#### 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 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 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**MobilityTraffic 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 23dBm

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 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 700MHz 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 0.416ms, 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 5dB to 7dB and antenna gain was changed from 8dBi to 0dBi. 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 1x1 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 x 106* | *1.5 x 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) | *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) | *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 x 106* | *1.5 x 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) | *19299520* | *4764761* |
| (31b) Coverage Area for data channel = (π (30b)2) (m2/site) | *19299520* | *4764761* |
|  |
| (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 1x1 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) | *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* |

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 x 106* | *1.5 x 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 pathlos |
| (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) | *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 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) | *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) | *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 x 106* | *1.5 x 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) | *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* |
| (31a) Coverage Area for control channel = (π (30a)2) (m2/site) | *19299520* | *4764761* |
| (31b) Coverage Area for data channel = (π (30b)2) (m2/site) | *19299520* | *4764761* |
|  |
| (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. |