 26.42 | 78.62 | 14.93 | 26.84 | 67.09 | 14.21 | 26.72 | 65.64 |
| UL UPT (Mbps) | 5%ile | 2444.1 | 1167.5 | 843.2 | 2229.7 | 1104.6 | 706.6 | 2166.3 | 1070.6 | 628.6 |
| 50%ile | 4685.5 | 3784.8 | 2307.0 | 4620.5 | 3527.0 | 1999.2 | 4610.6 | 3515.2 | 1949.6 |
| 95%ile | 5300.5 | 4788.8 | 4138.7 | 5239.9 | 4721.5 | 3949.1 | 5234.5 | 4712.4 | 3926.4 |
| mean | 4455.1 | 3413.0 | 2369.5 | 4376.4 | 3267.2 | 2135.5 | 4365.1 | 3256.5 | 2081.5 |
| UL delay (s) | 5%ile | 2.63 | 2.7 | 2.87 | 2.6 | 2.7 | 2.9 | 2.67 | 2.7 | 2.97 |
| 50%ile | 3.33 | 4.3 | 7.38 | 3.3 | 4.5 | 9.1 | 3.38 | 4.6 | 9.64 |
| 95%ile | 22.69 | 129.4 | 130.34 | 24.0 | 134.9 | 137.8 | 27.80 | 133.2 | 142.14 |
| mean | 13.27 | 22.1 | 28.73 | 13.5 | 23.7 | 31.8 | 13.89 | 23.7 | 33.26 |
| Arrival rate (files/s) | | 5 | 10 | 15 | 5 | 10 | 15 | 5 | 10 | 15 |
| 𝜌DL | | 0.99 | 0.99 | 0.95 | 0.99 | 0.99 | 0.97 | 0.99 | 0.99 | 0.97 |
| 𝜌UL | | 1 | 1 | 0.99 | 1 | 1 | 0.98 | 1 | 1 | 0.98 |
| BO | | 35 | 64 | 83 | 35 | 64 | 83 | 35 | 64 | 83 |
| Additional report/notes:  1. LBT procedure and parameters: LBT based on ETSI EN 302 567 v2.1.20, ED threshold= - 48 dBm, CWS=15.  2. Details of case: 2 operators (scenario A) with ceiling mounted gNB and same setting, case1: No LBT, case2: Omni-directional LBT, case3: directional LBT.  3. Details of COT sharing if used in evaluation: MCOT=5ms, No COT sharing used.  4. Other parameters: Frequency 60 GHz, BW = 2GHz, SCS=960 KHz, UE Antenna Configuration 2 (Mg,Ng,M,N,P) = (1,2,4,4,2), ftp3 file size=2Mbytes. | | | | | | | | | | |

Table B.2.2.8-3. System level evaluation results for scenario A – non-ceiling mounted BS with UE antenna configuration 2

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | Case 1 – No LBT | | | Case 2- Omnidirectional LBT | | | Case 3 – Directional LBT | | |
| R1-2009380 / Source 14 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 2489.86 | 1193.92 | 204.20 | 2306.31 | 1051.88 | 216.99 | 2405.16 | 1043.66 | 264.96 |
| 50%ile | 5205.24 | 3624.00 | 1620.08 | 4998.94 | 3379.49 | 1501.38 | 5030.37 | 3407.05 | 1642.74 |
| 95%ile | 5969.25 | 5326.55 | 4028.82 | 5734.06 | 4992.53 | 3790.01 | 5764.38 | 5052.36 | 3875.32 |
| mean | 4921.53 | 3480.37 | 1805.75 | 4732.19 | 3236.06 | 1688.56 | 4764.90 | 3248.37 | 1796.90 |
| DL delay (s) | 5%ile | 2.36 | 2.42 | 2.78 | 2.42 | 2.53 | 2.91 | 2.42 | 2.53 | 2.89 |
| 50%ile | 2.87 | 4.47 | 16.14 | 2.94 | 4.89 | 18.78 | 2.94 | 4.84 | 16.36 |
| 95%ile | 51.95 | 143.30 | 184.86 | 52.08 | 145.00 | 194.47 | 46.50 | 148.09 | 184.36 |
| mean | 14.88 | 25.34 | 48.36 | 14.95 | 26.30 | 52.79 | 14.54 | 27.06 | 48.76 |
| UL UPT (Mbps) | 5%ile | 2097.28 | 1113.5 | 838.14 | 2007.27 | 1036.2 | 799.88 | 1951.70 | 995.5 | 740.68 |
| 50%ile | 4830.23 | 3963.6 | 2416.94 | 4747.42 | 3808.6 | 2132.90 | 4733.81 | 3788.7 | 2117.29 |
| 95%ile | 5366.37 | 4931.5 | 4380.69 | 5303.91 | 4820.6 | 4229.17 | 5304.49 | 4803.3 | 4187.98 |
| mean | 4558.31 | 3554.1 | 2483.97 | 4481.93 | 3382.6 | 2310.29 | 4468.98 | 3362.9 | 2286.96 |
| UL delay (s) | 5%ile | 2.61 | 2.67 | 2.81 | 2.66 | 2.7 | 2.87 | 2.66 | 2.73 | 2.88 |
| 50%ile | 3.25 | 4.05 | 6.81 | 3.31 | 4.25 | 8.06 | 3.31 | 4.30 | 8.27 |
| 95%ile | 50.19 | 135.6 | 136.31 | 51.66 | 143.91 | 141.42 | 53.33 | 143.14 | 142.72 |
| mean | 14.63 | 23.3 | 30.36 | 14.97 | 25.57 | 32.73 | 14.97 | 25.45 | 33.05 |
| Arrival rate (files/s) | | 5 | 10 | 15 | 5 | 10 | 15 | 5 | 10 | 15 |
| 𝜌DL | | 0.99 | 0.99 | 0.98 | 0.99 | 0.99 | 0.98 | 0.99 | 0.99 | 0.99 |
| 𝜌UL | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0.98 | 1 |
| BO | | 34 | 59 | 74 | 34 | 59 | 74 | 34 | 59 | 74 |
| Additional report/notes:  1. LBT procedure and parameters: LBT based on ETSI EN 302 567 v2.1.20, ED threshold= - 48 dBm, CWS=15.  2. Details of case: 2 operators (scenario A) with non-ceiling mounted gNB and same setting, case1: No LBT, case2: Omni-directional LBT, case3: directional LBT.  3. Details of COT sharing if used in evaluation: MCOT=5ms, No COT sharing used.  4. Other parameters: Frequency 60 GHz, BW = 2GHz, SCS=960 KHz, UE Antenna Configuration 2 (Mg,Ng,M,N,P) = (1,2,4,4,2), ftp3 file size=2Mbytes | | | | | | | | | | |

### B.2.3 Indoor scenario B

#### B.2.3.1 Source 1 [65]

Table B.2.3.1-1. System level evaluation results for scenario B, with/without LBT

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | Case 1: no LBT | | | Case 2: ED -47dBm | | | Case 3: ED-68 dBm | | |
| R1-2007984 / Source 1 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 5985 | 4816 | 3791 | 5692 | 4554 | 3681 | 5698 | 4427 | 3317 |
| 50%ile | 8011 | 6452 | 5082 | 7637 | 6109 | 4849 | 7665 | 5799 | 4421 |
| 95%ile | 10675 | 9374 | 7848 | 10288 | 8935 | 7474 | 10254 | 8533 | 6892 |
| mean | 8748 | 7294 | 5895 | 8350 | 6924 | 5638 | 8327 | 6633 | 5138 |
| DL delay (s) | 5%ile | 0.021 | 0.025 | 0.034 | 0.021 | 0.027 | 0.035 | 0.021 | 0.029 | 0.039 |
| 50%ile | 0.022 | 0.030 | 0.042 | 0.024 | 0.031 | 0.043 | 0.024 | 0.033 | 0.050 |
| 95%ile | 0.047 | 0.067 | 0.100 | 0.049 | 0.069 | 0.102 | 0.049 | 0.072 | 0.116 |
| mean | 0.029 | 0.040 | 0.058 | 0.030 | 0.042 | 0.059 | 0.030 | 0.044 | 0.068 |
| UL UPT (Mbps) | 5%ile | 2076 | 1643 | 1254 | 1944 | 1518 | 1152 | 1921 | 1443 | 989 |
| 50%ile | 2904 | 2338 | 1767 | 2710 | 2169 | 1648 | 2698 | 2018 | 1399 |
| 95%ile | 4392 | 3790 | 3240 | 4179 | 3550 | 2996 | 4134 | 3312 | 2534 |
| mean | 3361 | 2783 | 2209 | 3165 | 2583 | 2060 | 3125 | 2390 | 1749 |
| UL delay (s) | 5%ile | 0.051 | 0.066 | 0.085 | 0.053 | 0.070 | 0.096 | 0.054 | 0.081 | 0.120 |
| 50%ile | 0.058 | 0.087 | 0.114 | 0.061 | 0.086 | 0.124 | 0.063 | 0.102 | 0.153 |
| 95%ile | 0.142 | 0.255 | 0.349 | 0.155 | 0.228 | 0.363 | 0.156 | 0.268 | 0.434 |
| mean | 0.081 | 0.134 | 0.179 | 0.087 | 0.125 | 0.192 | 0.088 | 0.148 | 0.232 |
| Arrival rate (files/s) | | 0.42 | 1.59 | 2.65 | 0.42 | 1.59 | 2.65 | 0.42 | 1.59 | 2.65 |
| 𝜌DL | | 1.00 | 1.00 | 0.99 | 1.00 | 1.00 | 0.99 | 1.00 | 1.00 | 0.99 |
| 𝜌UL | | 1.00 | 0.99 | 0.96 | 1.00 | 0.99 | 0.97 | 1.00 | 0.99 | 0.95 |
| BO | | 0.10 | 0.35 | 0.55 | 0.10 | 0.37 | 0.57 | 0.11 | 0.38 | 0.61 |
| Additional report/notes:  1. LBT procedure and parameters: LBT based on ETSI EN 302 567 v2.1.20, ED thresholds -47dBm or -68dBm, CWS: CW\_min = CW\_max = 3  2. any assumptions/parameters used not as in the agreed baseline: no  3. Details of case: 2 operators (scenario B) with the same settings, report only for OP A; case 1: no-LBT, case 2: LBT with ED = -47dBm, case 3: LBT with ED = -68dBm  5. Details of COT sharing if used in evaluation: 0.5ms COT for DL, 0.25ms COT for UL, DL COT sharing when traffic in both directions.  6. Other parameters: Frequency 60GHz, BW = 2GHz, SCS = 960kHz. | | | | | | | | | | |

Table B.2.3.1-2. System level evaluation results for scenario B with receiver assisted LBT

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | Case 1: no LBT | | | Case 2: RAL ED -47dBm | | | Case 3: RAL ED-68 dBm | | |
| R1-2007984 / Source 1 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 5985 | 4816 | 3791 | 5717 | 4593 | 3704 | 5767 | 4492 | 3577 |
| 50%ile | 8011 | 6452 | 5082 | 7674 | 6068 | 4843 | 7534 | 5977 | 4699 |
| 95%ile | 10675 | 9374 | 7848 | 10284 | 8923 | 7474 | 10280 | 8767 | 7084 |
| mean | 8748 | 7294 | 5895 | 8364 | 6898 | 5623 | 8342 | 6791 | 5437 |
| DL delay (s) | 5%ile | 0.021 | 0.025 | 0.034 | 0.021 | 0.027 | 0.035 | 0.021 | 0.028 | 0.037 |
| 50%ile | 0.022 | 0.030 | 0.042 | 0.024 | 0.032 | 0.043 | 0.024 | 0.032 | 0.044 |
| 95%ile | 0.047 | 0.067 | 0.100 | 0.049 | 0.070 | 0.102 | 0.048 | 0.071 | 0.105 |
| mean | 0.029 | 0.040 | 0.058 | 0.030 | 0.042 | 0.059 | 0.030 | 0.043 | 0.061 |
| UL UPT (Mbps) | 5%ile | 2076 | 1643 | 1254 | 1946 | 1511 | 1154 | 1932 | 1416 | 981 |
| 50%ile | 2904 | 2338 | 1767 | 2715 | 2164 | 1681 | 2715 | 1955 | 1387 |
| 95%ile | 4392 | 3790 | 3240 | 4177 | 3502 | 2917 | 4096 | 3312 | 2549 |
| mean | 3361 | 2783 | 2209 | 3168 | 2562 | 2046 | 3124 | 2386 | 1744 |
| UL delay (s) | 5%ile | 0.051 | 0.066 | 0.085 | 0.053 | 0.071 | 0.098 | 0.055 | 0.079 | 0.121 |
| 50%ile | 0.058 | 0.087 | 0.114 | 0.061 | 0.086 | 0.123 | 0.063 | 0.096 | 0.154 |
| 95%ile | 0.142 | 0.255 | 0.349 | 0.152 | 0.225 | 0.353 | 0.154 | 0.250 | 0.417 |
| mean | 0.081 | 0.134 | 0.179 | 0.086 | 0.126 | 0.190 | 0.088 | 0.139 | 0.227 |
| Arrival rate (files/s) | | 0.42 | 1.59 | 2.65 | 0.42 | 1.59 | 2.65 | 0.42 | 1.59 | 2.65 |
| 𝜌DL | | 1.00 | 1.00 | 0.99 | 1.00 | 1.00 | 0.99 | 1.00 | 1.00 | 0.99 |
| 𝜌UL | | 1.00 | 0.99 | 0.96 | 1.00 | 0.99 | 0.97 | 1.00 | 0.99 | 0.96 |
| BO | | 0.10 | 0.35 | 0.55 | 0.11 | 0.37 | 0.57 | 0.11 | 0.39 | 0.60 |
| Additional report/notes:  1. LBT procedure and parameters: LBT based on ETSI EN 302 567 v2.1.20, ED thresholds -47dBm or -68dBm, CWS: CW\_min = CW\_max = 3  2. any assumptions/parameters used not as in the agreed baseline: no  3. Details of case: 2 operators (scenario B) with the same settings, report only for OP A; case 1: no-LBT, case 2: receiver assisted LBT with ED = -47dBm, case 3: receiver assisted LBT with ED = -68dBm  Receiver assisted LBT: the LBT procedure is evaluated at the receiver instead of transmitter. The LBT result is assumed to be available instantly at the transmitter without accounting any overhead for exchanging this information between the transmitter and the receiver (refer to section 2.1.4 in R1-2007983 for more details).  5. Details of COT sharing if used in evaluation: 0.5ms COT for DL, 0.25ms COT for UL, DLCOT sharing when traffic in both directions  6. Other parameters: Frequency 60GHz, BW = 2GHz, SCS = 960kHz. | | | | | | | | | | |

Table B.2.3.1-3. System level evaluation results for scenario B with dynamic LBT

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | Case 1: no LBT | | | Case 2: Dynamic LBT ED -47dBm | | | Case 3: Dynamic LBT ED-68 dBm | | |
| R1-2007984 / Source 1 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 5985 | 4816 | 3791 | 6049 | 4837 | 3799 | 6062 | 4734 | 3674 |
| 50%ile | 8011 | 6452 | 5082 | 7934 | 6424 | 5051 | 7934 | 6342 | 4958 |
| 95%ile | 10675 | 9374 | 7848 | 10701 | 9340 | 7845 | 10682 | 9042 | 7625 |
| mean | 8748 | 7294 | 5895 | 8731 | 7259 | 5882 | 8743 | 7105 | 5716 |
| DL delay (s) | 5%ile | 0.021 | 0.025 | 0.034 | 0.021 | 0.026 | 0.034 | 0.021 | 0.027 | 0.036 |
| 50%ile | 0.022 | 0.030 | 0.042 | 0.023 | 0.030 | 0.042 | 0.022 | 0.032 | 0.045 |
| 95%ile | 0.047 | 0.067 | 0.100 | 0.046 | 0.068 | 0.100 | 0.045 | 0.069 | 0.109 |
| mean | 0.029 | 0.040 | 0.058 | 0.029 | 0.041 | 0.058 | 0.029 | 0.042 | 0.063 |
| UL UPT (Mbps) | 5%ile | 2076 | 1643 | 1254 | 2084 | 1647 | 1266 | 2066 | 1622 | 1211 |
| 50%ile | 2904 | 2338 | 1767 | 2941 | 2358 | 1781 | 2927 | 2264 | 1716 |
| 95%ile | 4392 | 3790 | 3240 | 4460 | 3861 | 3271 | 4385 | 3721 | 3081 |
| mean | 3361 | 2783 | 2209 | 3394 | 2803 | 2271 | 3359 | 2700 | 2117 |
| UL delay (s) | 5%ile | 0.051 | 0.066 | 0.085 | 0.050 | 0.064 | 0.084 | 0.051 | 0.067 | 0.092 |
| 50%ile | 0.058 | 0.087 | 0.114 | 0.057 | 0.079 | 0.111 | 0.058 | 0.081 | 0.120 |
| 95%ile | 0.142 | 0.255 | 0.349 | 0.142 | 0.235 | 0.330 | 0.142 | 0.213 | 0.342 |
| mean | 0.081 | 0.134 | 0.179 | 0.080 | 0.125 | 0.173 | 0.081 | 0.118 | 0.179 |
| Arrival rate (files/s) | | 0.42 | 1.59 | 2.65 | 0.42 | 1.59 | 2.65 | 0.42 | 1.59 | 2.65 |
| 𝜌DL | | 1.00 | 1.00 | 0.99 | 1.00 | 1.00 | 0.99 | 1.00 | 1.00 | 0.99 |
| 𝜌UL | | 1.00 | 0.99 | 0.96 | 1.00 | 0.99 | 0.97 | 1.00 | 0.99 | 0.96 |
| BO | | 0.10 | 0.35 | 0.55 | 0.10 | 0.35 | 0.55 | 0.10 | 0.36 | 0.56 |
| Additional report/notes:  1. LBT procedure and parameters: LBT based on ETSI EN 302 567 v2.1.20, ED thresholds -47dBm or -68dBm, CWS: CW\_min = CW\_max = 3  2. any assumptions/parameters used not as in the agreed baseline: no  3. Details of case: 2 operators (scenario B) with the same settings, report only for OP A; case 1: no-LBT, case 2: Dynamic LBT with ED = -47dBm, case 3: Dynamic LBT with ED = -68dBm  Dynamic LBT : a node operates without LBT unless the receiver experiences a failure in reception due to a drop in SINR, which reflects a presence of interferer. Only then, the node switches to LBT. Besides, when the LBT is switched on, the RAL described in section 2.1.4 of R1-2007983 is used  5. Details of COT sharing if used in evaluation: 0.5ms COT for DL, 0.25ms COT for UL, DL COT sharing when traffic in both directions.  6. Other parameters: Frequency 60GHz, BW = 2GHz, SCS = 960kHz. | | | | | | | | | | |

Table B.2.3.1-4. System level evaluation results for scenario B with directional LBT

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | Case 1: no LBT | | | Case 2: directional LBT ED -47dBm | | | Case 3: directional LBT ED-47+X dBm | | |
| R1-2007984 / Source 1 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 5985 | 4816 | 3791 | 5757 | 4508 | 3574 | 5758 | 4532 | 3530 |
| 50%ile | 8011 | 6452 | 5082 | 7643 | 5985 | 4684 | 7652 | 6005 | 4742 |
| 95%ile | 10675 | 9374 | 7848 | 10260 | 8957 | 7527 | 10267 | 8901 | 7487 |
| mean | 8748 | 7294 | 5895 | 8369 | 6880 | 5581 | 8376 | 6867 | 5571 |
| DL delay (s) | 5%ile | 0.021 | 0.025 | 0.034 | 0.021 | 0.027 | 0.036 | 0.021 | 0.027 | 0.036 |
| 50%ile | 0.022 | 0.030 | 0.042 | 0.024 | 0.032 | 0.043 | 0.024 | 0.032 | 0.043 |
| 95%ile | 0.047 | 0.067 | 0.100 | 0.048 | 0.074 | 0.106 | 0.048 | 0.073 | 0.108 |
| mean | 0.029 | 0.040 | 0.058 | 0.030 | 0.043 | 0.061 | 0.030 | 0.043 | 0.062 |
| UL UPT (Mbps) | 5%ile | 2076 | 1643 | 1254 | 1936 | 1507 | 1095 | 1936 | 1508 | 1094 |
| 50%ile | 2904 | 2338 | 1767 | 2717 | 2112 | 1622 | 2716 | 2119 | 1593 |
| 95%ile | 4392 | 3790 | 3240 | 4161 | 3548 | 2993 | 4155 | 3571 | 2970 |
| mean | 3361 | 2783 | 2209 | 3159 | 2556 | 2033 | 3155 | 2563 | 2019 |
| UL delay (s) | 5%ile | 0.051 | 0.066 | 0.085 | 0.053 | 0.071 | 0.092 | 0.053 | 0.069 | 0.093 |
| 50%ile | 0.058 | 0.087 | 0.114 | 0.061 | 0.090 | 0.124 | 0.062 | 0.087 | 0.124 |
| 95%ile | 0.142 | 0.255 | 0.349 | 0.155 | 0.253 | 0.395 | 0.155 | 0.252 | 0.385 |
| mean | 0.081 | 0.134 | 0.179 | 0.087 | 0.135 | 0.199 | 0.087 | 0.134 | 0.199 |
| Arrival rate (files/s) | | 0.42 | 1.59 | 2.65 | 0.42 | 1.59 | 2.65 | 0.42 | 1.59 | 2.65 |
| 𝜌DL | | 1.00 | 1.00 | 0.99 | 1.00 | 1.00 | 0.99 | 1.00 | 1.00 | 0.99 |
| 𝜌UL | | 1.00 | 0.99 | 0.96 | 1.00 | 0.99 | 0.96 | 1.00 | 0.99 | 0.96 |
| BO | | 0.10 | 0.35 | 0.55 | 0.10 | 0.37 | 0.57 | 0.10 | 0.37 | 0.57 |
| Additional report/notes:  1. LBT procedure and parameters: directional LBT, CWS: CW\_min = CW\_max = 3  2. any assumptions/parameters used not as in the agreed baseline: no  3. Details of case: 2 operators (scenario B) with the same settings, report only for OP A; case 1: no-LBT, case 2: directional LBT with ED = -47dBm, case 3: directional LBT with ED = -47+x dBm (i.e., -47+15dBm at gNB, -47+6dBm at UE)  5. Details of COT sharing if used in evaluation: 0.5ms COT for DL, 0.25ms COT for UL, DL COT sharing when traffic in both directions.  6. Other parameters: Frequency 60GHz, BW = 2GHz, SCS = 960kHz. | | | | | | | | | | |

Table B.2.3.1-5. System level evaluation results for scenario B with mixed LBT configurations

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | Case 1: no LBT  (OpA ) | | | Case 2: ED -47dBm  (OpB) | | |
|
| R1-2007984 / Source 1 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 5985 | 4816 | 3791 | 5794 | 4612 | 3656 |
| 50%ile | 8011 | 6452 | 5082 | 7619 | 6012 | 4740 |
| 95%ile | 10675 | 9374 | 7848 | 10250 | 8830 | 7401 |
| mean | 8748 | 7294 | 5895 | 8408 | 6880 | 5577 |
| DL delay (s) | 5%ile | 0.021 | 0.025 | 0.034 | 0.021 | 0.027 | 0.035 |
| 50%ile | 0.022 | 0.030 | 0.042 | 0.023 | 0.032 | 0.043 |
| 95%ile | 0.047 | 0.067 | 0.100 | 0.049 | 0.072 | 0.105 |
| mean | 0.029 | 0.040 | 0.058 | 0.031 | 0.043 | 0.061 |
| UL UPT (Mbps) | 5%ile | 2076 | 1643 | 1254 | 1987 | 1579 | 1192 |
| 50%ile | 2904 | 2338 | 1767 | 2742 | 2181 | 1653 |
| 95%ile | 4392 | 3790 | 3240 | 4132 | 3564 | 2986 |
| mean | 3361 | 2783 | 2209 | 3180 | 2609 | 2092 |
| UL delay (s) | 5%ile | 0.051 | 0.066 | 0.085 | 0.054 | 0.069 | 0.093 |
| 50%ile | 0.058 | 0.087 | 0.114 | 0.061 | 0.084 | 0.116 |
| 95%ile | 0.142 | 0.255 | 0.349 | 0.153 | 0.248 | 0.347 |
| mean | 0.081 | 0.134 | 0.179 | 0.087 | 0.129 | 0.185 |
| Arrival rate (files/s) | | 0.42 | 1.59 | 2.65 | 0.42 | 1.59 | 2.65 |
| 𝜌DL | | 1.00 | 1.00 | 0.99 | 1.00 | 1.00 | 0.99 |
| 𝜌UL | | 1.00 | 0.99 | 0.96 | 1.00 | 0.99 | 0.96 |
| BO | | 0.10 | 0.35 | 0.55 | 0.11 | 0.37 | 0.57 |
|  | Additional report/notes:  1. LBT procedure and parameters: LBT based on ETSI EN 302 567 v2.1.20, ED thresholds -47dBm, CWS: CW\_min = CW\_max = 3  2. any assumptions/parameters used not as in the agreed baseline: no  3. Details of case: 2 operators (scenario B); case 1: no-LBT for both OPs, case 2: LBT with ED = -47dBm for both OPs  5. Details of COT sharing if used in evaluation: 0.5ms COT for DL, 0.25ms COT for UL, DL COT sharing when traffic in both directions.  6. Other parameters: Frequency 60GHz, BW = 2GHz, SCS = 960kHz. | | | | | | | |

Table B.2.3.1-6. System level evaluation results for scenario B with mixed LBT configurations

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | Case 3: mixed configuration | | | | | |
| (Op A , no LBT ) | | | (Op B, -47dbm ) | | |
| R1-2007984 / Source 1 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 6084 | 4923 | 3856 | 5640 | 4499 | 3581 |
| 50%ile | 7922 | 6429 | 5034 | 7582 | 5983 | 4831 |
| 95%ile | 10764 | 9375 | 7841 | 10273 | 8900 | 7527 |
| mean | 8790 | 7289 | 5894 | 8363 | 6848 | 5634 |
| DL delay (s) | 5%ile | 0.020 | 0.025 | 0.034 | 0.021 | 0.027 | 0.035 |
| 50%ile | 0.022 | 0.030 | 0.041 | 0.023 | 0.032 | 0.043 |
| 95%ile | 0.046 | 0.067 | 0.097 | 0.053 | 0.079 | 0.112 |
| mean | 0.029 | 0.040 | 0.057 | 0.031 | 0.045 | 0.062 |
| UL UPT (Mbps) | 5%ile | 2110 | 1639 | 1279 | 1975 | 1570 | 1170 |
| 50%ile | 2923 | 2329 | 1781 | 2777 | 2247 | 1703 |
| 95%ile | 4447 | 3825 | 3262 | 4165 | 3642 | 3035 |
| mean | 3388 | 2773 | 2241 | 3204 | 2666 | 2107 |
| UL delay (s) | 5%ile | 0.050 | 0.064 | 0.084 | 0.053 | 0.067 | 0.087 |
| 50%ile | 0.058 | 0.082 | 0.112 | 0.060 | 0.082 | 0.114 |
| 95%ile | 0.141 | 0.222 | 0.322 | 0.160 | 0.257 | 0.383 |
| mean | 0.080 | 0.121 | 0.173 | 0.087 | 0.130 | 0.189 |
| Arrival rate (files/s) | | 0.42 | 1.59 | 2.65 | 0.42 | 1.59 | 2.65 |
| 𝜌DL | | 1.00 | 1.00 | 0.99 | 1.00 | 1.00 | 0.99 |
| 𝜌UL | | 1.00 | 0.99 | 0.96 | 1.00 | 0.99 | 0.97 |
| BO | | 0.10 | 0.36 | 0.54 | 0.11 | 0.37 | 0.57 |
|  | Additional report/notes:  1. LBT procedure and parameters: LBT based on ETSI EN 302 567 v2.1.20, ED thresholds -47dBm, CWS: CW\_min = CW\_max = 3  2. any assumptions/parameters used not as in the agreed baseline: no  3. Details of case: 2 operators (scenario B); case 3: no LBT for OP A, LBT with ED = -47dBm for OP B  5. Details of COT sharing if used in evaluation: 0.5ms COT for DL, 0.25ms COT for UL, DL COT sharing when traffic in both directions.  6. Other parameters: Frequency 60GHz, BW = 2GHz, SCS = 960kHz. | | | | | | | |

### B.2.4 Indoor scenario C

#### B.2.4.1 Source 1 [65]

Table B.2.4.1-1. System level evaluation results for scenario C, with/ without LBT

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | Case 1: no LBT | | | Case 2: ED -47dBm | | | Case 3: ED-68 dBm | | |
| R1-2007984 / Source 1 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 5736 | 4324 | 3083 | 5503 | 3993 | 2783 | 5475 | 3988 | 2651 |
| 50%ile | 9409 | 7759 | 6148 | 9095 | 7460 | 5892 | 9122 | 7335 | 5737 |
| 95%ile | 11217 | 10635 | 9494 | 10800 | 10224 | 9018 | 10804 | 10097 | 8884 |
| mean | 9186 | 7747 | 6317 | 8837 | 7367 | 5952 | 8849 | 7300 | 5853 |
| DL delay (s) | 5%ile | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 |
| 50%ile | 0,02 | 0,03 | 0,04 | 0,02 | 0,03 | 0,04 | 0,02 | 0,03 | 0,04 |
| 95%ile | 0,04 | 0,05 | 0,08 | 0,04 | 0,06 | 0,09 | 0,04 | 0,06 | 0,09 |
| mean | 0,03 | 0,03 | 0,05 | 0,03 | 0,04 | 0,05 | 0,03 | 0,04 | 0,05 |
| UL UPT (Mbps) | 5%ile | 2016 | 1392 | 882 | 1879 | 1289 | 847 | 1868 | 1206 | 729 |
| 50%ile | 3598 | 2911 | 2255 | 3371 | 2690 | 2051 | 3348 | 2596 | 1907 |
| 95%ile | 4770 | 4367 | 3856 | 4495 | 4054 | 3622 | 4430 | 3987 | 3381 |
| mean | 3540 | 2931 | 2321 | 3321 | 2705 | 2155 | 3286 | 2625 | 2007 |
| UL delay (s) | 5%ile | 0,04 | 0,05 | 0,05 | 0,05 | 0,05 | 0,06 | 0,05 | 0,05 | 0,06 |
| 50%ile | 0,06 | 0,08 | 0,11 | 0,06 | 0,09 | 0,12 | 0,07 | 0,09 | 0,14 |
| 95%ile | 0,10 | 0,17 | 0,28 | 0,11 | 0,17 | 0,28 | 0,11 | 0,19 | 0,33 |
| mean | 0,07 | 0,09 | 0,14 | 0,07 | 0,10 | 0,14 | 0,07 | 0,11 | 0,16 |
| Arrival rate (files/s) | | 0,49 | 1,79 | 3,04 | 0,49 | 1,79 | 3,04 | 0,49 | 1,79 | 3,04 |
| 𝜌DL | | 1,00 | 1,00 | 0,99 | 1,00 | 0,99 | 0,99 | 1,00 | 1,00 | 0,99 |
| 𝜌UL | | 1,00 | 0,99 | 0,95 | 1,00 | 0,98 | 0,95 | 1,00 | 0,99 | 0,94 |
| BO | | 0,10 | 0,35 | 0,55 | 0,11 | 0,37 | 0,57 | 0,11 | 0,37 | 0,58 |
| Additional report/notes:  1. LBT procedure and parameters: LBT based on ETSI EN 302 567 v2.1.20, ED thresholds -47dBm or -68dBm, CWS: CW\_min = CW\_max = 3  2. any assumptions/parameters used not as in the agreed baseline: no  3. Details of case: single operator (scenario C); case 1: no-LBT, case 2: LBT with ED = -47dBm, case 3: LBT with ED = -68dBm  5. Details of COT sharing if used in evaluation: 0.5ms COT for DL, 0.25ms COT for UL, DL COT sharing when traffic in both direction  6. Other parameters: Frequency 60GHz, BW = 2GHz, SCS = 960kHz. | | | | | | | | | | |

Table B.2.4.1-2. System level evaluation results for scenario C with receiver assisted LBT

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | Case 1: no LBT | | | Case 2: RAL ED -47dBm | | | Case 3: RAL ED-68 dBm | | |
| R1-2007984 / Source 1 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 5736 | 4324 | 3083 | 5503 | 3993 | 2783 | 5520 | 3854 | 2712 |
| 50%ile | 9409 | 7759 | 6148 | 9095 | 7460 | 5892 | 9004 | 7348 | 5750 |
| 95%ile | 11217 | 10635 | 9494 | 10800 | 10224 | 9018 | 10782 | 9908 | 8533 |
| mean | 9186 | 7747 | 6317 | 8837 | 7367 | 5952 | 8801 | 7277 | 5834 |
| DL delay (s) | 5%ile | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,03 |
| 50%ile | 0,02 | 0,03 | 0,04 | 0,02 | 0,03 | 0,04 | 0,02 | 0,03 | 0,04 |
| 95%ile | 0,04 | 0,05 | 0,08 | 0,04 | 0,06 | 0,09 | 0,04 | 0,06 | 0,09 |
| mean | 0,03 | 0,03 | 0,05 | 0,03 | 0,04 | 0,05 | 0,03 | 0,04 | 0,05 |
| UL UPT (Mbps) | 5%ile | 2016 | 1392 | 882 | 1879 | 1289 | 847 | 1908 | 1259 | 810 |
| 50%ile | 3598 | 2911 | 2255 | 3371 | 2690 | 2051 | 3367 | 2616 | 1985 |
| 95%ile | 4770 | 4367 | 3856 | 4495 | 4054 | 3622 | 4458 | 3968 | 3449 |
| mean | 3540 | 2931 | 2321 | 3321 | 2705 | 2155 | 3302 | 2652 | 2079 |
| UL delay (s) | 5%ile | 0,04 | 0,05 | 0,05 | 0,05 | 0,05 | 0,06 | 0,05 | 0,05 | 0,06 |
| 50%ile | 0,06 | 0,08 | 0,11 | 0,06 | 0,09 | 0,12 | 0,07 | 0,09 | 0,13 |
| 95%ile | 0,10 | 0,17 | 0,28 | 0,11 | 0,17 | 0,28 | 0,11 | 0,18 | 0,32 |
| mean | 0,07 | 0,09 | 0,14 | 0,07 | 0,10 | 0,14 | 0,07 | 0,10 | 0,16 |
| Arrival rate (files/s) | | 0,49 | 1,79 | 3,04 | 0,49 | 1,79 | 3,04 | 0,49 | 1,79 | 3,04 |
| 𝜌DL | | 1,00 | 1,00 | 0,99 | 1,00 | 0,99 | 0,99 | 1,00 | 1,00 | 0,99 |
| 𝜌UL | | 1,00 | 0,99 | 0,95 | 1,00 | 0,98 | 0,95 | 1,00 | 0,99 | 0,95 |
| BO | | 0,10 | 0,35 | 0,55 | 0,11 | 0,37 | 0,57 | 0,11 | 0,38 | 0,57 |
| Additional report/notes:  1. LBT procedure and parameters: LBT based on ETSI EN 302 567 v2.1.20, ED thresholds -47dBm or -68dBm, CWS: CW\_min = CW\_max = 3  2. any assumptions/parameters used not as in the agreed baseline: no  3. Details of case: single operator (scenario C); case 1: no-LBT, case 2: receiver assisted LBT with ED = -47dBm, case 3: receiver assisted LBT with ED = -68dBm  Receiver assisted LBT: the LBT procedure is evaluated at the receiver instead of transmitter. The LBT result is assumed to be available instantly at the transmitter without accounting any overhead for exchanging this information between the transmitter and the receiver (refer to section 2.1.4 in R1-2007983 for more details).  5. Details of COT sharing if used in evaluation: 0.5ms COT for DL, 0.25ms COT for UL, DL COT sharing when traffic in both directions  6. Other parameters: Frequency 60GHz, BW = 2GHz, SCS = 960kHz. | | | | | | | | | | |

Table B.2.4.1-3. System level evaluation results for scenario C with dynamic LBT

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | Case 1: no LBT | | | Case 2: Dynamic LBT ED -47dBm | | | Case 3: Dynamic LBT ED-68 dBm | | |
| R1-2007984 / Source 1 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 5736 | 4324 | 3083 | 5758 | 4201 | 2943 | 5659 | 4000 | 2910 |
| 50%ile | 9409 | 7759 | 6148 | 9472 | 7718 | 6253 | 9464 | 7680 | 6048 |
| 95%ile | 11217 | 10635 | 9494 | 11231 | 10394 | 9183 | 11234 | 10513 | 9232 |
| mean | 9186 | 7747 | 6317 | 9211 | 7639 | 6265 | 9164 | 7591 | 6135 |
| DL delay (s) | 5%ile | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 |
| 50%ile | 0,02 | 0,03 | 0,04 | 0,02 | 0,03 | 0,04 | 0,02 | 0,03 | 0,04 |
| 95%ile | 0,04 | 0,05 | 0,08 | 0,04 | 0,06 | 0,09 | 0,04 | 0,06 | 0,09 |
| mean | 0,03 | 0,03 | 0,05 | 0,03 | 0,03 | 0,05 | 0,03 | 0,03 | 0,05 |
| UL UPT (Mbps) | 5%ile | 2016 | 1392 | 882 | 2017 | 1373 | 888 | 1971 | 1308 | 784 |
| 50%ile | 3598 | 2911 | 2255 | 3627 | 2899 | 2236 | 3589 | 2855 | 2136 |
| 95%ile | 4770 | 4367 | 3856 | 4778 | 4411 | 3887 | 4755 | 4293 | 3734 |
| mean | 3540 | 2931 | 2321 | 3552 | 2940 | 2347 | 3522 | 2870 | 2228 |
| UL delay (s) | 5%ile | 0,04 | 0,05 | 0,05 | 0,04 | 0,05 | 0,05 | 0,04 | 0,05 | 0,06 |
| 50%ile | 0,06 | 0,08 | 0,11 | 0,06 | 0,08 | 0,11 | 0,06 | 0,08 | 0,12 |
| 95%ile | 0,10 | 0,17 | 0,28 | 0,10 | 0,16 | 0,27 | 0,10 | 0,17 | 0,28 |
| mean | 0,07 | 0,09 | 0,14 | 0,07 | 0,09 | 0,14 | 0,07 | 0,09 | 0,14 |
| Arrival rate (files/s) | | 0,49 | 1,79 | 3,04 | 0,49 | 1,79 | 3,04 | 0,49 | 1,79 | 3,04 |
| 𝜌DL | | 1,00 | 1,00 | 0,99 | 1,00 | 1,00 | 0,99 | 1,00 | 1,00 | 0,99 |
| 𝜌UL | | 1,00 | 0,99 | 0,95 | 1,00 | 0,99 | 0,96 | 1,00 | 0,99 | 0,95 |
| BO | | 0,10 | 0,35 | 0,55 | 0,10 | 0,36 | 0,55 | 0,10 | 0,36 | 0,56 |
| Additional report/notes:  1. LBT procedure and parameters: LBT based on ETSI EN 302 567 v2.1.20, ED thresholds -47dBm or -68dBm, CWS: CW\_min = CW\_max = 3  2. any assumptions/parameters used not as in the agreed baseline: no  3. Details of case: single operator (scenario C); case 1: no-LBT, case 2: Dynamic LBT with ED = -47dBm, case 3: Dynamic LBT with ED = -68dBm  Dynamic LBT: a node operates without LBT unless the receiver experiences a failure in reception due to a drop in SINR, which reflects a presence of interferer. Only then, the node switches to LBT. Besides, when the LBT is switched on, the RAL described in section 2.1.4 of R1-2007983 is used  5. Details of COT sharing if used in evaluation: 0.5ms COT for DL, 0.25ms COT for UL, DL COT sharing when traffic in both direction  6. Other parameters: Frequency 60GHz, BW = 2GHz, SCS = 960kHz. | | | | | | | | | | |

Table B.2.4.1-4. System level evaluation results for scenario C with directional LBT

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | Case 1: no LBT | | | Case 2: directional LBT ED -47dBm | | | Case 3: directional LBT ED-47+X dBm | | |
| R1-2007984 / Source 1 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 5736 | 4324 | 3083 | 5597 | 4045 | 2748 | 5597 | 4061 | 2795 |
| 50%ile | 9409 | 7759 | 6148 | 9109 | 7348 | 5801 | 9106 | 7363 | 5826 |
| 95%ile | 11217 | 10635 | 9494 | 10812 | 10036 | 8709 | 10812 | 10032 | 8709 |
| mean | 9186 | 7747 | 6317 | 8863 | 7281 | 5834 | 8863 | 7287 | 5856 |
| DL delay (s) | 5%ile | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 |
| 50%ile | 0,02 | 0,03 | 0,04 | 0,02 | 0,03 | 0,04 | 0,02 | 0,03 | 0,04 |
| 95%ile | 0,04 | 0,05 | 0,08 | 0,04 | 0,06 | 0,09 | 0,04 | 0,06 | 0,09 |
| mean | 0,03 | 0,03 | 0,05 | 0,03 | 0,04 | 0,05 | 0,03 | 0,04 | 0,05 |
| UL UPT (Mbps) | 5%ile | 2016 | 1392 | 882 | 1893 | 1211 | 695 | 1893 | 1211 | 694 |
| 50%ile | 3598 | 2911 | 2255 | 3394 | 2667 | 1996 | 3395 | 2660 | 1998 |
| 95%ile | 4770 | 4367 | 3856 | 4485 | 4055 | 3492 | 4485 | 4106 | 3589 |
| mean | 3540 | 2931 | 2321 | 3331 | 2691 | 2081 | 3332 | 2698 | 2101 |
| UL delay (s) | 5%ile | 0,04 | 0,05 | 0,05 | 0,05 | 0,05 | 0,06 | 0,05 | 0,05 | 0,06 |
| 50%ile | 0,06 | 0,08 | 0,11 | 0,06 | 0,09 | 0,13 | 0,06 | 0,09 | 0,13 |
| 95%ile | 0,10 | 0,17 | 0,28 | 0,11 | 0,19 | 0,32 | 0,11 | 0,19 | 0,31 |
| mean | 0,07 | 0,09 | 0,14 | 0,07 | 0,10 | 0,16 | 0,07 | 0,10 | 0,16 |
| Arrival rate (files/s) | | 0,49 | 1,79 | 3,04 | 0,49 | 1,79 | 3,04 | 0,49 | 1,79 | 3,04 |
| 𝜌DL | | 1,00 | 1,00 | 0,99 | 1,00 | 1,00 | 0,99 | 1,00 | 1,00 | 0,99 |
| 𝜌UL | | 1,00 | 0,99 | 0,95 | 1,00 | 0,99 | 0,95 | 1,00 | 0,99 | 0,95 |
| BO | | 0,10 | 0,35 | 0,55 | 0,11 | 0,37 | 0,58 | 0,10 | 0,37 | 0,58 |
| Additional report/notes:  1. LBT procedure and parameters: directional LBT, CWS: CW\_min = CW\_max = 3  2. any assumptions/parameters used not as in the agreed baseline: no  3. Details of case: single operator (scenario C); case 1: no-LBT, case 2: directional LBT with ED = -, case 3: directional LBT with ED = -47+x dBm (i.e., -47+15dBm at gNB, -47+6dBm at UE)  5. Details of COT sharing if used in evaluation: 0.5ms COT for DL, 0.25ms COT for UL, DL COT sharing when traffic in both directions.  6. Other parameters: Frequency 60GHz, BW = 2GHz, SCS = 960kHz. | | | | | | | | | | |

#### B.2.4.2 Source 2 [72]

Table B.2.4.2-1. System level evaluation results for indoor scenario C (no-LBT and omni-directional LBT)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | no-LBT | | | omni-directional LBT | | |
| Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| R1-2009610 / Source 2 | DL UPT (Mbps) | 5%ile | 2712.1 | 1271.5 | 585.9 | 2478.7 | 1136.6 | 474.6 |
| 50%ile | 6542.7 | 4481.1 | 4029.6 | 6091.8 | 4458.6 | 3595.8 |
| 95%ile | 9478.1 | 9472.7 | 9459.5 | 8954.3 | 8848.7 | 8715.9 |
| mean | 6383.1 | 5130.7 | 4346.5 | 5945.0 | 4722.5 | 3913.9 |
| DL delay (s) | 5%ile | 0.0228 | 0.0228 | 0.0228 | 0.0241 | 0.0244 | 0.0247 |
| 50%ile | 0.0329 | 0.0442 | 0.0534 | 0.0354 | 0.0481 | 0.0598 |
| 95%ile | 0.0792 | 0.1646 | 0.3375 | 0.0865 | 0.1870 | 0.4128 |
| mean | 0.0396 | 0.0636 | 0.1125 | 0.0427 | 0.0706 | 0.1309 |
| UL UPT (Mbps) | 5%ile | 3004.4 | 1470.8 | 801.5 | 2748.7 | 1271.5 | 551.6 |
| 50%ile | 6947.7 | 5450.4 | 4476.4 | 6508.5 | 4898.4 | 3944.6 |
| 95%ile | 10637 | 10594 | 9402.1 | 10014 | 9792.6 | 8676.5 |
| mean | 6835.8 | 5534.8 | 4759.1 | 6376.1 | 5058.1 | 4232.4 |
| UL delay (s) | 5%ile | 0.0203 | 0.0204 | 0.0227 | 0.0215 | 0.0220 | 0.0248 |
| 50%ile | 0.0311 | 0.0394 | 0.0481 | 0.0331 | 0.0438 | 0.0544 |
| 95%ile | 0.0719 | 0.1422 | 0.2501 | 0.0786 | 0.1671 | 0.3530 |
| mean | 0.0366 | 0.0573 | 0.0951 | 0.0395 | 0.0661 | 0.1228 |
| Arrival rate (files/s) | | 0.4 | 1.2 | 1.6 | 0.4 | 1.2 | 1.6 |
| 𝜌DL | | 99.69% | 99.52% | 98.91% | 99.65% | 99.44% | 98.71% |
| 𝜌UL | | 99.80% | 99.54% | 99.01% | 99.79% | 99.47% | 98.53% |
| BO | | 12.75% | 38.75% | 52% | 13.60% | 41.32% | 55.23% |
| Additional report/notes:  1. LBT procedure and parameters: LBT based on ETSI EN 302 567 v2.1.20, ED thresholds -47dBm for BBU, -32dBm for UE, CWS: CW\_min = CW\_max = 127  2. Details of case: 1 operators (scenario C), case1: no-LBT; case 2: omni-directional LBT  3. Details of COT sharing if used in evaluation: MCOT = 5ms, No COT sharing for DL/UL data transmission.  4. Other parameters: Frequency 60GHz, BW = 2GHz, SCS = 960kHz. Rank 1 transmission. BS to UE: InH open office channel, ftp3 file size = 27Mbyte. | | | | | | | |

Table B.2.4.2-2. System level evaluation results for indoor scenario C (directional LBT and receiver assisted LBT)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | directional LBT | | | receiver-assisted LBT | | |
| Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| R1-2009610 / Source 2 | DL UPT (Mbps) | 5%ile | 2487.3 | 1128.1 | 462.6 | 2558.2 | 1209.5 | 561.7 |
| 50%ile | 6069.5 | 4452.3 | 3588.1 | 6119.3 | 4564.6 | 3801.1 |
| 95%ile | 8955.1 | 8838.9 | 8732.4 | 8959.9 | 8860 | 8761.1 |
| mean | 5931.7 | 4711.4 | 3892.5 | 5995.4 | 4826.2 | 4078.2 |
| DL delay (s) | 5%ile | 0.0241 | 0.0244 | 0.0247 | 0.0241 | 0.0243 | 0.0246 |
| 50%ile | 0.0355 | 0.0482 | 0.0599 | 0.0353 | 0.0471 | 0.0565 |
| 95%ile | 0.0867 | 0.1884 | 0.4249 | 0.0834 | 0.1738 | 0.3608 |
| mean | 0.0427 | 0.0705 | 0.1315 | 0.0420 | 0.0669 | 0.1214 |
| UL UPT (Mbps) | 5%ile | 2786.3 | 1266.3 | 558.5 | 2864.9 | 1353.5 | 619.5 |
| 50%ile | 6510.4 | 4914.7 | 3943.5 | 6562.9 | 5096.8 | 4128.0 |
| 95%ile | 10006 | 9819.6 | 8623.7 | 10020 | 9805.7 | 8768.0 |
| mean | 6376.3 | 5050.6 | 4229.1 | 6443.4 | 5180.5 | 4374.5 |
| UL delay (s) | 5%ile | 0.0216 | 0.0219 | 0.0249 | 0.0215 | 0.0220 | 0.0244 |
| 50%ile | 0.0331 | 0.0437 | 0.0545 | 0.0329 | 0.0422 | 0.0520 |
| 95%ile | 0.0775 | 0.1666 | 0.3475 | 0.0754 | 0.1562 | 0.3143 |
| mean | 0.0395 | 0.0662 | 0.1225 | 0.0388 | 0.0622 | 0.1122 |
| Arrival rate (files/s) | | 0.4 | 1.2 | 1.6 | 0.4 | 1.2 | 1.6 |
| 𝜌DL | | 99.64% | 99.44% | 98.71% | 99.65% | 99.44% | 98.78% |
| 𝜌UL | | 99.79% | 99.48% | 98.55% | 99.79% | 99.49% | 98.72% |
| BO | | 13.60% | 41.31% | 55.25% | 13.64% | 41.33% | 55.20% |
| Additional report/notes:  1. LBT procedure and parameters: LBT based on ETSI EN 302 567 v2.1.20, ED thresholds -47dBm for BBU, -32dBm for UE, CWS: CW\_min = CW\_max = 127  2. Details of case: 1 operators (scenario C), case1: directional LBT; case 2: receiver-assisted LBT  3. Details of COT sharing if used in evaluation: MCOT = 5ms, No COT sharing for DL/UL data transmission.  4. Other parameters: Frequency 60GHz, BW = 2GHz, SCS = 960kHz. Rank 1 transmission. BS to UE: InH open office channel, ftp3 file size = 27Mbyte. | | | | | | | |

#### B.2.4.3 Source 5 [64]

Table B.2.4.3-1. single operator performance of different LBT mode of various traffic load with CCA=-68dBm

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | LBT mode | | omni | | | directional | | |
| R1-2009450/ Source 5 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 2753.1533 | 711.4508 | 56.8123 | 2794.9436 | 1093.1202 | 107.4513 |
| 50%ile | 11980.9873 | 10158.8506 | 8452.8770 | 12696.9189 | 11023.2432 | 9319.9990 |
| 95%ile | 21861.1777 | 18747.8184 | 17432.8926 | 22533.1016 | 21525.3809 | 20521.2188 |
| mean | 11620.6953 | 9689.7852 | 8216.0859 | 11983.1641 | 10961.0996 | 9795.4639 |
| DL delay (s) | 5%ile | 0.009 | 0.010 | 0.010 | 0.009 | 0.009 | 0.009 |
| 50%ile | 0.022 | 0.029 | 0.032 | 0.020 | 0.022 | 0.026 |
| 95%ile | 0.128 | 1.437 | 4.216 | 0.116 | 0.334 | 4.489 |
| mean | 0.040 | 0.588 | 0.897 | 0.037 | 0.283 | 0.656 |
| Arrival rate (files/s) | | 2 | 3.5 | 5 | 2 | 3.5 | 5 |
| 𝜌DL | | 99.83% | 99.07% | 99.04% | 98.98% | 99.14% | 100% |
| BO | | 29.417% | 65.342% | 81.175% | 34.901 % | 60.136 % | 70.984% |
| Additional report/notes:  1.LBT procedure and parameters  Refer to Section A.2 in R1-2009450. Subcarrier spacing is 960KHz;  LBT procedure align with v2.1.20 of EN 302 567;  CWmax=10;  2.any assumptions/parameters used not as in the agreed baseline  3. Details of case: single operators; omni-directional LBT, directional LBT schemes; Indoor Scenario C  4. Other metric(s) and definition if reported  5. Details of COT sharing if used in evaluation:DL Only, No COT sharing | | | | | | | |

#### B.2.4.4 Source 6 [68]

Table B.2.4.4-1. System level evaluation results for indoor scenario C, without LBT

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tdoc/ source | Cases | | Case 1（Scenario C） | | |
| Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| R1-2009615/ Source 6 | DL UPT (Mbps) | 5%ile | 641.7 | 208.39 | 112.84 |
| 50%ile | 920.144 | 732.81 | 549.18 |
| 95%ile | 2443.25 | 1715.76 | 1237.39 |
| mean | 1089.23 | 755.14 | 566.22 |
| DL delay (s) | 5%ile | 0.102 | 0.141 | 0.174 |
| 50%ile | 0.24 | 0.324 | 0.478 |
| 95%ile | 0.343 | 1.409 | 2.78 |
| mean | 0.234 | 0.486 | 0.907 |
| Arrival rate (files/s) | | 0.6 | 1.2 | 1.8 |
| 𝜌DL | | 0.977 | 0.887 | 0.839 |
| BO | | 13.13% | 38.68% | 61.56% |
| Additional report/notes:   |  |  | | --- | --- | | Carrier Frequency | 60GHz | | Bandwidth | 400MHz | | Subcarrier Spacing | 120kHz | | Channel Model | InH Open Office model | | BS antenna Array configuration | (Mg, Ng,M, N, P) = (1, 1, 4, 8, 2), dH = dV = 0.5 λ | | UE antenna Array configuration | (Mg, Ng,M, N, P) = (1, 2, 2, 2, 2), dH = dV = 0.5 λ | | BS antenna pattern | Antenna power pattern given in Table A.2.1-7 of TR38.802 for ceiling mount  (with exception of antenna element gain) | | UE antenna pattern | Antenna power pattern given in Table A.2.1-8 of TR38.802 | | Traffic Model | FTP Model 3 (27Mbyte file) | | UE Receiver | MMSE-IRC | | RSRP condition | UE with RSRP below a -71 dBm + 10 log10( bandwidth/2GHz ) are not considered in simulation and not counted toward UE distribution count | | RANK adaptation | 1 or 2 | | | | | |

#### B.2.4.5 Source 13 [29]

Table B.2.4.5-1. System level evaluation results for scenario

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Cases | | Case 1: Indoor-C Scenario  (2GHz CBW) | | | Case 2: Indoor-C Scenario  (400MHz CBW) | | |
| R1-2009062 / Source 13 | Traffic load  Metrics | | Low load | Medium load | High load | Low load | Medium load | High load |
| DL UPT (Mbps) | 5%ile | 4842 | 2722 | 1175 | 1354 | 618 | 280 |
| 50%ile | 10402 | 7727 | 5254 | 3053 | 1870 | 1191 |
| 95%ile | 15275 | 15275 | 13382 | 3053 | 3053 | 3053 |
| mean | 10161 | 8044 | 6080 | 2611 | 1926 | 1408 |
| DL delay (ms) | 5%ile | 14 | 14 | 16 | 71 | 71 | 71 |
| 50%ile | 21 | 28 | 41 | 71 | 115 | 181 |
| 95%ile | 45 | 79 | 183 | 160 | 350 | 771 |
| mean | 24 | 36 | 68 | 90 | 150 | 275 |
| UL UPT (Mbps) | 5%ile | 489 | 223 | 172 | 283 | 132 | 62 |
| 50%ile | 1203 | 665 | 517 | 511 | 357 | 245 |
| 95%ile | 1947 | 1539 | 1597 | 723 | 626 | 590 |
| mean | 1176 | 760 | 656 | 514 | 369 | 284 |
| UL delay (ms) | 5%ile | 104 | 138 | 133 | 295 | 345 | 366 |
| 50%ile | 179 | 325 | 417 | 423 | 601 | 881 |
| 95%ile | 413 | 934 | 1254 | 761 | 1616 | 3498 |
| mean | 220 | 416 | 522 | 447 | 759 | 1267 |
| Arrival rate (files/s) | | 48 | 192 | 288 | 9.6 | 48 | 72 |
| 𝜌DL | | 100% | 100% | 100% | 100% | 100% | 100% |
| 𝜌UL | | 100% | 100% | 100% | 100% | 100% | 99.9% |
| BO | | 8% | 35% | 53% | 6% | 31% | 51% |

#### B.2.4.6 Source 15 [71]

Table B.2.4.6-1. System level evaluation results for scenario indoor-C

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | Case 1  No-LBT | | | Case 2  Omni-LBT | | |
| R1-2009157 / Source 15 | Traffic load  Metrics | | Low load | Medium load | High load | Low load | Medium load | High load |
| DL UPT (Mbps) | 5%ile | 12.3 | 13.13 | 4.9 | 12.2 | 13.6 | 5.0 |
| 50%ile | 23.4 | 21.7 | 8.0 | 20.1 | 21.8 | 7.5 |
| 95%ile | 34.1 | 30.1 | 12.9 | 32.6 | 30 | 12.9 |
| mean | 23.1 | 21.7 | 8.28 | 22.3 | 21.8 | 8.0 |
| DL delay (ms) | 5%ile | 0.23 | 0.25 | 0.18 | 0.23 | 0.25 | 0.18 |
| 50%ile | 0.32 | 0.31 | 0.2 | 0.33 | 0.31 | 0.2 |
| 95%ile | 0.44 | 0.35 | 0.24 | 0.44 | 0.36 | 0.24 |
| mean | 0.33 | 0.3 | 0.2 | 0.34 | 0.31 | 0.2 |
| UL UPT (Mbps) | 5%ile | 6.7 | 5.8 | 2.8 | 6.4 | 3.9 | 2.8 |
| 50%ile | 7.3 | 6.5 | 3.3 | 6.8 | 7.1 | 3.3 |
| 95%ile | 8.0 | 7.4 | 5.1 | 7.3 | 7.4 | 5.1 |
| mean | 7.3 | 6.6 | 3.5 | 6.9 | 6.2 | 3.5 |
| UL delay (ms) | 5%ile | 0.25 | 0.26 | 0.2 | 0.25 | 0.24 | 0.21 |
| 50%ile | 0.27 | 0.26 | 0.25 | 0.27 | 0.27 | 0.25 |
| 95%ile | 0.28 | 0.27 | 0.28 | 0.28 | 0.3 | 0.28 |
| mean | 0.27 | 0.26 | 0.25 | 0.27 | 0.27 | 0.25 |
| Arrival rate (files/s) | | 200 DL/UL | 1250 DL/500 UL | 1400 DL/667 UL | 200 DL/UL | 1250 DL/500 UL | 1400 DL/667 UL |
| BO(%) | | 12 | 43 | 71.7 |  |  |  |
| Additional report/notes:  SCS = 480 kHz, BW = 400 MHz. file size = 0.5 MB  LBT Procedures: No-LBT, Omni-LBT with -47 dBm ED  All channels (gNB-UE, gNB-gNB, UE-UE) InH-Open office. | | | | | | | |

### B.2.5 Outdoor scenario B

#### B.2.5.1 Source 1 [65]

Table B.2.5.1-1. System level evaluation results for outdoor B, with/without LBT

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | Case 1: no LBT | | | Case 2: ED -47dBm | | | Case 3: ED-68 dBm | | |
| R1-2007984 / Source 1 | Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| DL UPT (Mbps) | 5%ile | 2324 | 1691 | 1196 | 2167 | 1646 | 1173 | 2189 | 1665 | 1186 |
| 50%ile | 5632 | 4694 | 3759 | 5338 | 4421 | 3535 | 5396 | 4418 | 3472 |
| 95%ile | 8365 | 7152 | 6155 | 7932 | 6904 | 5846 | 8026 | 7009 | 5888 |
| mean | 5749 | 4820 | 3951 | 5472 | 4570 | 3691 | 5493 | 4595 | 3676 |
| DL delay (s) | 5%ile | 0.023 | 0.026 | 0.031 | 0.024 | 0.028 | 0.034 | 0.024 | 0.029 | 0.035 |
| 50%ile | 0.038 | 0.049 | 0.069 | 0.041 | 0.052 | 0.074 | 0.040 | 0.052 | 0.074 |
| 95%ile | 0.074 | 0.101 | 0.162 | 0.076 | 0.106 | 0.177 | 0.075 | 0.110 | 0.189 |
| mean | 0.044 | 0.059 | 0.088 | 0.046 | 0.063 | 0.095 | 0.046 | 0.063 | 0.097 |
| UL UPT (Mbps) | 5%ile | 1363 | 1089 | 832 | 1287 | 988 | 735 | 1271 | 1003 | 727 |
| 50%ile | 2958 | 2599 | 2189 | 2779 | 2432 | 1986 | 2786 | 2385 | 1953 |
| 95%ile | 4171 | 3744 | 3367 | 3877 | 3522 | 3091 | 3899 | 3481 | 3064 |
| mean | 3022 | 2655 | 2260 | 2842 | 2480 | 2065 | 2841 | 2443 | 2021 |
| UL delay (s) | 5%ile | 0.048 | 0.053 | 0.059 | 0.051 | 0.056 | 0.064 | 0.051 | 0.058 | 0.068 |
| 50%ile | 0.073 | 0.087 | 0.112 | 0.078 | 0.095 | 0.130 | 0.078 | 0.097 | 0.129 |
| 95%ile | 0.124 | 0.165 | 0.258 | 0.134 | 0.185 | 0.283 | 0.131 | 0.183 | 0.297 |
| mean | 0.080 | 0.101 | 0.139 | 0.086 | 0.109 | 0.152 | 0.086 | 0.110 | 0.157 |
| Arrival rate (files/s) | | 0.36 | 1.34 | 2.32 | 0.36 | 1.34 | 2.32 | 0.36 | 1.34 | 2.32 |
| 𝜌DL | | 0.999 | 0.997 | 0.987 | 0.999 | 0.996 | 0.989 | 1.000 | 0.997 | 0.989 |
| 𝜌UL | | 0.999 | 0.993 | 0.978 | 0.999 | 0.993 | 0.981 | 0.998 | 0.993 | 0.979 |
| BO | | 0.100 | 0.350 | 0.550 | 0.105 | 0.368 | 0.570 | 0.105 | 0.366 | 0.569 |
| Additional report/notes:  1. LBT procedure and parameters: LBT based on ETSI EN 302 567 v2.1.20, ED thresholds -47dBm or -68dBm, CWS: CW\_min = CW\_max = 3  2. any assumptions/parameters used not as in the agreed baseline: single site, UMi street canyon channel & PL model from TR38.901  3. Details of case: 2 operators (scenario B) with the same settings, report only for OP A; case 1: no-LBT, case 2: LBT with ED = -47dBm, case 3: LBT with ED = -68dBm  5. Details of COT sharing if used in evaluation: 0.5ms COT for DL, 0.25ms COT for UL, DL COT sharing when traffic in both directions.  6. Other parameters: Frequency 60GHz, BW = 2GHz, SCS = 960kHz. | | | | | | | | | | |

#### B.2.5.2 Source 2 [72]

Table B.2.5.2-1. System level evaluation results for outdoor scenario B (1 site, no-LBT and omni-directional LBT)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | no-LBT | | | omni-directional LBT | | |
| Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| R1-2009610 / Source 2 | DL UPT (Mbps) | 5%ile | 1717.8 | 571.6 | 114.3 | 1650.1 | 465.4 | 82.3 |
| 50%ile | 4271.6 | 3191.9 | 2307.5 | 3986.2 | 2871.9 | 1985.4 |
| 95%ile | 7548.5 | 7296.0 | 7053.1 | 7115.3 | 6746.6 | 6462.0 |
| mean | 4543.2 | 3467.8 | 2746.8 | 4242.6 | 3131.2 | 2434.7 |
| DL delay (s) | 5%ile | 0.0584 | 0.0292 | 0.0306 | 0.0301 | 0.0317 | 0.0329 |
| 50%ile | 0.0506 | 0.0673 | 0.0919 | 0.0540 | 0.0746 | 0.1069 |
| 95%ile | 0.1236 | 0.3558 | 1.0587 | 0.1294 | 0.4282 | 1.3218 |
| mean | 0.0589 | 0.1096 | 0.2430 | 0.0631 | 0.1278 | 0.3009 |
| UL UPT (Mbps) | 5%ile | 2771.4 | 861.9 | 223.1 | 2582.3 | 694.0 | 115.5 |
| 50%ile | 6935.2 | 4863.5 | 3648.8 | 6475.1 | 4332.3 | 3097.7 |
| 95%ile | 10570 | 9542.9 | 9058.7 | 9824.7 | 8894.9 | 8501.6 |
| mean | 6574.7 | 5028.7 | 4045.6 | 6142.3 | 4546.0 | 3540.6 |
| UL delay (s) | 5%ile | 0.0204 | 0.0223 | 0.0238 | 0.0219 | 0.0239 | 0.0252 |
| 50%ile | 0.0311 | 0.0443 | 0.0586 | 0.0333 | 0.0497 | 0.0692 |
| 95%ile | 0.0779 | 0.2433 | 0.7830 | 0.0830 | 0.2974 | 1.0580 |
| mean | 0.0385 | 0.0772 | 0.1719 | 0.0416 | 0.0912 | 0.2261 |
| Arrival rate (files/s) | | 0.4 | 1.2 | 1.6 | 0.4 | 1.2 | 1.6 |
| 𝜌DL | | 99.66% | 99.07% | 96.74% | 99.61% | 98.85% | 95.26% |
| 𝜌UL | | 99.80% | 99.40% | 97.19% | 99.78% | 99.22% | 96.05% |
| BO | | 15.86% | 47.41% | 61.76% | 16.92% | 50.47% | 64.82% |
| Additional report/notes:  1. LBT procedure and parameters: LBT based on ETSI EN 302 567 v2.1.20, ED thresholds -47dBm for BBU, -32dBm for UE, CWS: CW\_min = CW\_max = 127  2. Details of case: 2 operators (outdoor scenario B, 1 site with wrapped around) with the same settings, case1: no-LBT; case 2: omni-directional LBT  3. Details of COT sharing if used in evaluation: MCOT = 5ms, No COT sharing for DL/UL data transmission.  4. Other parameters: Frequency 60GHz, BW = 2GHz, SCS = 960kHz, Rank 1 transmission. ftp3 file size = 27Mbyte. | | | | | | | |

Table B.2.5.2-2. System level evaluation results for outdoor scenario B (1 site, directional LBT and receiver assisted LBT)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | directional LBT | | | receiver-assisted LBT | | |
| Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| R1-2009610 / Source 2 | DL UPT (Mbps) | 5%ile | 1654.3 | 479.9 | 77.5 | 1642.2 | 468.6 | 81.5 |
| 50%ile | 3980.2 | 2843.3 | 1936.8 | 3978.3 | 2878.8 | 2035.3 |
| 95%ile | 7110.6 | 6722.2 | 6445.0 | 7060.1 | 6709.4 | 6435.9 |
| mean | 4227.9 | 3119.4 | 2413.8 | 4207.0 | 3152.7 | 2464.7 |
| DL delay (s) | 5%ile | 0.0302 | 0.0318 | 0.0330 | 0.0305 | 0.0318 | 0.0331 |
| 50%ile | 0.0542 | 0.0752 | 0.1089 | 0.0542 | 0.0742 | 0.1041 |
| 95%ile | 0.1289 | 0.4167 | 1.3588 | 0.1307 | 0.4221 | 1.3624 |
| mean | 0.0632 | 0.1275 | 0.3056 | 0.0633 | 0.1284 | 0.2997 |
| UL UPT (Mbps) | 5%ile | 2581.5 | 679.19 | 117.2 | 2580.8 | 701.0 | 133.3 |
| 50%ile | 6478.3 | 4323.7 | 3093.7 | 6486.2 | 4413.9 | 3213.7 |
| 95%ile | 9838.3 | 8912.6 | 8516.8 | 9880.6 | 8910.9 | 8504.7 |
| mean | 6138.7 | 4537.8 | 3550.8 | 6165.1 | 4589.3 | 3604.5 |
| UL delay (s) | 5%ile | 0.0219 | 0.0240 | 0.0253 | 0.0219 | 0.0236 | 0.0252 |
| 50%ile | 0.0333 | 0.0498 | 0.0691 | 0.0333 | 0.0488 | 0.0666 |
| 95%ile | 0.0837 | 0.3032 | 1.0907 | 0.0833 | 0.2950 | 1.0840 |
| mean | 0.0416 | 0.0923 | 0.2282 | 0.0415 | 0.0890 | 0.2253 |
| Arrival rate (files/s) | | 0.4 | 1.2 | 1.6 | 0.4 | 1.2 | 1.6 |
| 𝜌DL | | 99.61% | 98.86% | 95.08% | 99.61% | 98.84% | 95.25% |
| 𝜌UL | | 99.79% | 99.18% | 96.03% | 99.78% | 99.23% | 96.39% |
| BO | | 16.93% | 50.45% | 64.81% | 16.97% | 50.58% | 64.90% |
| Additional report/notes:  1. LBT procedure and parameters: LBT based on ETSI EN 302 567 v2.1.20, ED thresholds -47dBm for BBU, -32dBm for UE, CWS: CW\_min = CW\_max = 127  2. Details of case: 2 operators (outdoor scenario B, 1 site with wrapped around) with the same settings, case1: directional LBT; case 2: receiver-assisted LBT  3. Details of COT sharing if used in evaluation: MCOT = 5ms, No COT sharing for DL/UL data transmission.  4. Other parameters: Frequency 60GHz, BW = 2GHz, SCS = 960kHz, Rank 1 transmission. ftp3 file size = 27Mbyte. | | | | | | | |

Table B.2.5.2-3. System level evaluation results for outdoor scenario B (7 site, no-LBT and omni-directional LBT)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | no-LBT | | | omni-directional LBT | | |
| Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| R1-2009610 / Source 2 | DL UPT (Mbps) | 5%ile | 1456.9 | 909.7 | 229.5 | 1294.1 | 749.5 | 180.6 |
| 50%ile | 4252.2 | 3809.4 | 2996.6 | 3962.8 | 3390.4 | 2687.2 |
| 95%ile | 7472.9 | 7389.9 | 7142.7 | 7027.2 | 6877.8 | 6682.8 |
| mean | 4460.8 | 3887.5 | 3258.4 | 4144.6 | 3558.5 | 2947.9 |
| DL delay (s) | 5%ile | 0.0288 | 0.0293 | 0.0303 | 0.0306 | 0.0314 | 0.0325 |
| 50%ile | 0.0510 | 0.0588 | 0.0722 | 0.0548 | 0.0654 | 0.0807 |
| 95%ile | 0.1440 | 0.2349 | 0.5771 | 0.1557 | 0.2664 | 0.6798 |
| mean | 0.0625 | 0.0904 | 0.1567 | 0.0678 | 0.1022 | 0.1808 |
| UL UPT (Mbps) | 5%ile | 2603.7 | 1349.6 | 346.4 | 2288.2 | 1147.3 | 248.2 |
| 50%ile | 6936.5 | 5628.5 | 4358.9 | 6455.4 | 5204.2 | 3836.5 |
| 95%ile | 10518 | 9156.1 | 9053.4 | 9688.7 | 8694.4 | 8515.9 |
| mean | 6452.0 | 5610.1 | 4637.2 | 6013.1 | 5151.1 | 4177.2 |
| UL delay (s) | 5%ile | 0.0209 | 0.0235 | 0.0238 | 0.0224 | 0.0248 | 0.0252 |
| 50%ile | 0.0312 | 0.0385 | 0.0492 | 0.0339 | 0.0421 | 0.0556 |
| 95%ile | 0.0869 | 0.1573 | 0.4317 | 0.0944 | 0.1796 | 0.5169 |
| mean | 0.0414 | 0.0597 | 0.1131 | 0.0447 | 0.0675 | 0.1317 |
| Arrival rate (files/s) | | 0.4 | 0.8 | 1.4 | 0.4 | 0.8 | 1.4 |
| 𝜌DL | | 98.79% | 98.59% | 96.37% | 98.68% | 98.39% | 95.55% |
| 𝜌UL | | 99.27% | 99.14% | 96.83% | 99.26% | 98.88% | 95.81% |
| BO | | 16.04% | 35.34% | 57.44% | 17.11% | 35.40% | 60.35% |
| Additional report/notes:  1. LBT procedure and parameters: LBT based on ETSI EN 302 567 v2.1.20, ED thresholds -47dBm for BBU, -32dBm for UE, CWS: CW\_min = CW\_max = 127  2. Details of case: 2 operators (outdoor scenario B, 7 site) with the same settings, case1: no-LBT; case 2: omni-directional LBT  3. Details of COT sharing if used in evaluation: MCOT = 5ms, No COT sharing for DL/UL data transmission.  4. Other parameters: Frequency 60GHz, BW = 2GHz, SCS = 960kHz, Rank 1 transmission. ftp3 file size = 27Mbyte. | | | | | | | |

Table B.2.5.2-4. System level evaluation results for outdoor scenario B (7 site, directional LBT and receiver assisted LBT)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Tdoc /  Source | Cases | | directional LBT schemes | | | receiver-assisted LBT | | |
| Traffic load  Metrics | | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO | Low load  10%~25% BO | Medium load  35%~50% BO | High load  above 55% BO |
| R1-2009610 / Source 2 | DL UPT (Mbps) | 5%ile | 1286.7 | 750.8 | 179.2 | 1385.6 | 743.9 | 198.2 |
| 50%ile | 3934.1 | 3258.1 | 2643.7 | 3926.1 | 3299.0 | 2705 |
| 95%ile | 7085.9 | 6762.7 | 6671.5 | 6938.1 | 6748.1 | 6514 |
| mean | 4109.5 | 3485.6 | 2934.1 | 4110.0 | 3520.0 | 2933.3 |
| DL delay (s) | 5%ile | 0.0301 | 0.0315 | 0.0317 | 0.0306 | 0.0316 | 0.0327 |
| 50%ile | 0.0548 | 0.0656 | 0.0798 | 0.0546 | 0.0643 | 0.0787 |
| 95%ile | 0.1482 | 0.2616 | 0.6793 | 0.1527 | 0.2618 | 0.6499 |
| mean | 0.0672 | 0.1009 | 0.1808 | 0.0670 | 0.0996 | 0.1757 |
| UL UPT (Mbps) | 5%ile | 2126.9 | 1082.2 | 245.9 | 2285.2 | 1091.7 | 274.1 |
| 50%ile | 6214.7 | 5064.6 | 3816.0 | 6363.7 | 5151.7 | 3903.9 |
| 95%ile | 8849.0 | 8607.6 | 8455.1 | 9595.1 | 8640.3 | 8491.6 |
| mean | 5873.7 | 5085.0 | 4157.8 | 5947.3 | 5124.8 | 4216.9 |
| UL delay (s) | 5%ile | 0.0242 | 0.0248 | 0.0263 | 0.0223 | 0.0247 | 0.0252 |
| 50%ile | 0.0343 | 0.0423 | 0.0576 | 0.0336 | 0.0417 | 0.0544 |
| 95%ile | 0.0975 | 0.1876 | 0.5191 | 0.0916 | 0.1835 | 0.5068 |
| mean | 0.0458 | 0.0686 | 0.1359 | 0.0445 | 0.0681 | 0.1290 |
| Arrival rate (files/s) | | 0.4 | 0.8 | 1.4 | 0.4 | 0.8 | 1.4 |
| 𝜌DL | | 98.45% | 98.83% | 95.85% | 98.63% | 98.37% | 95.49% |
| 𝜌UL | | 99.13% | 98.80% | 95.93% | 99.31% | 98.89% | 96.01% |
| BO | | 17.51% | 35.84% | 61.15% | 17.32% | 35.93% | 60.93% |
| Additional report/notes:  1. LBT procedure and parameters: LBT based on ETSI EN 302 567 v2.1.20, ED thresholds -47dBm for BBU, -32dBm for UE, CWS: CW\_min = CW\_max = 127  2. Details of case: 2 operators (outdoor scenario B, 7 site) with the same settings, case1: directional LBT; case 2: receiver-assisted LBT  3. Details of COT sharing if used in evaluation: MCOT = 5ms, No COT sharing for DL/UL data transmission.  4. Other parameters: Frequency 60GHz, BW = 2GHz, SCS = 960kHz, Rank 1 transmission. ftp3 file size = 27Mbyte. | | | | | | | |

# Annex C: Change history

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2020-10 |  | R1-2007958 |  |  |  | Draft skeleton TR | V0.0.2 |
| 2020-11 |  | R1-2009713 |  |  |  | Updated TR based on agreements from RAN1 #103-e. | V0.1.0 |