|  |  |
| --- | --- |
| **Radiocommunication Study Groups** |  |
|  |  |
|  |  |
| Source: Document 5D/TEMP/16(Rev.1) | **Revision 1 to**  **Document IMT-2020/26-E** |
| **16 December 2019** |
| **English only** |
| Working Party 5D | |
| Observations of SWG Evaluation  (Proponents ETSI (TC DECT) and DECT Forum) | |

PART I

(WP 5D #33 Meeting)

**IMT-2020 submission in Document 5D/1299 (Proponents ETSI (TC DECT) and DECT Forum)**

Working Party 5D (WP 5D) has identified at WP 5D #33 meeting, in its review of the **Proponents** **ETSI(TC DECT) amd DECT Forum updated submission in Document** [5D/1299](https://www.itu.int/md/R15-WP5D-C-1299/en), the submission in Document 5D/1299 meets the completeness of step 3.

Observations on the submitted self-evaluation

The criteria for the self-evaluation is found in the template for the document IMT-2020/YYY in Section 4.3 “Self-Evaluation”. See Document [5D/1110](https://www.itu.int/md/R15-WP5D-C-1110/en) Chapter 5, Attachment 5.9, Chairman’s Report of WP 5D #31 Meeting, October 2018.

A summary of key findings is provided in Part I Attachment 1.

Part I Attachment 2 provides the guidance to understand the supplementary document.

Conclusion:

***4.3) Self-evaluation:*** *The entity that proposes a candidate RIT or SRIT to the ITU-R (the proponent) shall include with it either an self-evaluation or an evaluation submitted by another entity and endorsed by the proponent, and based on the compliance templates in § 5.2.4. (Report ITU-R M.2411 section 5.1 § 2).*

Self-evaluation supplied: X Yes  No

Comments (specify)

**These submissions by the ETSI(TC DECT) and DECT Forum Proponents are determined to have satisfactorily fulfilled Section 4.3 for the self-evaluation.**

Evaluation type **X** provided by proponent (for the ETSI (TC DECT) and DECT Forum RIT)

Comments (specify the entity)

SWG Evaluation requests that this compete document be included in the relevant IMT-2020/17(Rev.1) document for the **Proponents ETSI (TC DECT) and DECT Forum** submission.

part i

Attachment 1

Summary of discussions by SWG Evaluation for IMT-2020 submission   
in Document 5D/1299 (Proponent ETSI(TC DECT) and DECT Forum)



part i

Attachment 2

Consideration of Supplementary Materials Provided per Report ITU-R M.2411 Section 5.2

For submission ETSI (TC DECT) and DECT Forum incorporated in Document [5D/1299](https://www.itu.int/md/R15-WP5D-C-1299/en), it is noted that the provided supplementary material included with the submission as indicated below does not provide information that is directly relevant and pertinent to the IMT-2020 evaluation and does not align with the provision of Report ITU-R M.2411 Section 5.2 to “*provide further understanding of the submission*”.

WP 5D has observed that this supplementary information, in the parametric values or other assumptions and analysis utilized, does not align with that specified in Report ITU-R M.2412 for a specific scenario being assessed.

The supplementary material, in particular, in Document 5D/1299 that this applies to is indicated below:

…..

*from Doc.5D/*[*1299(Part 1*](https://www.itu.int/dms_ties/itu-r/md/15/wp5d/c/R15-WP5D-C-1299!P1!MSW-E.docx)*) – Annex A: mMTC self-evaluation details; Sec. A.1: System simulations for mMTC*

We present following simulation results: results based on ITU-R evaluation configuration and in addition the results based on DECT configuration (operating at 1 900 MHz with a BS antenna height of 5 m).

In conjunction with the supplementary material noted above, and pertaining to Step 3 (for self-evaluation aspects) and/or Step 4 for this submission, it is noted that:

– WP 5D has not considered the indicated supplementary materials in the IMT-2020 evaluation as it is not directly relevant to the formal IMT-2020 evaluation.

– WP 5D therefore offers no endorsement of this supplementary information in the context of IMT-2020 suitability.

PART II

(WP 5D #32 Meeting)

IMT-2020 submission in Documents 5D/1230 and 5D/1253   
(Proponents ETSI (TC DECT) and DECT Forum)

Working Party 5D has so far identified at WP 5D Meeting #32, in its review of the **ETSI (TC DECT) submission in Document** [5D/1230](https://www.itu.int/md/R15-WP5D-C-1230/en),some submission deficiencies and clarification of technology issues which impact the submission and the ability of WP 5D to have the submission move forward in the IMT-2020 process.  The proponent had been requested in the discussions in Meeting #32 to remedy the deficient information and it is noted that **ETSI (TC DECT)** and **DECT forum** did provide further information. This is a summary of the observations of SWG Evaluation.

Observations on the submitted Self-Evaluation

The criteria for the self-evaluation is found in the template for the document IMT-2020/YYY in Section 4.3 “Self-Evaluation”. See Document [5D/1110](https://www.itu.int/md/R15-WP5D-C-1110/en), Chapter 5, Attachment 5.9, Chairman’s Report of WP 5D # 31 Meeting, October 2018.

A summary of key findings is provided in Attachment 1.

Attachment 2 provides the further information supplied to WP 5D #32 Meeting during the course of the meeting by the Proponent in response the request by SWG Evaluation for the Proponent to provide the information required by the process in such format as mandated by the process. Attachment 2 should be considered, on a going forward basis in WP 5D as an official part of the submission provided in Document 5D/1230, i.e., as an Amendment.

Conclusion:

***4.3) Self-evaluation:*** *The entity that proposes a candidate RIT or SRIT to the ITU-R (the proponent) shall include with it either an self-evaluation or an evaluation submitted by another entity and endorsed by the proponent, and based on the compliance templates in § 5.2.4. (Report ITU-R M.2411 section 5.1 § 2).*

Self-evaluation supplied: X Yes  No

Comments (specify)

**This submission cannot, in its current form, be determined to have satisfactorily fulfilled Section 4.3 for the self-evaluation. The supplied self-evaluation and any amendments accepted during WP 5D Meeting #32 *for the “DECT-2020 NR” RIT - DECT-2020 NR RIT Component of submitted SRIT* do not yet permit WP 5D to determine** **if a complete and satisfactory self-evaluation as required by the IMT-2020 process has been fully provided.**

**The Proponents should provide the full details requested in the process and in the specifically defined way to WP 5D, considering the comments raised in Meeting #32, in order for WP 5D to proceed further in the process with this submission.**

Evaluation type **X** provided by proponent (for “DECT-2020 NR” RIT – DECT-2020 NR RIT Component of submitted SRIT)

**X** submitted by another entity and endorsed by the proponent (for “3GPP 5G NR” RIT – 3GPP 5G candidate for inclusion in IMT-2020: Submission 2 for IMT-2020 (RIT Component of submitted SRIT)

Comments (specify the entity) 3GPP Proponent

SWG Evaluation requests that this compete document be included in the relevant IMT-2020/YYY document for the **ETSI (TC DECT)** and **DECT Forum** submission.

PART II

Attachment 1

Summary of discussions by SWG Evaluation for IMT-2020 submission in Document 5D/1230 (Proponents ETSI (TC DECT) and DECT Forum)

Clarification about “technically identical” by ETSI, DECT:

– The proposed SRIT consists of two component RITs:

• “DECT-2020 NR” RIT - DECT-2020 NR RIT.

• “3GPP 5G NR” RIT - 3GPP 5G candidate for inclusion in IMT-2020: Submission 2 for IMT-2020 (RIT).

The views from this SWG:

– Regarding the Document [5D/1230](https://www.itu.int/md/R15-WP5D-C-1230/en) from ETSI and the Document [5D/1253](https://www.itu.int/md/R15-WP5D-C-1253/en) from DECT. Forum, ETSI indicated to the 32nd meeting of WP 5D that for the purposes of evaluation, “3GPP 5G NR” RIT[[1]](#footnote-1) as one component RIT of this candidate technology submission in Document 5D/1230 is technically the same as the candidate technology submission provided in Document [5D/1217](https://www.itu.int/md/R15-WP5D-C-1217/en).

– WP 5D has concluded that because “3GPP 5G NR” RIT1 as one component RIT of Documents 5D/1230 and 5D/1217 are technically identical submissions, a single evaluation is applicable for both.

– It is clarified that the component indicated by the terminology *“DECT-2020 NR” RIT[[2]](#footnote-2) and the component indicated by the terminology “3GPP 5G NR” RIT* are different technologies notwithstanding the similarity of the use of the terminology *“NR”*

– Technique issue raised in this meeting *for “DECT-2020 NR” RIT - DECT-2020 NR RIT Component of submitted SRIT:*

• The configurations applied in self-evaluation to mMTC are not the same as that in Report ITU-R M.2412. Can proponent confirm by evaluation results that using the same configurations in Report ITU-R M.2412, the technology proposed still can fulfil the requirements?

○ To make meaningful simulations of DECT-2020 performance, several aspects of the environment needs to be considered and potentially modified. (From Doc. 5D/1230, A.1.3 Table 14)

• Evaluation methodology for evaluating reliability in Urban Macro URLLC is different from that defined in Report ITU-R M.2412

• Parameters applied to link budget evaluation for eMBB, mMTC and URLLC under the component RIT *“DECT-2020 NR” RIT are not aligned with those defined in Report ITU-R M.2411*

• DECT clarified that they do not support usage-scenario of eMBB for “DECT‑2020 NR” RIT

* + Regarding configurations applied in self-evaluation to Urban Macro-mMTC, some of configurations are different from those defined in Report ITU-R M.2412, which impact the evaluation results, including e.g. penetration loss, mobility speed, device distribution.
  + Regarding configurations applied in self-evaluation to Urban Macro-URLLC, the evaluation methodology is different from that defined in Report ITU-R M.2412, which impact the evaluation results.
  + Any further technique issue?

The meeting received a clarification document from ETSI(TC DECT) to explain the concerns raised *for “DECT-2020 NR” RIT - DECT-2020 NR RIT Component of submitted SRIT:*

– “ETSI DECT response r3” is the clarifications document **(see Attachment 2 below).**

– Any remaining issues (based on this clarification)?

• Self-evaluation on two technical performance requirements that are connection density under mMTC and Reliability based on Report ITU-R M.2412 are not complete.

• Link budget under mMTC and URLLC based on Report ITU-R M.2412 are not complete.

• Details of evaluation on Mobility interruption time is missing.

PART II

Attachment 2

**Amendment 1 to IMT-2020 Submission in Document 5D/1230  
(Proponents ETSI (TC DECT) and DECT Forum)  
  
Source:**



**DECT response to the raised comments  
 *for “DECT-2020 NR” RIT - DECT-2020 NR RIT Component of submitted SRIT***

**Compliance template for technical performance**

|  | Category | | | Required value | Requirement met? | Comments |
| --- | --- | --- | --- | --- | --- | --- |
| Usage scenario | Test environment | Downlink or uplink |  |  |  |
| 5.2.4.3.1 Peak data rate (Gbit/s) (4.1) | eMBB | Not applicable | Downlink | 20 |  Yes  No | Claims YES, but not covered in self-evaluation report |
| Uplink | 10 |  Yes  No |
| 5.2.4.3.2 Peak spectral efficiency (bit/s/Hz) (4.2) | eMBB | Not applicable | Downlink | 30 |  Yes  No | Claims YES, but not covered in self-evaluation report |
| Uplink | 15 |  Yes  No |
| 5.2.4.3.3 User experienced data rate (Mbit/s) (4.3) | eMBB | Dense Urban – eMBB | Downlink | 100 |  Yes  No | N/A |
| Uplink | 50 |  Yes  No |
| 5.2.4.3.4 5th percentile user spectral efficiency (bit/s/Hz) (4.4) | eMBB | Indoor Hotspot – eMBB | Downlink | 0.3 |  Yes  No | N/A |
| Uplink | 0.21 |  Yes  No |
| eMBB | Dense Urban – eMBB | Downlink | 0.225 |  Yes  No | N/A |
| Uplink | 0.15 |  Yes  No |
| eMBB | Rural – eMBB | Downlink | 0.12 |  Yes  No | N/A |
| Uplink | 0.045 |  Yes  No |
| 5.2.4.3.5 Average spectral efficiency (bit/s/Hz/ TRxP) (4.5) | eMBB | Indoor Hotspot – eMBB | Downlink | 9 |  Yes  No | N/A |
| Uplink | 6.75 |  Yes  No |
| eMBB | Dense Urban – eMBB | Downlink | 7.8 |  Yes  No | N/A |
| Uplink | 5.4 |  Yes  No |
| eMBB | Rural – eMBB | Downlink | 3.3 |  Yes  No | N/A |
|  Yes  No | N/A |
| Uplink | 1.6 |  Yes  No | N/A |
|  Yes  No | N/A |
| 5.2.4.3.6 Area traffic capacity (Mbit/s/m2) (4.6) | eMBB | Indoor-Hotspot – eMBB | Downlink | 10 |  Yes  No | N/A |
| 5.2.4.3.7 User plane latency (ms) (4.7.1) | eMBB | Not applicable | Uplink and Downlink | 4 |  Yes  No | N/A |
| URLLC | Not applicable | Uplink and Downlink | 1 |  Yes  No | YES,  Covered by self-evaluation |
| 5.2.4.3.8 Control plane latency (ms) (4.7.2) | eMBB | Not applicable | Not applicable | 20 |  Yes  No | N/A |
| URLLC | Not applicable | Not applicable | 20 |  Yes  No | YES,  Covered by self-evaluation |
| 5.2.4.3.9 Connection density (devices/km2) (4.8) | mMTC | Urban Macro – mMTC | Uplink | 1 000 000 |  Yes  No | Claims YES, but not following Report ITU-R M.2412 eval. guidelines |
| 5.2.4.3.10 Energy efficiency (4.9) | eMBB | Not applicable | Not applicable | Capability to support a high sleep ratio and long sleep duration |  Yes  No | N/A |
| 5.2.4.3.11 Reliability (4.10) | URLLC | Urban Macro –URLLC | Uplink or Downlink | 1-10-5 success probability of transmitting a layer 2 PDU (protocol data unit) of size 32 bytes within 1 ms in channel quality of coverage edge |  Yes  No | Claims YES, but not following Report ITU-R M.2412 eval. guidelines |
| 5.2.4.3.12 Mobility classes (4.11) | eMBB | Indoor Hotspot – eMBB | Uplink | Stationary, Pedestrian |  Yes  No | N/A |
| eMBB | Dense Urban – eMBB | Uplink | Stationary, Pedestrian,  Vehicular (up to 30 km/h) |  Yes  No | N/A |
| eMBB | Rural – eMBB | Uplink | Pedestrian, Vehicular, High speed vehicular |  Yes  No | N/A |
| 5.2.4.3.13  Mobility Traffic channel link data rates (bit/s/Hz) (4.11) | eMBB | Indoor Hotspot – eMBB | Uplink | 1.5 (10 km/h) |  Yes  No | N/A |
| eMBB | Dense Urban – eMBB | Uplink | 1.12 (30 km/h) |  Yes  No | N/A |
| eMBB | Rural – eMBB | Uplink | 0.8 (120 km/h) |  Yes  No | N/A |
| 0.45 (500 km/h) |  Yes  No | N/A |
| 5.2.4.3.14 Mobility interruption time (ms)  (4.12) | eMBB and URLLC | Not applicable | Not applicable | 0 |  Yes  No | Claims YES, but not covered in self-evaluation report |
| 5.2.4.3.15 Bandwidth and Scalability (4.13) | Not applicable | Not applicable | Not applicable | At least 100 MHz |  Yes  No | Yes |
| Up to 1 GHz |  Yes  No | Yes |
| Support of multiple different bandwidth values(4) |  Yes  No | Yes |

Note: Parameters applied to link budget evaluation for eMBB, mMTC and URLLC under the component RIT “DECT-2020 NR” RIT are not aligned with those defined in M.2411

Comment: Uplink transmit power in the link budget templates should be 23dBm instead of 24dBm

Response: Annex 2 containing the link budget templates has been updated using uplink transmit power of 23 dBm

Comment: On which versions of the ITU-R Reports is the submission based?

Response: The submission is based on M.2410-0 (11/2017), M.2411-0 (11/2017) and Report ITU-R M.2412-0 (11/2017).

DECT Response

5.2.4.3.1, 5.2.4.3.2 Comments on eMBB related information for DECT-2020

Any information on eMBB for DECT-2020 is only included as an additional information in the submission. We do not claim to support eMBB with DECT-2020. Can be set to “N/A”.

5.2.4.3.9 Comments on connection density evaluation for mMTC

As indicated in the submission, there are a few deviations from the ITU parameters for the mMTC simulations. As analysed in more detail in Annex 1, the usage of the exact ITU parameters will only lead to an improvement of the results or will not change the results in the submission. As the provided results are significantly better than the IMT-2020 minimum requirement, it can be concluded that the criteria of 1 000 000 devices/km2 with given traffic model can easily be met.

5.2.4.3.11 Comments on reliability evaluation for URLLC

Not possible to resolve immediately, because we have to change the setup for the simulation and run additional simulations. We would need time until end of August to provide the information.

5.2.4.3.14 Comments on ‘Mobility interruption time’

The requirement is met by the ‘seamless handover’ feature of DECT as described in 5.2.3.2.5.1.

Parameters applied to link budget evaluation for eMBB, mMTC and URLLC.

Link budget for eMBB: Only supplied as additional information. We do not claim to support eMBB with DECT-2020.

Link budget for mMTC and URLLC: The link budgets have been recalculated using the ITU‑parameters and the tables can be found in Annex 2. As expected, for 700 MHz the range increases compared to 2 GHz.

Annex 1

Investigation on the influence of the differences in the assumptions for the mMTC simulations for DECT-2020

Carrier frequency for evaluation

Carrier frequency for evaluation was changed from 700MHz to 1900MHz thus propagation of signal is generally more difficult.

Therefore using the ITU-value is expected to improve the results.

BS antenna height and channel model

BS antenna height was changed from 25m to 5 meters and subsequently as BS is at lower height the channel model has to be changed from urban macro to urban street canyon. This change makes the signal more difficult to propagate from/to BS and devices in the mesh deployment.

Therefore using the ITU-assumption is expected to improve the results.

Total Tx Power per TRxP in BS/sink

BS TX power reduced from 46dBm to 23dBm. The higher ITU value will increase the range.

Using the ITU-value will improve the results and link reliability.

Device deployment

As the device density is practically 1 device/m2, (uniform distribution) the modelling of outdoor/indoor with mesh does not make really difference. We rather used NLOS for all links in the simulation.

Using the ITU-assumption will give about the same results.

UE mobility model and speeds of interest

For single packet transmission that takes 0.416 ms, the 3 km/h velocity does not really make any difference for the performance. This was anyhow taken into account in the link simulation, which were used to define the SNR/BER mapping for packet transmission applied in the simulation.

Using the ITU-assumption will give about the same results.

BS noise figure and BS/sink antenna element gain

BS noise figure was changed from 5 dB to 7 dB and antenna gain was changed from 8 dBi to 0 dBi. The higher noise figure and lower antenna gain are reducing the range of a link. With the ITU assumption the range would be increased, which could only improve the results.

Using the ITU-assumption will give the same or better results.

Summary

With the modified parameters used in the submission it is more difficult to meet the minimum requirement. When using the ITU values, then for each parameter the effect would be either an improvement of the result or practically the same result. In overall, using the ITU values will improve the result.

As the provided results are significantly better than the minimum requirement, it can be concluded that when using the ITU values the criteria of 1 000 000 devices/km2 with given traffic model can easily be met.

Other merits of the simulation methodology in the provided results

We used non buffer assumption in the simulation, which models channel access accurately. We also consider the sharing access to random devices that needs to transmit data, which is the most difficult part for high number of devices system analysis. Any full buffer simulation would easily ignore this as the overhead of sharing radio resource is ignored.

Also acknowledgement for data transmission were explicitly modelled.

Annex 2

Link budget templates for DECT-2020

##### 5.2.3.3.2 Urban Macro-mMTC environment for DECT-2020 NR

For the purpose of Table 4 calculations, the system configuration is according to parameters shown in the table below.

TABLE 11

System configuration parameters for Urban Macro-mMTC

|  |  |  |
| --- | --- | --- |
| Parameter | Value | Description |
| Modulation | QPSK | OFDM subcarrier modulation |
| R | 3/4 | Rate of binary convolutional code |
| W | 1.728 | Transmission bandwidth (MHz) |
| NSS | 1 | Number of spatial streams |
| NPL | 32 | Payload size (bytes) |
| ACR | 6 | Adjacent channel rejection (dB) |

FIGURE 9

Receiver performance for mMTC 1 × 1 configurations

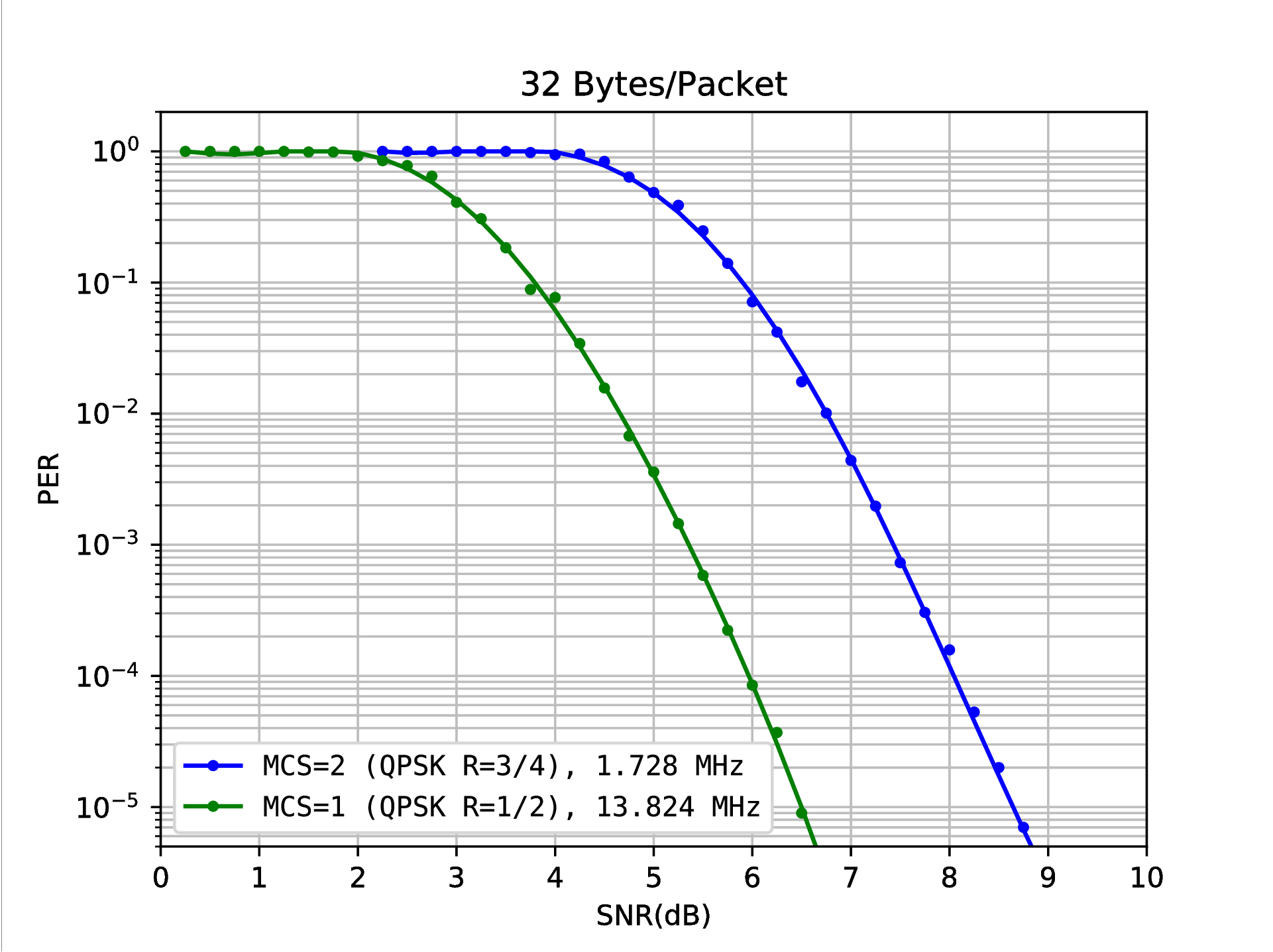


TABLE 4

Link budget template for Urban Macro–mMTC (NLOS)

| Item | Downlink | Uplink |
| --- | --- | --- |
| **System configuration** | | |
| Carrier frequency (GHz) | 0.7 | 0.7 |
| BS antenna heights (m) | 25 | 25 |
| UE antenna heights (m) | 1.5 | 1.5 |
| Cell area reliability(1) (%) (Please specify how it is calculated.) | 100% | 100% |
| Transmission bit rate for control channel (bit/s) | 1872000 | 1872000 |
| Transmission bit rate for data channel (bit/s) | 1872000 | 1872000 |
| Target packet error ratio for the required SNR in item (19a) for control channel | 10-5 | 10-5 |
| Target packet error ratio for the required SNR in item (19b) for data channel | 10-5 | 10-5 |
| Spectral efficiency(2) (bit/s/Hz) | 1.4 | 1.4 |
| Pathloss model(3) (Select from LOS, NLOS or O-to-I) | NLOS | NLOS |
| UE speed (km/h) | 0 | 0 |
| Feeder loss (dB) | 0 | 0 |
| **Transmitter** | | |
| (1) Number of transmit antennas (The number shall be within the indicated range in § 8.4 of Report ITU-R M.2412-0) | 1 | 1 |
| (2) Maximal transmit power per antenna (dBm) | 38 | 23 |
| (3) Total transmit power = function of (1) and (2) (dBm)  (The value shall not exceed the indicated value in § 8.4 of Report ITU-R M.2412-0) | 38 | 23 |
| (4) Transmitter antenna gain (dBi) | 8 | 0 |
| (5) Transmitter array gain (depends on transmitter array configurations and technologies such as adaptive beam forming, CDD (Cyclic delay diversity), etc.) (dB) | 0 | 0 |
| (6) Control channel power boosting gain (dB) | 0 | 0 |
| (7) Data channel power loss due to pilot/control boosting (dB) | 0 | 0 |
| (8) Cable, connector, combiner, body losses, etc. (enumerate sources) (dB) (feeder loss must be included for and only for downlink) | 1 | 2 |
| (9a) Control channel e.i.r.p. = (3) + (4) + (5) + (6) – (8) dBm | 45 | 21 |
| (9b) Data channel e.i.r.p. = (3) + (4) + (5) – (7) – (8) dBm | 45 | 21 |
| **Receiver** | | |
| (10) Number of receive antennas (The number shall be within the indicated range in § 8.4 of Report ITU-R M.2412-0) | 2 | 2 |
| (11) Receiver antenna gain (dBi) | 0 | 8 |
| (12) Cable, connector, combiner, body losses, etc. (enumerate sources) (dB) (feeder loss must be included for and only for uplink) | 2 | 1 |

TABLE 4 (*continued*)

| Item | Downlink | Uplink |
| --- | --- | --- |
| (13) Receiver noise figure (dB) | 7 | 5 |
| (14) Thermal noise density (dBm/Hz) | −174 | −174 |
| (15) Receiver interference density (dBm/Hz) | −170 | −170 |
| (16) Total noise plus interference density  = 10 log (10^(((13)+(14))/10) + 10^((15)/10)) dBm/Hz | −165 | −166 |
| (17) Occupied channel bandwidth (for meeting the requirements of the traffic type) (Hz) | 1.5 × 106 | 1.5 × 106 |
| (18) Effective noise power = (16) + 10 log((17)) dBm | −103 | −105 |
| (19a) Required SNR for the control channel (dB) | 5.4 | 5.4 |
| (19b) Required SNR for the data channel (dB) | 5.4 | 5.4 |
| (20) Receiver implementation margin (dB) | 4 | 2 |
| (21a) H-ARQ gain for control channel (dB) | 0 | 0 |
| (21b) H-ARQ gain for data channel (dB) | 0 | 0 |
| (22a) Receiver sensitivity for control channel  = (18) + (19a) + (20) – (21a) dBm | −94 | −97 |
| (22b) Receiver sensitivity for data channel  = (18) + (19b) + (20) – (21b) dBm | −94 | −97 |
| (23a) Hardware link budget for control channel  = (9a) + (11) - (22a) dB | 139 | 126 |
| (23b) Hardware link budget for data channel  = (9b) + (11) - (22b) dB | 139 | 126 |
| **Calculation of available pathloss** | | |
| (24) Lognormal shadow fading std deviation (dB) | 6 | 6 | |
| (25) Shadow fading margin (function of the cell area reliability and (24)) (dB) | 22.2 | 22.2 | |
| (26) BS selection/macro-diversity gain (dB) | 0 | 0 | |
| (27) Penetration margin (dB) | 0 | 0 | |
| (28) Other gains (dB) (if any please specify) | 0 | 0 | |
| (29a) Available path loss for control channel  = (23a) – (25) + (26) – (27) + (28) – (12) dB | 115 | 103 | |
| (29b) Available path loss for data channel  = (23b) – (25) + (26) – (27) + (28) – (12) dB | 115 | 103 | |
| **Range/coverage efficiency calculation** | | | |
| (30a) Maximum range for control channel (based on (29a) and according to the system configuration section of the link budget) (m) | 480 | 234 | |
| (30b) Maximum range for data channel (based on (29b) and according to the system configuration section of the link budget) (m) | 480 | 234 | |

TABLE 4 (*end*)

| Item | Downlink | Uplink |
| --- | --- | --- |
| (31a) Coverage Area for control channel = (π (30a)2) (m2/site) | 723030 | 172723 |
| (31b) Coverage Area for data channel = (π (30b)2) (m2/site) | 723030 | 172723 |
| (1) Cell area reliability is defined as the percentage of the cell area over which coverage can be guaranteed. It is obtained from the cell edge reliability, shadow fading standard deviation and the path loss exponent. The latter two values are used to calculate a fade margin. Macro diversity gain may be considered explicitly and improve the system margin or implicitly by reducing the fade margin.  (2) The spectral efficiency of the chosen modulation scheme.  (3) The pathloss models are summarized in § 9.1 of Report ITU-R M.2412-0. | | |

TABLE 4

Link budget template for Urban Macro–mMTC (LOS)

| Item | Downlink | Uplink |
| --- | --- | --- |
| **System configuration** | | |
| Carrier frequency (GHz) | 0.7 | 0.7 |
| BS antenna heights (m) | 25 | 25 |
| UE antenna heights (m) | 1.5 | 1.5 |
| Cell area reliability(1) (%) (Please specify how it is calculated.) | 100% | 100% |
| Transmission bit rate for control channel (bit/s) | 1 872 000 | 1 872 000 |
| Transmission bit rate for data channel (bit/s) | 1 872 000 | 1 872 000 |
| Target packet error ratio for the required SNR in item (19a) for control channel | 10-5 | 10-5 |
| Target packet error ratio for the required SNR in item (19b) for data channel | 10-5 | 10-5 |
| Spectral efficiency(2) (bit/s/Hz) | 1.4 | 1.4 |
| Pathloss model(3) (Select from LOS, NLOS or O-to-I) | LOS | LOS |
| UE speed (km/h) | 0 | 0 |
| Feeder loss (dB) | 0 | 0 |
| **Transmitter** | | |
| (1) Number of transmit antennas (The number shall be within the indicated range in § 8.4 of Report ITU-R M.2412-0) | 1 | 1 |
| (2) Maximal transmit power per antenna (dBm) | 38 | 23 |
| (3) Total transmit power = function of (1) and (2) (dBm)  (The value shall not exceed the indicated value in § 8.4 of Report ITU-R M.2412-0) | 38 | 23 |
| (4) Transmitter antenna gain (dBi) | 8 | 0 |
| (5) Transmitter array gain (depends on transmitter array configurations and technologies such as adaptive beam forming, CDD (Cyclic delay diversity), etc.) (dB) | 0 | 0 |
| (6) Control channel power boosting gain (dB) | 0 | 0 |
| (7) Data channel power loss due to pilot/control boosting (dB) | 0 | 0 |
| (8) Cable, connector, combiner, body losses, etc. (enumerate sources) (dB) (feeder loss must be included for and only for downlink) | 1 | 2 |
| (9a) Control channel e.i.r.p. = (3) + (4) + (5) + (6) – (8) dBm | 45 | 21 |
| (9b) Data channel e.i.r.p. = (3) + (4) + (5) – (7) – (8) dBm | 45 | 21 |
| **Receiver** | | |
| (10) Number of receive antennas (The number shall be within the indicated range in § 8.4 of Report ITU-R M.2412-0) | 2 | 2 |
| (11) Receiver antenna gain (dBi) | 0 | 8 |
| (12) Cable, connector, combiner, body losses, etc. (enumerate sources) (dB) (feeder loss must be included for and only for uplink) | 2 | 1 |

TABLE 4 (*continued*)

| Item | Downlink | Uplink |
| --- | --- | --- |
| (13) Receiver noise figure (dB) | 7 | 5 |
| (14) Thermal noise density (dBm/Hz) | −174 | −174 |
| (15) Receiver interference density (dBm/Hz) | −170 | −170 |
| (16) Total noise plus interference density  = 10 log (10^(((13)+(14))/10) + 10^((15)/10)) dBm/Hz | −165 | −166 |
| (17) Occupied channel bandwidth (for meeting the requirements of the traffic type) (Hz) | 1.5 × 106 | 1.5 × 106 |
| (18) Effective noise power = (16) + 10 log((17)) dBm | −103 | −105 |
| (19a) Required SNR for the control channel (dB) | 5.4 | 5.4 |
| (19b) Required SNR for the data channel (dB) | 5.4 | 5.4 |
| (20) Receiver implementation margin (dB) | 4 | 2 |
| (21a) H-ARQ gain for control channel (dB) | 0 | 0 |
| (21b) H-ARQ gain for data channel (dB) | 0 | 0 |
| (22a) Receiver sensitivity for control channel  = (18) + (19a) + (20) – (21a) dBm | -94 | -97 |
| (22b) Receiver sensitivity for data channel  = (18) + (19b) + (20) – (21b) dBm | -94 | -97 |
| (23a) Hardware link budget for control channel  = (9a) + (11) - (22a) dB | 139 | 126 |
| (23b) Hardware link budget for data channel  = (9b) + (11) - (22b) dB | 139 | 126 |
| **Calculation of available pathloss** | | |
| (24) Lognormal shadow fading std deviation (dB) | 4 | 4 | |
| (25) Shadow fading margin (function of the cell area reliability and (24)) (dB) | 13.8 | 13.8 | |
| (26) BS selection/macro-diversity gain (dB) | 0 | 0 | |
| (27) Penetration margin (dB) | 0 | 0 | |
| (28) Other gains (dB) (if any please specify) | 0 | 0 | |
| (29a) Available path loss for control channel  = (23a) – (25) + (26) – (27) + (28) – (12) dB | 124 | 111 | |
| (29b) Available path loss for data channel  = (23b) – (25) + (26) – (27) + (28) – (12) dB | 124 | 111 | |
| Range/coverage efficiency calculation | | | |
| (30a) Maximum range for control channel (based on (29a) and according to the system configuration section of the link budget) (m) | 2479 | 1232 | |
| (30b) Maximum range for data channel (based on (29b) and according to the system configuration section of the link budget) (m) | 2479 | 1232 | |

TABLE 4 (*end*)

| Item | Downlink | Uplink |
| --- | --- | --- |
| (31a) Coverage Area for control channel = (π (30a)2) (m2/site) | 19 299 520 | 4 764 761 |
| (31b) Coverage Area for data channel = (π (30b)2) (m2/site) | 19 299 520 | 4 764 761 |
| (1) Cell area reliability is defined as the percentage of the cell area over which coverage can be guaranteed. It is obtained from the cell edge reliability, shadow fading standard deviation and the path loss exponent. The latter two values are used to calculate a fade margin. Macro diversity gain may be considered explicitly and improve the system margin or implicitly by reducing the fade margin.  (2) The spectral efficiency of the chosen modulation scheme.  (3) The pathloss models are summarized in § 9.1 of Report ITU-R M.2412-0. | | |

##### 5.2.3.3.3 Urban Macro-URLLC environment for DECT-2020 NR

For the purpose of Table 5 calculations, the system configuration is according to parameters shown in the table below.

TABLE 12

System configuration parameters for Urban Macro-URLLC

|  |  |  |
| --- | --- | --- |
| Parameter | Value | Description |
| Modulation | QPSK | OFDM subcarrier modulation |
| R | 3/4 | Rate of binary convolutional code |
| W | 1.728 | Transmission bandwidth (MHz) |
| NSS | 1 | Number of spatial streams |
| NPL | 32 | Payload size (bytes) |
| ACR | 6 | Adjacent channel rejection (dB) |

Figure 10

Receiver performance for URLLC 1 × 1 configurations

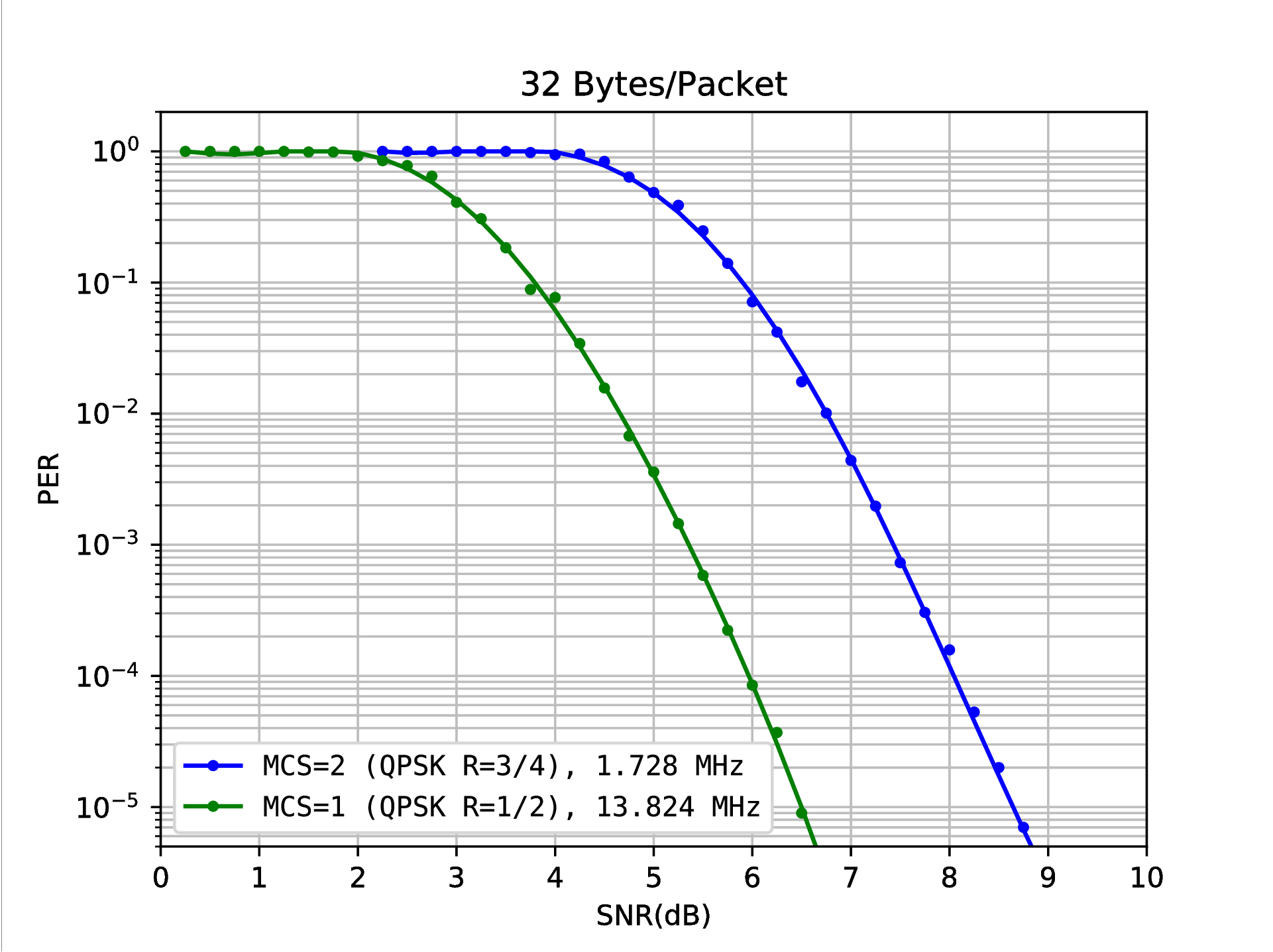


TABLE 5

Link budget template for Urban Macro–URLLC (NLOS)

| Item | Downlink | Uplink |
| --- | --- | --- |
| **System configuration** | | |
| Carrier frequency (GHz) | 0.7 | 0.7 |
| BS antenna heights (m) | 25 | 25 |
| UE antenna heights (m) | 1.5 | 1.5 |
| Cell area reliability(1) (%) (Please specify how it is calculated.) | 100% | 100% |
| Transmission bit rate for control channel (bit/s) | 1 872 000 | 1 872 000 |
| Transmission bit rate for data channel (bit/s) | 1 872 000 | 1 872 000 |
| Target packet error ratio for the required SNR in item (19a) for control channel | 10-5 | 10-5 |
| Target packet error ratio for the required SNR in item (19b) for data channel | 10-5 | 10-5 |
| Spectral efficiency(2) (bit/s/Hz) | 1.4 | 1.4 |
| Pathloss model(3) (Select from LOS, NLOS or O-to-I) | NLOS | NLOS |
| UE speed (km/h) | 0 | 0 |
| Feeder loss (dB) | 0 | 0 |
| **Transmitter** | | |
| (1) Number of transmit antennas  (The number shall be within the indicated range in § 8.4 of Report ITU‑R M.2412-0) | 1 | 1 |
| (2) Maximal transmit power per antenna (dBm) | 38 | 23 |
| (3) Total transmit power = function of (1) and (2) (dBm)  (The value shall not exceed the indicated value in § 8.4 of Report ITU-R M.2412-0) | 38 | 23 |
| (4) Transmitter antenna gain (dBi) | 8 | 0 |
| (5) Transmitter array gain (depends on transmitter array configurations and technologies such as adaptive beam forming, CDD (cyclic delay diversity), etc.) (dB) | 0 | 0 |

TABLE 5 (*continued*)

| Item | Downlink | Uplink |
| --- | --- | --- |
| (6) Control channel power boosting gain (dB) | 0 | 0 |
| (7) Data channel power loss due to pilot/control boosting (dB) | 0 | 0 |
| (8) Cable, connector, combiner, body losses, etc. (enumerate sources) (dB) (Feeder loss must be included for and only for downlink) | 1 | 2 |
| (9a) Control channel e.i.r.p. = (3) + (4) + (5) + (6) - (8) dBm | 45 | 21 |
| (9b) Data channel e.i.r.p. = (3) + (4) + (5) - (7) - (8) dBm | 45 | 21 |
| *Receiver* | | |
| (10) Number of receive antennas (The number shall be within the indicated range in § 8.4 of Report ITU-R M.2412-0) | 2 | 2 |
| (11) Receiver antenna gain (dBi) | 0 | 8 |
| (12) Cable, connector, combiner, body losses, etc. (enumerate sources) (dB) (Feeder loss must be included for and only for uplink) | 2 | 1 |
| (13) Receiver noise figure (dB) | 7 | 5 |
| (14) Thermal noise density (dBm/Hz) | −174 | −174 |
| (15) Receiver interference density (dBm/Hz) | −170 | −170 |
| (16) Total noise plus interference density  = 10 log (10^(((13) + (14))/10) + 10^((15)/10)) dBm/Hz | −165 | −166 |
| (17) Occupied channel bandwidth (for meeting the requirements of the traffic type) (Hz) | 1.5 × 106 | 1.5 × 106 |
| (18) Effective noise power = (16) + 10 log((17)) dBm | −103 | -105 |
| (19a) Required SNR for the control channel (dB) | 5.4 | 5.4 |
| (19b) Required SNR for the data channel (dB) | 5.4 | 5.4 |
| (20) Receiver implementation margin (dB) | 4 | 2 |
| (21a) H-ARQ gain for control channel (dB) | 0 | 0 |
| (21b) H-ARQ gain for data channel (dB) | 0 | 0 |
| (22a) Receiver sensitivity for control channel  = (18) + (19a) + (20) – (21a) dBm | −94 | -97 |
| (22b) Receiver sensitivity for data channel  = (18) + (19b) + (20) – (21b) dBm | −94 | -97 |
| (23a) Hardware link budget for control channel  = (9a) + (11) - (22a) dB | 139 | 126 |
| (23b) Hardware link budget for data channel  = (9b) + (11) - (22b) dB | 139 | 126 |
| **Calculation of available pathloss** | | |
| (24) Lognormal shadow fading std deviation (dB) | 6 | 6 |
| (25) Shadow fading margin (function of the cell area reliability and (24)) (dB) | 22.2 | 22.2 |

TABLE 5 (*end*)

| **Item** | **Downlink** | **Uplink** |
| --- | --- | --- |
| (26) BS selection/macro-diversity gain (dB) | 0 | 0 |
| (27) Penetration margin (dB) | 0 | 0 |
| (28) Other gains (dB) (if any please specify) | 0 | 0 |
| (29a) Available path loss for control channel  = (23a) – (25) + (26) – (27) + (28) – (12) dB | 115 | 103 |
| (29b) Available path loss for data channel  = (23b) – (25) + (26) – (27) + (28) – (12) dB | 115 | 103 |
| **Range/coverage efficiency calculation** | | |
| (30a) Maximum range for control channel (based on (29a) and according to the system configuration section of the link budget) (m) | 480 | 234 |
| (30b) Maximum range for data channel (based on (29b) and according to the system configuration section of the link budget) (m) | 480 | 234 |
| (31a) Coverage Area for control channel = (π (30a)2) (m2/site) | 723 030 | 172 723 |
| (31b) Coverage Area for data channel = (π (30b)2) (m2/site) | 723 030 | 172 723 |
| (1) Cell area reliability is defined as the percentage of the cell area over which coverage can be guaranteed. It is obtained from the cell edge reliability, shadow fading standard deviation and the path loss exponent. The latter two values are used to calculate a fade margin. Macro diversity gain may be considered explicitly and improve the system margin or implicitly by reducing the fade margin.  (2) The spectral efficiency of the chosen modulation scheme.  (3) The pathloss models are summarized in § 9.1 of Report ITU-R M.2412-0. | | |

TABLE 5

Link budget template for Urban Macro–URLLC (LOS)

| **Item** | **Downlink** | **Uplink** |
| --- | --- | --- |
| **System configuration** | | |
| Carrier frequency (GHz) | 0.7 | 0.7 |
| BS antenna heights (m) | 25 | 25 |
| UE antenna heights (m) | 1.5 | 1.5 |
| Cell area reliability(1) (%) (Please specify how it is calculated.) | 100% | 100% |
| Transmission bit rate for control channel (bit/s) | 1 872 000 | 1 872 000 |
| Transmission bit rate for data channel (bit/s) | 1 872 000 | 1 872 000 |
| Target packet error ratio for the required SNR in item (19a) for control channel | 10-5 | 10-5 |
| Target packet error ratio for the required SNR in item (19b) for data channel | 10-5 | 10-5 |
| Spectral efficiency(2) (bit/s/Hz) | 1.4 | 1.4 |
| Pathloss model(3) (Select from LOS, NLOS or O-to-I) | LOS | LOS |
| UE speed (km/h) | 0 | 0 |
| Feeder loss (dB) | 0 | 0 |
| **Transmitter** | | |
| (1) Number of transmit antennas  (The number shall be within the indicated range in § 8.4 of Report ITU‑R M.2412-0) | 1 | 1 |
| (2) Maximal transmit power per antenna (dBm) | 38 | 23 |
| (3) Total transmit power = function of (1) and (2) (dBm)  (The value shall not exceed the indicated value in § 8.4 of Report ITU-R M.2412-0) | 38 | 23 |
| (4) Transmitter antenna gain (dBi) | 8 | 0 |
| (5) Transmitter array gain (depends on transmitter array configurations and technologies such as adaptive beam forming, CDD (cyclic delay diversity), etc.) (dB) | 0 | 0 |

TABLE 5 (*continued*)

| Item | Downlink | Uplink |
| --- | --- | --- |
| (6) Control channel power boosting gain (dB) | 0 | 0 |
| (7) Data channel power loss due to pilot/control boosting (dB) | 0 | 0 |
| (8) Cable, connector, combiner, body losses, etc. (enumerate sources) (dB) (Feeder loss must be included for and only for downlink) | 1 | 2 |
| (9a) Control channel e.i.r.p. = (3) + (4) + (5) + (6) - (8) dBm | 45 | 21 |
| (9b) Data channel e.i.r.p. = (3) + (4) + (5) - (7) - (8) dBm | 45 | 21 |
| **Receiver** | | |
| (10) Number of receive antennas (The number shall be within the indicated range in § 8.4 of Report ITU-R M.2412-0) | 2 | 2 |
| (11) Receiver antenna gain (dBi) | 0 | 8 |
| (12) Cable, connector, combiner, body losses, etc. (enumerate sources) (dB) (Feeder loss must be included for and only for uplink) | 2 | 1 |
| (13) Receiver noise figure (dB) | 7 | 5 |
| (14) Thermal noise density (dBm/Hz) | −174 | −174 |
| (15) Receiver interference density (dBm/Hz) | −170 | −170 |
| (16) Total noise plus interference density  = 10 log (10^(((13) + (14))/10) + 10^((15)/10)) dBm/Hz | −165 | −166 |
| (17) Occupied channel bandwidth (for meeting the requirements of the traffic type) (Hz) | 1.5 × 106 | 1.5 × 106 |
| (18) Effective noise power = (16) + 10 log((17)) dBm | −103 | −105 |
| (19a) Required SNR for the control channel (dB) | 5.4 | 5.4 |
| (19b) Required SNR for the data channel (dB) | 5.4 | 5.4 |
| (20) Receiver implementation margin (dB) | 4 | 2 |
| (21a) H-ARQ gain for control channel (dB) | 0 | 0 |
| (21b) H-ARQ gain for data channel (dB) | 0 | 0 |
| (22a) Receiver sensitivity for control channel  = (18) + (19a) + (20) – (21a) dBm | −94 | −97 |
| (22b) Receiver sensitivity for data channel  = (18) + (19b) + (20) – (21b) dBm | −94 | −97 |
| (23a) Hardware link budget for control channel  = (9a) + (11) - (22a) dB | 139 | 126 |
| (23b) Hardware link budget for data channel  = (9b) + (11) - (22b) dB | 139 | 126 |
| **Calculation of available pathloss** | | |
| (24) Lognormal shadow fading std deviation (dB) | 4 | 4 |
| (25) Shadow fading margin (function of the cell area reliability and (24)) (dB) | 13.8 | 13.8 |

TABLE 5 (*end*)

| Item | Downlink | Uplink |
| --- | --- | --- |
| (26) BS selection/macro-diversity gain (dB) | 0 | 0 |
| (27) Penetration margin (dB) | 0 | 0 |
| (28) Other gains (dB) (if any please specify) | 0 | 0 |
| (29a) Available path loss for control channel  = (23a) – (25) + (26) – (27) + (28) – (12) dB | 124 | 111 |
| (29b) Available path loss for data channel  = (23b) – (25) + (26) – (27) + (28) – (12) dB | 124 | 111 |
| **Range/coverage efficiency calculation** | | |
| (30a) Maximum range for control channel (based on (29a) and according to the system configuration section of the link budget) (m) | 2 479 | 1 232 |
| (30b) Maximum range for data channel (based on (29b) and according to the system configuration section of the link budget) (m) | 2 479 | 1 232 |
| (31a) Coverage Area for control channel = (π (30a)2) (m2/site) | 19 299 520 | 4 764 761 |
| (31b) Coverage Area for data channel = (π (30b)2) (m2/site) | 19 299 520 | 4 764 761 |
| (1) Cell area reliability is defined as the percentage of the cell area over which coverage can be guaranteed. It is obtained from the cell edge reliability, shadow fading standard deviation and the path loss exponent. The latter two values are used to calculate a fade margin. Macro diversity gain may be considered explicitly and improve the system margin or implicitly by reducing the fade margin.  (2) The spectral efficiency of the chosen modulation scheme.  (3) The pathloss models are summarized in § 9.1 of Report ITU-R M.2412-0. | | |

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. “3GPP 5G NR” RIT is “3GPP 5G *candidate for inclusion in IMT-2020: Submission 2 for IMT‑2020 (RIT)” in Document 5D/1230.* [↑](#footnote-ref-1)
2. “DECT-2020 NR” RIT *is “DECT-2020 NR RIT” in Document 5D/1230.* [↑](#footnote-ref-2)