#### 5.2.3.2 Description template – characteristics **template**

*In this document the terminology ‘Fixed Part’ (FP) and ‘Portable Part’ (PP) is used to identify the two radio end points. These are the names traditionally used in DECT. The FP is normally (but not always) fixed and corresponds to what is referred to as BS in mobile terminology, the PP is normally (but not always) mobile and corresponds to what is referred to as UE in mobile terminology. Hybrid devices, combining the roles of FP and PP, may also exist.*

| Item | Item to be described |
| --- | --- |
| **5.2.3.2.1** | **Test environment(s)** |
| 5.2.3.2.1.1 | What test environments (described in Report ITU-R M.2412-0) does this technology description template address?*The information will be provided in later update.* |
| **5.2.3.2.2** | **Radio interface functional aspects**  |
| 5.2.3.2.2.1 | *Multiple access schemes*Which access scheme(s) does the proposal use? Describe in detail the multiple access schemes employed with their main parameters.*Both time-division and frequency-division multiple access. The system can simultaneously use multiple frequency sub-channels, and within each, sequential uplink or downlink transfers may occur. Time-overlapping transmit/receive is not supported: the FP device can perform independent transmission to multiple PP devices on a given time interval; on a different time interval the FP device can receive transmissions from multiple PP devices.**An FP device can support simultaneous links to multiple PP devices.**Nominal sub-carrier spacing is 27 kHz with a nominal time slot duration of 416.67µs. Additional sub-carrier spacings up to 216 kHz are supported depending on deployment.*  |
| 5.2.3.2.2.2 | *Modulation scheme* |
| 5.2.3.2.2.2.1 | What is the baseband modulation scheme? If both data modulation and spreading modulation are required, describe in detail.Describe the modulation scheme employed for data and control information.What is the symbol rate after modulation?*For both data and control orthogonal frequency-division multiplexing (OFDM) with 24 kHz nominal symbol rate is used. The selected modulation and code rate depend on the wanted service and the quality of the radio channel. Table 1 lists 13 different configurations, which have been defined.**Table 1: Modulation Configurations*

|  |  |  |
| --- | --- | --- |
| *Modulation* | *Code RateR* | *Allowed Constellation Error EVM (dB)* |
| *BPSK* | *1/4* | *-4* |
| *BPSK* | *1/2* | *-5* |
| *QPSK* | *1/2* | *-10* |
| *QPSK* | *3/4* | *-13* |
| *16-QAM* | *1/2* | *-16* |
| *16-QAM* | *3/4* | *-19* |
| *64-QAM* | *2/3* | *-22* |
| *64-QAM* | *3/4* | *-25* |
| *64-QAM* | *5/6* | *-27* |
| *256-QAM* | *3/4* | *-30* |
| *256-QAM* | *5/6* | *-32* |
| *1024-QAM* | *3/4* | *-35* |
| *1024-QAM* | *5/6* | *-37* |

 |
| 5.2.3.2.2.2.2 | *PAPR*What is the RF peak to average power ratio after baseband filtering (dB)? Describe the PAPR (peak-to-average power ratio) reduction algorithms if they are used in the proposed RIT/SRIT.*Expected PAPR range is 7-12 dB. More details will be provided in later update.* |
| 5.2.3.2.2.3  | *Error control coding scheme and interleaving* |
| 5.2.3.2.2.3.1 | Provide details of error control coding scheme for both downlink and uplink.For example, – FEC or other schemes?The proponents can provide additional information on the decoding schemes.*Error control includes binary convolutional coding (BCC) and low-density parity check coding (LDPC), for both uplink and downlink. Code rates supported are in the range 1/4 to 5/6.* |
| 5.2.3.2.2.3.2 | Describe the bit interleaving scheme for both uplink and downlink.*Bit interleaving, and tone interleaving are used with varying parameters, for both uplink and downlink.* |
| **5.2.3.2.3** | **Describe channel tracking capabilities (e.g. channel tracking algorithm, pilot symbol configuration, etc.) to accommodate rapidly changing delay spread profile.***Channel tracking tools define channel training symbols and dynamic pilots as the primary methods of combating rapid channel response changes.* |
| **5.2.3.2.4** | **Physical channel structure and multiplexing**  |
| 5.2.3.2.4.1 | What is the physical channel bit rate (Mbit/s or Gbit/s) for supported bandwidths?I.e. the product of the modulation symbol rate (in symbols per second), bits per modulation symbol, and the number of streams supported by the antenna system.*Examples of peak bit rates per link are summarized in Table 2. This is the physical channel bit rate, not actual data rate, which depends on FEC code rate employed.**Table 2: Example peak bit rates (6 spatial streams).*

|  |  |  |  |
| --- | --- | --- | --- |
| *Bandwidth (MHz)* | *Occupied Bandwidth (MHz)* | *Sub-carrier spacing (kHz)* | *Bit rate (Mbps)* |
| *0.864* | *0.648* | *27* | *28.80* |
| *1.728* | *1.512* | *27* | *74.88* |
| *3.456* | *3.131* | *27* | *155.52* |
| *6.912* | *6.588* | *27* | *336.96* |
| *13.824* | *13.500* | *27* | *673.92* |
| *20.736* | *17.928* | *27* | *915.84* |
| *27.648* | *27.000* | *27* | *1347.84* |
| *55.296* | *52.704* | *216* | *2695.68* |
| *110.592* | *108.000* | *216* | *5391.36* |
| *165.888* | *143.424* | *216* | *7326.72* |
| *221.184* | *216.000* | *216* | *10782.72* |

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| 5.2.3.2.4.2 | *Layer 1 and Layer 2 overhead estimation.*Describe how the RIT/SRIT accounts for all layer 1 (PHY) and layer 2 (MAC) overhead and provide an accurate estimate that includes static and dynamic overheads.*Layer 1 overhead comprises the following elements**• synchronization training symbols (range: 1 – 2)**• channel training symbols (range: 1 – 7)**• control symbols (range: 1 – 2)**• guard time (range: 0 – 1 symbol)**• cyclic prefix (1/8 DFT window)**• null sub-carriers (range: 8 – 56)**• FEC (rates: 1/4 – 5/6)**For fixed bandwidth, number of streams and FEC rate, the overhead is fixed. The overhead ratio depends on the packet payload size.**Layer 2 overhead includes the following elements**• MAC header**• Frame checksum (FCS)**Assuming continuous transmission of packets occupying one complete frame, the achievable layer 1 data rates per link are summarized in Table 3**Table 3: Examples of peak data rates available to layer 2 (6 spatial streams).*

|  |  |  |  |
| --- | --- | --- | --- |
| *Bandwidth (MHz)* | *Occupied Bandwidth (MHz)* | *Sub-carrier spacing (kHz)* | *Bit rate (Mbps)* |
| *0.864* | *0.648* | *27* | *22.90* |
| *1.728* | *1.512* | *27* | *59.54* |
| *3.456* | *3.131* | *27* | *123.66* |
| *6.912* | *6.588* | *27* | *267.93* |
| *13.824* | *13.500* | *27* | *535.86* |
| *20.736* | *17.928* | *27* | *728.22* |
| *27.648* | *27.000* | *27* | *1071.72* |
| *55.296* | *52.704* | *216* | *2143.44* |
| *110.592* | *108.000* | *216* | *4286.88* |
| *165.888* | *143.424* | *216* | *5825.76* |
| *221.184* | *216.000* | *216* | *8573.76* |

*-* |
| 5.2.3.2.4.3 | *Variable bit rate capabilities:* Describe how the proposal supports different applications and services with various bit rate requirements.*For the nominal sub-carrier spacing of 27 kHz the proposed RIT layer 1 supports 145 different data rates in the range of 120 Kbps to 1.1 Gbps. Lower data rates are associated with more robust transmission characteristics. Higher data rates require more favourable link conditions and tighter system specifications. For the sub-carrier spacing of 216 kHz data rates up to 8.6 Gbps can be supported.* |
| 5.2.3.2.4.4 | *Variable payload capabilities:*Describe how the RIT/SRIT supports IP-based application layer protocols/services (e.g. VoIP, video-streaming, interactive gaming, etc.) with variable-size payloads.*Layer 1 payload size is dynamically adjustable from 0 to over 200 symbols. Payload bit capacity is dynamically adjustable by the choice of modulation and coding scheme, bandwidth and number of streams.* |
| 5.2.3.2.4.5 | *Signalling transmission scheme:*Describe how transmission schemes are different for signalling/control from that of user data.*Layer 1 control header uses the most robust signalling scheme, which is BPSK modulation combined with rate-1/2 convolutional coding. Supplemental header robustness is achievable by the use of 2×bit repetition (effective rate-1/4). Layer 1 data signalling ranges from BPSK to 1024-QAM, FEC rate range is 1/4 to 5/6, for both binary convolutional coding and low-density parity check coding.* |
| 5.2.3.2.4.6 | *Small signalling overhead*Signalling overhead refers to the radio resource that is required by the signalling divided by the total radio resource which is used to complete a transmission of a packet. The signalling includes necessary messages exchanged in DL and UL directions during a signalling mechanism, and Layer 2 protocol header for the data packet.Describe how the RIT/SRIT supports efficient mechanism to provide small signalling overhead in case of small packet transmissions.*Layer 1 protocol supports discontinuous transmission whereby the payload can be broken into segments.**Starting from the second segment, packet preamble and control resource usage is reduced by up to 50%.**Layer 2 employs optional and/or delayed ACK, NAK with implicit ARQ.**Low contention overhead is achieved by dynamic time-frequency resource assignment.* |
| **5.2.3.2.5** | **Mobility management (Handover)** |
| 5.2.3.2.5.1 | Describe the handover mechanisms and procedures which are associated with – Inter-System handover including the ability to support mobility between the RIT/SRIT and at least one other IMT system– Intra-System handover 1 Intra-frequency and Inter-frequency 2 Within the RIT or between component RITs within one SRIT (if applicable)Characterize the type of handover strategy or strategies (for example, UE or base station assisted handover, type of handover measurements).What other IMT system (other than IMT-2020) could be supported by the handover mechanism?***Intra-System handover****Intra-System handover may be intra-cell or inter cell.* *Intra-cell handover may be controlled by either the PP or the FP and triggered when quality on allocated carrier-slot-combinations becomes poor and other free carrier-slot-combinations exist. Detection of free carrier-slot-combinations is based on a spectrum sensing paradigm and takes into account the activity of other uncoordinated systems. Seamless handover is supported. The PP sends a handover-request to the FP on the selected random access channel. If the FP accepts the request, then it indicates the position of the new traffic channel and the data will be switched over. After that the old channel will be released.**Inter-cell handover is generally controlled by the PP and triggered when quality on allocated carrier-slot-combinations becomes poor and another suitable FP is becoming stronger. Seamless handover is supported. The PP sends a handover-request to the new FP on the selected random access channel. If the FP accepts the request, then it indicates the position of the new traffic channel and the data will be switched over. After that the old channel will be released.****Inter-System handover (for proposed IMT-2020 RIT):****Inter-System handover is performed in the same way as inter-cell handover. Seamless handover is supported. Both systems should be interconnected by the proper network infrastructure.****Inter-System handover to other IMT systems (other than IMT-2020)*** *Inter-System handover to IMT-2000 TDMA FDMA (DECT) is supported.**Handover to IMT-2000 TDMA FDMA is controlled by the PP and triggered when another suitable FP becomes stronger. Seamless handover is supported. The PP sends a handover-request to the FP on the selected channel. After the new connection is confirmed by the FP, the data is switched over to the new connection and the old one is released. Both systems should be interconnected by the proper network infrastructure.* |
| 5.2.3.2.5.2 | Describe the handover mechanisms and procedures to meet the simultaneous handover requirements of a large number of users in high speed scenarios (up to 500km/h moving speed) with high handover success rate.*The information will be provided in later update.* |
| **5.2.3.2.6** | **Radio resource management**  |
| 5.2.3.2.6.1 | Describe the radio resource management, for example support of:– centralised and/or distributed RRM– dynamic and flexible radio resource management– efficient load balancing.*Radio resource management is based on the implementation of the cognitive radio, spectrum sensing paradigm and is able to take into account the activity of other systems –coordinated or uncoordinated- operating in the same area, Channels are automatically selected and allocated based on measurement of background RSSI. The FP may also take into account carrier slot positions in order to allocate the most convenient resource blocks for system efficiency. Both FP and PP participate in the process. No radio planning is needed in any case.* |
| 5.2.3.2.6.2 | *Inter-RIT interworking*Describe the functional blocks and mechanisms for interworking (such as a network architecture model) between component RITs within a SRIT, if supported.*The information will be provided in later update.* |
| 5.2.3.2.6.3 | *Connection/session management*The mechanisms for connection/session management over the air-interface should be described. For example:– The support of multiple protocol states with fast and dynamic transitions. – The signalling schemes for allocating and releasing resources. *The information will be provided in later update.* |
| **5.2.3.2.7** | **Frame structure** |
| 5.2.3.2.7.1 | Describe the frame structure for downlink and uplink by providing sufficient information such as:– frame length– the number of time slots per frame– the number and position of switch points per frame for TDD– guard time or the number of guard bits– user payload information per time slot– sub-carrier spacing– control channel structure and multiplexing– power control bit rate.*The basic frame structure consists of 24 time slots in 10 ms (for 27 kHz sub-carrier spacing). Half slots can be used for some services. Slots can be concatenated to form multi-slot transmissions. Any slot can be used for uplink or downlink transmission (i.e. there is no pre-set direction for the slot). When there is a change in the source of the transmission, then a guard space is used. Several transmissions to/from different PPs may occur simultaneously on non-overlapping channels. The transmissions are scheduled in such a way that none of the devices is required to transmit and receive simultaneously. For higher sub-carrier spacing the number of slots per frame can vary accordingly. The frame structure parameters for 27 kHz sub-carrier spacing are summarized in Table 4.**Table 4: Frame structure parameters (27 kHz sub-carrier spacing).*

|  |  |  |
| --- | --- | --- |
| *Parameter* | *Value/Range* | *Description* |
| *TFRAME* | *10 ms* | *Frame length* |
| *NSLOT* | *24* | *Time slots per frame*  |
| *TSLOT* | *416.7 μs* | *Slot duration (TFRAME/NSLOT )* |
| *NSW* | *24* | *Switch points per frame* |
| *NSPS* | *10* | *Number of OFDM symbols per slot* |
| *TSYM* | *41.67 μs* | *OFDM symbol duration (TSLOT /NSPS)* |
| *TGT* | *0 ≤ TGT ≤ TSYM* | *Guard time (Note 1)* |
| *NPLSL* | *≤ 468000* | *User payload information bits per time slot (Note 2)* |
| *ΔF* | *27 kHz* | *Sub-carrier spacing* |
| *–* | *–* | *Power control bit rate (Note 3)* |

*Notes:**1. Guard time is required when switching transmission source.**2. Max NPLSL payload size shown corresponds to 27.648 MHz bandwidth, 6 streams, 1024-QAMmodulation transmission, and slot containing data field symbols only.**3. Power control bit rate is variable.*  |
| **5.2.3.2.8** | **Spectrum capabilities and duplex technologies**NOTE 1 – Parameters for both downlink and uplink should be described separately, if necessary. |
| 5.2.3.2.8.1 | *Spectrum sharing and flexible spectrum use*Does the RIT/SRIT support flexible spectrum use and/or spectrum sharing? Provide the detail.Description such as capability to flexibly allocate the spectrum resources in an adaptive manner for paired and un-paired spectrum to address the uplink and downlink traffic asymmetry. *The technology is able to effectively implement adaptive spectrum sharing, even between uncoordinated systems. The spectrum sensing paradigm (cognitive radio) is used for automatic dynamic channel selection, See section 5.2.3.2.6.1. Several FPs (even uncoordinated) may share the same spectrum with no need for frequency planning.**There is however the possibility to use conventional frequency planning between systems, if desired.* |
| 5.2.3.2.8.2 | *Channel bandwidth scalability* Describe how the proposed RIT/SRIT supports channel bandwidth scalability, including the supported bandwidths. Describe whether the proposed RIT/SRIT supports extensions for scalable bandwidths wider than 100 MHz.Describe whether the proposed RIT/SRIT supports extensions for scalable bandwidths wider than 1 GHz, e.g. when operated in higher frequency bands noted in § 5.2.4.2.Consider, for example:– The scalability of operating bandwidths. – The scalability using single and/or multiple RF carriers.Describe multiple contiguous (or non-contiguous) band aggregation capabilities, if any. Consider for example the aggregation of multiple channels to support higher user bit rates.*Channel bandwidth is scalable in multiples of WBC (1.728 MHz). Assuming 27 kHz sub-carrier spacing, the largest operating bandwidth for a single link is 27.648 MHz. In case of 216 kHz sub-carrier spacing, the largest operating bandwidth for a single link is 221.184 MHz. Further scalability beyond these figures is possible by using multiple layer 1 links.* |
| 5.2.3.2.8.3 | What are the frequency bands supported by the RIT/SRIT? Please list.*The information will be provided in later update.* |
| 5.2.3.2.8.4 | What is the minimum amount of spectrum required to deploy a contiguous network, including guardbands (MHz)? *Minimum practical spectrum for a contiguous network is assumed to be 10 MHz. Operation over 5 MHz may be possible with certain restrictions. In EU region, 20 MHz are assumed to be available as minimum spectrum.* |
| 5.2.3.2.8.5 | What are the minimum and maximum transmission bandwidth (MHz) measured at the 3 dB down points?*Minimum transmission bandwidth is about 1.512 MHz. Maximum transmission bandwidth is about 27 MHz (in case of 27 kHz sub-carrier spacing), or about 216 MHz (in case of 216 kHz sub-carrier spacing).* |
| 5.2.3.2.8.6 | What duplexing scheme(s) is (are) described in this template? (e.g. TDD, FDD or half-duplex FDD). Provide the description such as:– What duplexing scheme(s) can be applied to paired spectrum? Provide the details (see below as some examples).– What duplexing scheme(s) can be applied to un-paired spectrum? Provide the details (see below as some examples).Describe details such as:– What is the minimum (up/down) frequency separation in case of full- and half-duplex FDD? – What is the requirement of transmit/receive isolation in case of full- and half-duplex FDD? Does the RIT require a duplexer in either the UE or base station? – What is the minimum (up/down) time separation in case of TDD?– Whether the DL/UL ratio variable for TDD? What is the DL/UL ratio supported? If the DL/UL ratio for TDD is variable, what would be the coexistence criteria for adjacent cells?*The proposed RIT utilizes both TDD and FDD on contiguous or non-contiguous frequency segments. Frequency segments and time slots are allocated to PP devices for downlink and uplink transmissions by the FP device. FP devices can transmit (downlink) or receive (uplink) on contiguous or non-contiguous frequency segments. PP devices can transmit (uplink) or receive (downlink) on contiguous frequency segments only. At each slot time and across all allocated segments, the FP device can be either in uplink mode or in downlink mode but not both.* |
| **5.2.3.2.9** | **Support of Advanced antenna capabilities** |
| 5.2.3.2.9.1 | Fully describe the multi-antenna systems (e.g. massive MIMO) supported in the UE, base station, or both that can be used and/or must be used; characterize their impacts on systems performance; e.g. does the RIT have the capability for the use of:– spatial multiplexing techniques,– spatial transmit diversity techniques,– beam-forming techniques (e.g. analogue, digital, hybrid). *The proposed RIT supports multiplexing of NSTS ≤ 6 space-time streams with 6 × 6 antenna configuration (NTX = NRX = 6). NTX > NSTS and/or NRX > NSTS can be configured to increase diversity and/or to enable digital beamforming. Space-time Block Coding (STBC) is also supported (2 × 1 configuration).* |
| 5.2.3.2.9.2 | How many antenna elements are supported by the base station and UE for transmission and reception? What is the antenna spacing (in wavelengths)? *Both FP and PP can be equipped with NTX,NRX ≥ NSTS antennas where NSTS ≤ 6. Target antenna spacing is λ/4, where λ is the wavelength of the carrier signal.* |
| 5.2.3.2.9.3 | Provide details on the antenna configuration that is used in the self-evaluation.*Antenna range supported by test models is 1 ≤ NTX,NRX ≤ 6.* |
| 5.2.3.2.9.4 | If spatial multiplexing (MIMO) is supported, does the proposal support (provide details if supported)– Single-codeword (SCW) and/or multi-codeword (MCW)– Open and/or closed loop MIMO– Cooperative MIMO– Single-user MIMO and/or multi-user MIMO.*The proposed RIT supports**• Open and closed loop MIMO**• Single-user MIMO and multi-user MIMO* |
| 5.2.3.2.9.5 | Other antenna technologies Does the RIT/SRIT support other antenna technologies, for example:– remote antennas,– distributed antennas.If so, please describe.*N/A* |
| 5.2.3.2.9.6 | Provide the antenna tilt angle used in the self-evaluation.*The information will be provided in later update.* |
| **5.2.3.2.10** | **Link adaptation and power control** |
| 5.2.3.2.10.1 | Describe link adaptation techniques employed by RIT/SRIT, including:– the supported modulation and coding schemes;– the supporting channel quality measurements, the reporting of these measurements, their frequency and granularity.Provide details of any adaptive modulation and coding schemes, including:– Hybrid ARQ or other retransmission mechanisms? – Algorithms for adaptive modulation and coding, which are used in the self-evaluation. – Other schemes?*The proposed RIT layer 1 supports 13 modulation and coding schemes that can be used in link adaptation without advance negotiation. Up to 16 bandwidth configurations can be used without advance negotiation. Channel quality measurements include RSSI for each sub-channel.* |
| 5.2.3.2.10.2 | Provide details of any power control scheme included in the proposal, for example:– Power control step size (dB)– Power control cycles per second– Power control dynamic range (dB)– Minimum transmit power level with power control– Associated signalling and control messages.*Power control step size is 1 dB.**Target power control cycles is once per second on average.**Power control dynamic range is 20 dB.**Minimum transmit power level is 0 dBm.* |
| **5.2.3.2.11** | **Power classes** |
| 5.2.3.2.11.1  | *UE emitted power* |
| 5.2.3.2.11.1.1 | What is the radiated antenna power measured at the antenna (dBm)?*The information will be provided in later update.* |
| 5.2.3.2.11.1.2  | What is the maximum peak power transmitted while in active or busy state?*The information will be provided in later update.* |
| 5.2.3.2.11.1.3 | What is the time averaged power transmitted while in active or busy state? Provide a detailed explanation used to calculate this time average power.*The information will be provided in later update.* |
| 5.2.3.2.11.2 | *Base station emitted power* |
| 5.2.3.2.11.2.1 | What is the base station transmit power per RF carrier?*The information will be provided in later update.* |
| 5.2.3.2.11.2.2  | What is the maximum peak transmitted power per RF carrier radiated from antenna?*The information will be provided in later update.* |
| 5.2.3.2.11.2.3 | What is the average transmitted power per RF carrier radiated from antenna?*The information will be provided in later update.* |
| **5.2.3.2.12** | **Scheduler, QoS support and management, data services** |
| 5.2.3.2.12.1 | QoS support– What QoS classes are supported?– How QoS classes associated with each service flow can be negotiated.– QoS attributes, for example: • data rate (ranging from the lowest supported data rate to maximum data rate supported by the MAC/PHY); • control plane and user plane latency (delivery delay); • packet error ratio (after all corrections provided by the MAC/PHY layers), and delay variation (jitter).– Is QoS supported when handing off between radio access networks? If so, describe the corresponding procedures.– How users may utilize several applications with differing QoS requirements at the same time.*The information will be provided in later update.* |
| 5.2.3.2.12.2 | *Scheduling mechanisms*– Exemplify scheduling algorithm(s) that may be used for full buffer and non-full buffer traffic in the technology proposal for evaluation purposes.Describe any measurements and/or reporting required for scheduling. *The information will be provided in later update.* |
| **5.2.3.2.13** | **Radio interface architecture and protocol stack** |
| 5.2.3.2.13.1 | Describe details of the radio interface architecture and protocol stack such as:– Logical channels– Control channels– Traffic channelsTransport channels and/or physical channels.*The diagram below (Figure 1), depicts a generic PHL packet format (with preamble, PHL header, PHY SDU and tail / padding). However, the MAC packet format is agnostic to the specific PHL packet format, as it just concerned about the PHY SDU / MAC PDU.**Figure 1: Generic PHL packet format**The MAC PDU consists of three fields (Control, Data and CRC). Some bits in the “Control” field are used to indicate the type of contents of the “Data” field, i.e. either E-type, U-type, or E+U-type. E-type contains signalling and U-type contains traffic data.**Different traffic scenarios can utilize the ability to select E-type / U-type differently. For example:** *Initial Access Bearer, prior to establishment of Traffic Bearer*
	+ *E-type only, since clearly no traffic at this stage*
* *ULE Packet Mode*
	+ *E+U-type, since we require control and data from the start*
* *Regular voice/data Traffic Bearer*
	+ *E-type during initial call setup (e.g. transfer of CC-SETUP, CC-CONNECT, etc.)*
	+ *U-type when data service is connected*
	+ *E+U-type when additional signalling is required (e.g. CC-INFO, or the CC-RELEASE).*
* *Low latency audio Traffic Bearer*
	+ *E+U-type for one of the slots, and U-type only for the others*
 |
| 5.2.3.2.13.2 | What is the bit rate required for transmitting feedback information?*The information will be provided in later update.* |
| 5.2.3.2.13.3 | *Channel access:*Describe in details how RIT/SRIT accomplishes initial channel access, (e.g. contention or non-contention based).*Assuming that the PP is already locked to the FP’s beacon, then the basic procedure for initial channel access is as follows:** *PP MAC selects one of the RAC positions and transmits an “Access Request” message to the FP.*
	+ *The Access Request message includes the required data-rate, reliability, latency, whether the connection is symmetric or asymmetric, etc. It could also be more specific and request a particular number of slots, channels or MCS.*
* *The FP MAC receives and examines the request, and determines if it can be granted or not.*
* *If the request is accepted, then the FP MAC transmits an “Access Grant” message to the PP on the appropriate down-link position.*
	+ *The Access Grant message includes the specific slot / channel positions of the allocated down-link and up-link resources.*
	+ *After a granted request, the FP and PP are able to use the allocated resources*
	+ *If the PP does not establish the connection using the allocated resources within a certain time then they will be released.*
* *If the request is rejected, then the FP MAC transmits an “Access Reject” message to the PP at the appropriate down-link position.*
	+ *The PP may decide to re-attempt the Access Request, possibly using different criteria.*
* *If neither an Access Grant or Access Reject is received, then the PP must assume that the FP did not receive the Access Request, and so the PP may decide to re-attempt the Access Request, after a random back-off time.*
 |
| **5.2.3.2.14** | **Cell selection** |
| 5.2.3.2.14.1 | Describe in detail how the RIT/SRIT accomplishes cell selection to determine the serving cell for the users.*Each FP sends a broadcast with all relevant information which is needed to access a cell. The PP receives the broadcast and determines, if access is allowed in the respective cell. If several suitable FPs can be received, then the FP with the best signal is selected. If the PP has no active channel, then location registration may be initiated. A PP with an active channel may initiate a handover.* |
| **5.2.3.2.15** | **Location determination mechanisms** |
| 5.2.3.2.15.1 | Describe any location determination mechanisms that may be used, e.g. to support location based services. *The information will be provided in later update.* |
| **5.2.3.2.16** | **Priority access mechanisms** |
| 5.2.3.2.16.1 | Describe techniques employed to support prioritization of access to radio or network resources for specific services or specific users (e.g. to allow access by emergency services).*The information will be provided in later update.* |
| **5.2.3.2.17** | **Unicast, multicast and broadcast***Layer 1 can transmit a physical broadcast packet over the entire working bandwidth, using duplicate transmission mode. In this mode a basic channel packet is duplicated across all working channels, over a contiguous slot sequence.* |
| 5.2.3.2.17.1 | Describe how the RIT/SRIT enables:– broadcast capabilities,– multicast capabilities,– unicast capabilities,using both dedicated carriers and/or shared carriers. Please describe how all three capabilities can exist simultaneously.*The information will be provided in later update.* |
| 5.2.3.2.17.2 | Describe whether the proposal is capable of providing multiple user services simultaneously to any user with appropriate channel capacity assignments?*The information will be provided in later update.* |
| 5.2.3.2.17.3 | Provide details of the codec used.Does the RIT/SRIT support multiple voice and/or video codecs? Provide the detail.*The information will be provided in later update.* |
| **5.2.3.2.18** | **Privacy, authorization, encryption, authentication and legal intercept schemes**  |
| 5.2.3.2.18.1 | Any privacy, authorization, encryption, authentication and legal intercept schemes that are enabled in the radio interface technology should be described. Describe whether any synchronisation is needed for privacy and encryptions mechanisms used in the RIT/SRIT.Describe how the RIT/SRIT addresses the radio access security, with a particular focus on the following security items:– system signalling integrity and confidentiality,– user equipment identity authentication and confidentiality,– subscriber identity authentication and confidentiality,– user data integrity and confidentialityDescribe how the RIT/SRIT may be protected against attacks, for example: – passive, – man in the middle,– replay,– denial of service. *The information will be provided in later update.* |
| **5.2.3.2.19** | **Frequency planning** |
| 5.2.3.2.19.1 | How does the RIT/SRIT support adding new cells or new RF carriers? Provide details.*A new FP device can negotiate frequency channel (re)partitioning with existing FP devices, with possible coordination with a master entity through a back-channel, for example over the Internet. If necessary, existing FP devices initiates a protocol for configuring its PP clients to a different time-frequency map.* |
| **5.2.3.2.20** | **Interference mitigation within radio interface** |
| 5.2.3.2.20.1 | Does the proposal support Interference mitigation? If so, describe the corresponding mechanism.*The technology supports real-time interference mitigation even between uncoordinated systems. This is achieved by the observation of the spectrum before any channel allocation (cognitive radio spectrum sensing paradigm) and by the capacity of all systems to implement handover to “free” carrier/slots that are always selected using real-time spectrum observation.* *Power control can be used to minimise interference to other systems.* |
| 5.2.3.2.20.2 | What is the signalling, if any, which can be used for intercell interference mitigation?*The technology is able to implement interference mitigation without any communication between systems (see 5.2.3.2.20.1) by using radio scan. This is important, e.g. to implement interference mitigation between uncoordinated systems. Coordination between cells of the same system can also be supported.*  |
| 5.2.3.2.20.3 | *Link level interference mitigation*Describe the feature or features used to mitigate intersymbol interference.*Inter-symbol interference is greatly reduced by the inclusion of cyclic prefix on every symbol.*  |
| 5.2.3.2.20.4 | Describe the approach taken to cope with multipath propagation effects (e.g. via equalizer, rake receiver, cyclic prefix, etc.). *The proposed RIT includes channel training symbols for channel estimation and equalization. The proposed RIT also includes cyclic prefix in each symbol to reduce inter-symbol interference (see §5.1.1.20.3).* |
| 5.2.3.2.20.5 | *Diversity techniques*Describe the diversity techniques supported in the user equipment and at the base station, including micro diversity and macro diversity, characterizing the type of diversity used, for example:– Time diversity: repetition, Rake-receiver, etc.– Space diversity: multiple sectors, etc.– Frequency diversity: frequency hopping (FH), wideband transmission, etc.– Code diversity: multiple PN codes, multiple FH code, etc.– Multi-user diversity: proportional fairness (PF), etc.– Other schemes.Characterize the diversity combining algorithm, for example, switched diversity, maximal ratio combining, equal gain combining. Provide information on the receiver/transmitter RF configurations, for example:– number of RF receivers– number of RF transmitters.*The proposed RIT provides for time diversity by means of space-time block coding (STBC) technique. STBC can be used for both downlink and uplink transmission. In addition, HARQ with soft combining may be employed.**The proposed RIT supports space diversity by increasing the number of antennas and corresponding transmit/receive chains, and/or by employing beamforming. Both open-loop and closed-loop beamforming are supported.**Receivers with multiple receive chains automatically perform maximal ratio combining (MRC), based on per-antenna channel estimation. The actual number of transmit/receive antennas employed is a design consideration.**The proposed RIT defines the minimum number of antennas for FP and PP devices, depending on usage scenario. It is expected that FP devices will be required to use a minimum number of antennas and corresponding transmit/receive chains that is greater than one.* |
| **5.2.3.2.21** | **Synchronization requirements** |
| 5.2.3.2.21.1 | Describe RIT’s/SRIT’s timing requirements, e.g.– Is base station-to-base station synchronization required? Provide precise information, the type of synchronization, i.e. synchronization of carrier frequency, bit clock, spreading code or frame, and their accuracy.– Is base station-to-network synchronization required?State short-term frequency and timing accuracy of base station transmit signal.*The information will be provided in later update.* |
| 5.2.3.2.21.2 | Describe the synchronization mechanisms used in the proposal, including synchronization between a user terminal and a base station. *There are two synchronisation mechanisms:** *Packet level synchronisation, where each packet contains a synchronisation pattern, examples are shown in Figure 3 and Figure 4 below.*
* *Frame synchronisation provided by regular transmission from the FP. Variants of the standard packet types may be used, e.g. the beacon packet shown in* Figure 5 below.

*Standard Packet Types**Figure 2 shows the long preamble packet type, which is an example of a packet using a robust packet level synchronisation pattern. Packet fields are described in Table 5**Figure 2: Long preamble packet type**Table 5: Packet fields.*

|  |  |
| --- | --- |
| *Field* | *Description* |
| *STF* | *Synchronization training field.*  |
| *CTF1* | *First channel training field.*  |
| *HF* | *Header field containing parameters used in packet construction.*  |
| *CTF2,...,NCTF* | *Second channel training field. Present only if the packet contains more than one spatial stream:* |
| *DF* | *Data field. Contains the service payload.* |

*High-Efficiency (HE) Packet Types**These packet types enable more efficient communication for certain scenarios, including Low Latency Communications. Figure 3 shows the full-slot HE packet type, which is an example of a packet using a single reference symbol (RPF). Packet fields are described in Table 6.*phl5-ppdu-hefs-300dpi.png*Figure 3: Full-slot HE packet type**Table 6: Packet fields*

|  |  |
| --- | --- |
| *Field* | *Description* |
| *RPF* | *Reference Pilot Field.*  |
| *DF* | *Data field. Contains the service payload.* |
| *GF* | *Inter-slot guard interval* |

*Beacon packet type**Specific packet types are designed for beacons transmitted by the FP. These packets include a synchronization field and carry MAC identification data and are used by the PPs to gain synchronization to the FP.* phl5-ppdu_beacon.png*Figure 4: Beacon packet type**Table 7: Packet fields*

|  |  |
| --- | --- |
| *Field* | *Description* |
| *STF* | *Synchronization training field.* |
| *CTF1* | *Channel training field.*  |
| *DF* | *Data field. Contains typically several MAC control channels.*  |
| *GF* | *Inter-slot guard interval*  |

 |
| 5.2.3.2.22 | Link budget templateProponents should complete the link budget template in § 5.2.3.3 to this description template for the environments supported in the RIT.*The information will be provided in later update.* |
| **5.2.3.2.23** | **Support for wide range of services** |
| 5.2.3.2.23.1 | Describe what kind of services/applications can be supported in each usage scenarios in Recommendation ITU-R M.2083 (eMBB, URLLC, and mMTC).*eMBB, URLLC, and mMTC are supported. Example applications are home automation, industry automation, asset tracking, PMSE (audio and video production), augmented reality, remote reality and indoor broadband.*  |
| 5.2.3.2.23.2 | Describe any capabilities/features to flexibly deploy a range of services across different usage scenarios (eMBB, URLLC, and mMTC) in an efficient manner, (e.g. a proposed RIT/SRIT is designed to use a single continuous or multiple block(s) of spectrum).*The information will be provided in later update.* |
| **5.2.3.2.24** | **Global circulation of terminals**Describe technical basis for global circulation of terminals not causing harmful interference in any country where they circulate, including a case when terminals have capability of device-to-device direct communication mode.*The information will be provided in later update.* |
| **5.2.3.2.25** | **Energy efficiency**Describe how the RIT/SRIT supports a high sleep ratio and long sleep duration.Describe other mechanisms of the RIT/SRIT that improve the support of energy efficiency operation for both network and device.*The information will be provided in later update.* |
| **5.2.3.2.26** | **Other items**  |
| 5.2.3.2.26.1 | *Coverage extension schemes*Describe the capability to support/ coverage extension schemes, such as relays or repeaters.*The information will be provided in later update.* |
| 5.2.3.2.26.2 | *Self-organisation* Describe any self-organizing aspects that are enabled by the RIT/SRIT.*The information will be provided in later update.* |
| 5.2.3.2.26.3 | Describe the frequency reuse schemes (including reuse factor and pattern) for the assessment of average spectral efficiency and 5th percentile user spectral efficiency.*The information will be provided in later update.* |
| 5.2.3.2.26.4 | Is the RIT/component RIT an evolution of an existing IMT technology? Provide the detail.*The information will be provided in later update.* |
| 5.2.3.2.26.5 | Does the proposal satisfy a specific spectrum mask? Provide the detail. (This information is not intended to be used for sharing studies.)*The information will be provided in later update.* |
| 5.2.3.2.26.6 | Describe any UE power saving mechanisms used in the RIT/SRIT. *The information will be provided in later update.* |
| 5.2.3.2.26.7 | *Simulation process issues*Describe the methodology used in the analytical approach.Proponent should provide information on the width of confidence intervals of user and system performance metrics of corresponding mean values, and evaluation groups are encouraged to provide this information as requested in § 7.1 of Report ITU-R M.2412‑0.*The information will be provided in later update.* |
| 5.2.3.2.26.8 | *Operational life time*Describe the mechanisms to provide long operational life time for devices without recharge for at least massive machine type communications*The information will be provided in later update.* |
| 5.2.3.2.26.9 | *Latency for infrequent small packet* Describe the mechanisms to reduce the latency for infrequent small packet, which is, in a transfer of infrequent application layer small packets/messages, the time it takes to successfully deliver an application layer packet/message from the radio protocol layer 2/3 SDU ingress point at the UE to the radio protocol layer 2/3 SDU egress point in the base station, when the UE starts from its most “battery efficient” state.*A specific packet type named “ULE packet” has been created for infrequent small packet transmission. This format reuses some concepts of DECT ULE (Ultra Low Energy) and is specifically optimized for battery efficient operation. The ULE packet is able to transmit in a single burst: layer 1 fields, MAC control commands and a limited amount of U-plane data.* |
| 5.2.3.2.26.10 | *Control plane latency*Provide additional information whether the RIT/SRIT can support a lower control plane latency (refer to § 4.7.2 in Report ITU-R M.2410-0).*The information will be provided in later update.* |
| 5.2.3.2.26.11 | *Reliability*Provide additional information whether the RIT/RSIT can support reliability for larger packet sizes (refer to § 4.10 in Report ITU-R M.2410-0).*The information will be provided in later update.* |
| 5.2.3.2.26.12 | *Mobility*Provide additional information for the downlink mobility performance of the RIT/SRIT (refer to § 4.11 in Report ITU-R M.2410-0).*The information will be provided in later update.* |
| **5.2.3.2.27** | **Other information**Please provide any additional information that the proponent believes may be useful to the evaluation process.*The information will be provided in later update.* |

#### 5.2.3.3 **Description** template – link budget template

*5.2.3.3.1 Indoor Hotspot-eMBB environment*

*For the purpose of table 1 calculations, the system configuration is according to parameters shown in the table below.*

*Table: System configuration parameters for Indoor Hotspot-eMBB*

|  |  |  |
| --- | --- | --- |
| ***Parameter*** | ***Value*** | ***Description*** |
| *Modulation* | *QPSK* | *OFDM subcarrier modulation* |
| *R* | *1/2* | *Rate of binary convolutional code* |
| *W* | *1,728* | *Transmission bandwidth (MHz)* |
| *NSS* | *1* | *Number of spatial streams* |
| *NPL* | *256* | *Payload size (bytes)* |
| *ACR* | *10* | *Adjacent channel rejection (dB)* |
|  | *InHA* | *Path loss model* |



*Figure 5: Receiver performance for various antenna configurations*

TABLE 1

Link budget template for Indoor Hotspot-eMBB

| Item | Downlink | Uplink |
| --- | --- | --- |
| System configuration |
| Carrier frequency (GHz) | 4  | 4 |
| BS antenna heights (m) | 3 | 3 |
| UE antenna heights (m) | 1.5 | 1.5 |
| Cell area reliability(1) (%) (Please specify how it is calculated.) |  |  |
| Transmission bit rate for control channel (bit/s) | *1248000* | *1248000* |
| Transmission bit rate for data channel (bit/s) | *1248000* | *1248000* |
| Target packet error ratio for the required SNR in item (19a) for control channel | *0,01* | *0,01* |
| Target packet error ratio for the required SNR in item (19b) for data channel | *0,01* | *0,01* |
| Spectral efficiency(2) (bit/s/Hz) | *1.4* | *1.4* |
| Pathloss model(3) (select from LOS or NLOS) | *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) | *24* | *24* |
| (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) | *24* | *24* |

TABLE 1 (*continued*)

| Item | Downlink | Uplink |
| --- | --- | --- |
| (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 | *31* | *22* |
| (9b) Data channel e.i.r.p. = (3) + (4) + (5) – (7) – (8) dBm | *31* | *22* |
| 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) | *-166* | *-166* |
| (16) Total noise plus interference density = 10 log (10^(((13) + (14))/10) + 10^((15)/10)) dBm/Hz | *-163* | *-164* |
| (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 | *-102* | *-102* |
| (19a) Required SNR for the control channel (dB)  | *1.7* | *1.7* |
| (19b) Required SNR for the data channel (dB)  | *1.7* | *1.7* |
| (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 | *-96* | *-99* |
| (22b) Receiver sensitivity for data channel  = (18) + (19b) + (20) – (21b) dBm | *-96* | *-99* |
| (23a) Hardware link budget for control channel  = (9a) + (11) − (22a) dB | *127* | *129* |

TABLE 1 (*end*)

| Item | Downlink | Uplink |
| --- | --- | --- |
| (23b) Hardware link budget for data channel  = (9b) + (11) − (22b) dB | *127* | *129* |
| 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)  | *8* | *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 | *117* | *120* |
| (29b) Available path loss for data channel  = (23b) – (25) + (26) – (27) + (28) – (12) dB | *117* | *120* |
| 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) | *198* | *229* |
| (30b) Maximum range for data channel (based on (29b) and according to the system configuration section of the link budget) (m) | *198* | *229* |
| (31a) Coverage Area for control channel = (π (30a)2) (m2/site) | *122761* | *164900* |
| (31b) Coverage Area for data channel = (π (30b)2) (m2/site) | *122761* | *164900* |
| (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. |

*5.2.3.3.2 Urban Macro-URLLC environment*

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

*Table: 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)* |
|  | *UMiB* | *Path loss model* |



*Figure 6: Receiver performance for URLLC 1x1 configurations*

TABLE 5

Link budget template for Urban Macro–URLLC

| Item | Downlink | Uplink |
| --- | --- | --- |
| System configuration |
| Carrier frequency (GHz) | 4 | 4 |
| BS antenna heights (m) | 25 | 25 |
| UE antenna heights (m) | 1.5 | 1.5 |
| Cell area reliability(1) (%) (Please specify how it is calculated.) |  |  |
| 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/LOS* | *NLOS/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* | *24* |
| (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* | *24* |
| (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* | *22* |
| (9b) Data channel e.i.r.p. = (3) + (4) + (5) - (7) - (8) dBm | *45* | *22* |
| 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* | *127* |
| (23b) Hardware link budget for data channel  = (9b) + (11) - (22b) dB | *139* | *127* |
| Calculation of available pathloss *(NLOS)* |
| (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* | *104* |
| (29b) Available path loss for data channel  = (23b) – (25) + (26) – (27) + (28) – (12) dB | *115* | *104* |
| 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) | *280* | *145* |
| (30b) Maximum range for data channel (based on (29b) and according to the system configuration section of the link budget) (m) | *280* | *145* |
| (31a) Coverage Area for control channel = (π (30a)2) (m2/site) | *246883* | *66353* |
| (31b) Coverage Area for data channel = (π (30b)2) (m2/site) | *246883* | *66353* |
| Calculation of available pathloss *(LOS)* |
| (24) Lognormal shadow fading std deviation (dB) | *4* | *4* |
| (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* | *104* |
| (29b) Available path loss for data channel  = (23b) – (25) + (26) – (27) + (28) – (12) dB | *115* | *104* |
| 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) | *280* | *145* |
| (30b) Maximum range for data channel (based on (29b) and according to the system configuration section of the link budget) (m) | *280* | *145* |
| (31a) Coverage Area for control channel = (π (30a)2) (m2/site) | *246883* | *66353* |
| (31b) Coverage Area for data channel = (π (30b)2) (m2/site) | *246883* | *66353* |
| (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. |

# **6 Abbreviations**

BS Base station

eMBB Enhanced mobile broadband

FDD Frequency division duplex

FEC Forward error correction

FH Frequency hopping

FP Fixed Part (corresponds to BS)

H-ARQ Hybrid automatic repeat request

MCW Multi-codeword

MIMO Multiple-input/multiple-output

mMTC Massive machine type communications

PAPR Peak to average power ratio

PF Proportional fairness

QoS Quality of service

PP Portable Part (corresponds to UE)

RIT Radio interface technology

RRM Radio resource management

SCW Single-codeword

SDU Service data unit

SRIT Set of RIT

TDD Time division duplex

TRxP Transmission reception point

URLLC Ultra-reliable and low latency communications

UE User equipment.

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