## Characteristics template for EUHT RIT

The description templates describe the characteristic of EUHT RIT. The EUHT RIT developed by NUFRONT supports both Sub-6GHz bands (from 450MHz to 6000MHz) and millimeter wave bands (mmWave bands, e.g. above 24GHz).

| 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?  *This proposal addresses all the five test environments across the three usage scenarios (eMBB, mMTC, and URLLC) as described in Report ITU-R M.2412-0.* |
| **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.   * ***Downlink and uplink***   *The multiple access is a combination of*   * *OFDMA: The base station allocates mutually orthogonal frequencies to different users to transfer data. The minimum allocable frequency resource of the OFDMA is 16 sub-carriers (Resource Unit, RU). The sub-carrier spacing of EUHT in Sub-6GHz bands is 78.125KHz/ 39.0625KHz/19.53KHz. The sub-carrier spacing of EUHT in mmWave bands is 390.625KHz.*    + *The CP-OFDM* *is applied for both downlink and uplink. The CP ratio can be configured to 1/4 or 1/8.* * *TDMA: The base station allocates different OFDM symbols to different users to transfer data. The granularity is one OFDM symbol.* * *SDMA: Transmission to/from multiple users uses the same time/frequency resource. (For more details, see Item 5.2.3.2.9).* |
| 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 Sub-6GHz bands:*  *- Downlink and Uplink*   * *For both data and higher-layer control information: BPSK, QPSK, 16QAM, 64QAM，256QAM, 1024QAM.* * *L1/L2 control: BPSK and QPSK* * *Symbol rate: 69.4K symbols/s (When the OFDM symbol duration is 14.4us and the 1/8-ratio CP is applied)*   *For mmWave bands:*  *- Downlink and Uplink*   * *For both data and higher-layer control information: BPSK, QPSK, 16QAM, 64QAM，256QAM, 1024QAM.* * *L1/L2 control: QPSK* * *Symbol rate: 347.2K symbols/s (When the OFDM symbol duration is 2.88us and the 1/8-ratio CP is applied).* |
| 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.  *The PAPR depends on the waveform and the number of sub-carriers.*  *-* ***Downlink and Uplink***  *Both the uplink PAPR and the downlink PAPR are 8.6dB (99.9%).*  *All the PAPR reduction algorithms are implemented at the transmitter irrespective of uplink or downlink. The CFR (Crest Factor Reduction) algorithm may be used to reduce the PAPR to 7dB or even lower.* |
| 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.   * ***Downlink and Uplink*** * *For TCH data: Support low density parity check (LDPC) coding and convolutional coding. The LDPC channel coder facilitates the low-latency and high-throughput decoder implementation. Bit interleaving is optional for the LDPC. The LDPC and convolutional coding, combined with rate matching based on shortening/puncturing/repetition, achieve all the needed code rates.* * *For L1/L2 control:*   *Convolutional coding with 1/2 in URLLC mode; LDPC with 4/7 code rate is used in other modes.*  *The decoding mechanism is implemented specific for the receiver. Examples of information on the decoding mechanism is provided together with the self-evaluation document.* |
| 5.2.3.2.2.3.2 | Describe the bit interleaving scheme for both uplink and downlink.   * ***Downlink and Uplink*** * *For TCH data: Bit interleaving is performed for convolutional coding and it is optional for the LDPC coding.* * *For L1/L2 control: Bit interleaving is performed after convolutional coding is completed.* |
| **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.**  *For Sub-6GHz bands:*  *To support channel tracking, different types of reference signals can be transmitted on downlink and uplink respectively.*  ***Downlink:***   * *DL short preamble can be used for synchronization; long preamble (a.k.a. common reference signal, CRS) can be used for downlink channel estimation and for coherent demodulation of control channel (CCH).* * *Downlink demodulation reference signals (DL-DRS) can be periodically inserted for downlink channel estimation and coherent demodulation of downlink transmit channel (DL-TCH). The DL-DRS period is configurable.* * *Downlink sounding reference signals (DL-SRS) can be used for downlink channel sounding.* * *Phase tracking pilots can be used for channel tracking, the residual frequency offset compensation of downlink, and the common phase offset compensation.*   ***Uplink:***   * *Uplink demodulation reference signals (UL-DRS) can be periodically inserted for uplink channel estimation and coherent demodulation of uplink transmitting channel (UL-TCH). The UL-DRS period is configurable.* * *Uplink sounding reference signals (UL-SRS) can be used for uplink channel sounding.* * *Phase tracking pilots can be used for channel tracking, the residual frequency offset compensation of uplink, and the common phase offset compensation.*   *For mmWave bands:*  *To support channel tracking, different types of reference signals can be transmitted on downlink and uplink respectively.*  ***Downlink:***   * *Directional System information channel (D-SICH) with different beampattern can be used for completing the base station TX antenna beam training.* * *Downlink training sequence (DL-TRN) can be used for downlink channel tracking and beam tracking.* * *DL preamble can be used for synchronization* * *Downlink demodulation reference signals (DRS) can be periodically inserted for downlink channel estimation and the demodulation of downlink transmission channel and control channel (CCH & DL-TCH).* * *Downlink sounding reference signals (DL-SRS) can be used for the downlink channel sounding.* * *Phase tracking pilot frequency can be used for channel tracking, the residual frequency offset compensation of downlink, and the common phase offset compensation.*   ***Uplink:***   * *Directional System information channel (D-SICH) with different beampattern can be used for completing the user TX antenna beam training.* * *UL TRN can be used for uplink channel tracking and beam tracking.* * *Uplink demodulation reference signals (UL-DRS) can be periodically inserted for the uplink channel estimation and the demodulation of uplink transmission channel (UL-TCH).* * *Uplink sounding reference signals (UL-SRS) can be used for the uplink channel sounding.* * *Phase tracking pilot frequency can be used for channel tracking, the residual frequency offset compensation of uplink, and the common phase offset compensation.*   *Details of channel tracking/estimation algorithms belong to the category of receiver implementation. For example, the MMSE-based channel estimation can be used to appropriately interpolate in the time and frequency domain.* |
| **5.2.3.2.4** | **Physical channel structure and multiplexing** |
| 5.2.3.2.4.1 | What is the physical channel bit rate (M 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.  *The bit rate of the physical channel depends on the modulation mode, code rate, number of spatial streams, number of data subcarriers and FFT size of channel bandwidth, cyclic prefix (CP) length, and subcarrier spacing. For each spatial stream, the bit rate of the physical channel can be expressed as*   * *is the coding rate.* * *is the number of the bits used by each subcarrier modulation symbol (BPSK: 1, QPSK: 2, 16QAM: 4, 64QAM: 6, 256QAM: 8, 1024QAM: 10)* * *is the number of data subcarriers. NFFT is the FFT size of the channel bandwidth. NCP is the cyclic prefix length.* * *is the subcarrier spacing. Please refer to section 5.2.3.2.7.* * *is number of spatial streams.*   *For example, a 100 MHz bandwidth with 1120 subcarriers using 78.125KHz subcarrier spacing, 7/8 coding rate, 1/8 CP ratio, 8 spatial streams, and 1024QAM modulation results in a physical channel bit rate of 5.44 Gbit/s.* |
| 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.  *For Sub-6GHz bands:*  *-* ***Downlink:***  *The downlink L1/L2 overhead includes:*   1. *Different types of reference signals* 2. *DL-TCH demodulation reference signals (DRS)* 3. *DL* *sounding reference signals (DL-SRS)* 4. *The L1/L2* *System Information and Control signalling (SICH/CCH).* 5. *The short preamble (S-Preamble) and the common reference signal (CRS) are 1 OFDM symbol respectively. With exception of URLLC scenario, the S-Preamble and CRS are multiple PN sequences.* 6. *The L2 MAC PDU header.*  |  |  |  | | --- | --- | --- | | *Reference signal type* | *Example configurations*  *(2ms frame length, 20MHz, 78.125KHz subcarrier spacing, short CP)* | *Overhead for example configurations* | | *S-Preamle & CRS* | *Both the S-Preamble and the CRS are 1 OFDM symbol generally.*  *In the URLLC scenario, the S-Preamble is 7 PN sequences with 255 points and the CRS is a 511-point PN sequence (Simultaneously put 64 zeros before and after the sequence respectively as two channel protection spacings).* | *1.44%*  *6.06% in the URLLC scenario* | | *SICH/CCH* | *SICH is an OFDM symbol and CCH is at least 2 OFDM symbols generally.*  *In the URLLC scenario, SICH/CCH is 8 OFDM symbols.* | *At least 2.16%*  *5.76% in the URLLC*  *scenario* | | *DRS* | *DRS is 1, 2, 3, 4 OFDM symbols generally.*  *In the URLLC scenario, there is no DRS and its role is replaced with the CRS.* | *0.72% - 2.88%.* | | *DL-SRS* | *SRS is 1, 2, 3, 4 OFDM symbols per 10 frames (20ms)* | *0.072% - 0.288%* |   *-* ***Uplink:***  *The uplink L1/L2 overhead includes:*   1. *Different types of reference signals* 2. *UL-TCH demodulation reference signals (UL-DRS)* 3. *UL sounding reference signals (UL-SRS)* 4. *The L2 controls the overhead such as random access, uplink time alignment control, power headroom report and buffer status report.* 5. *The L2 MAC PDU header.*  |  |  |  | | --- | --- | --- | | *DRS* | *The DRS is 1, 2, 3, 4 OFDM symbols generally.*  *In the URLLC scenario, the CRS is a 511-point PN sequence (Simultaneously put 64 zeros before and after the sequence respectively as two channel protection spacings).* | *0.72% - 2.88%.*  *1.59% in the URLLC scenario.* | | *UL-SRS* | *SRS is 1, 2, 3, 4 OFDM symbols per 10 frames (20ms)* | *0.072% - 0.288%* |   *For mmWave bands:*  *-* ***Downlink:***  *The downlink L1/L2 overhead includes:*   1. *Different types of reference signals* 2. *Demodulation reference signals (DRS) for DL-TCH and CCH* 3. *DL sounding reference signals (DL-SRS)* 4. *Sequence for beam training and tracking (DL-TRN)* 5. *DL preamble* 6. *Synchronous signals and demodulation reference signals in D-SICH with different antenna beam pattern used in beam training.* 7. *L1/L2 control channels (CCH), at most 30 OFDM symbols.* 8. *The L1/L2 downlink feedback signalling is transmitted in the header of DL-TCH, at most 15 OFDM symbols.* 9. *The L2 MAC PDU header.*   *-* ***Uplink:***  *The uplink L1/L2 overhead includes:*   1. *Different types of reference signals* 2. *UL-TCH demodulation reference signals (UL DRS)* 3. *UL sounding reference signals (UL-SRS)* 4. *Sequence for beam training and tracking (UL-TRN)* 5. *Random access channels (RACH)* 6. *The L1/L2 uplink feedback signalling can reach at most 15 OFDM symbols when it is transmitted in UL-TCH.* 7. *L2 MAC PDU headers.*   *The overheads caused by different overload types are shown in the following table.*   |  |  |  | | --- | --- | --- | | *Signal type* | *Example configurations (20ms frame length, 100MHz bandwidth, short CP)* | *Overhead calculation* | | *DL-DRS* | *1 OFDM x Nss* | *1ofdm/1ms\*(19/20)\*Nss*  *=0.27%\*Nss* | | *DL-SRS* | *1 OFDM x Nss* | *1ofdm/1ms\*(19/20)\*Nss*  *=0.27%\*Nss* | | *DL-TRN* | *3 OFDM x Ntx\*Nrx* | *0.81%\* Ntx\*Nrx* | | *SICH/RACH* | *1ms* | *1ms/20ms = 5%* | | *CCH* | *30 OFDM* | *8.2%* | | *DL-signalling* | *15 OFDM* | *4.1%* | | *DL-preamble* | *1 OFDM* | *1ofdm/1ms\*(19/20)*  *=0.27%* | | *UL-DRS* | *1 OFDM x Nss* | *1ofdm/1ms\*(19/20)\*Nss*  *=0.27%\*Nss* | | *UL-SRS* | *1 OFDM x Nss* | *1ofdm/1ms\*(19/20)\*Nss*  *=0.27%\*Nss* | | *UL-TRN* | *3 OFDM \* Ntx\*Nrx* | *0.81%\* Ntx\*Nrx* | | *UL-signalling* | *15 OFDM* | *4.1%* |   *Note:*  *Nss: number of the spatial streams.*  *Ntx: number of the TX antennas.*  *Nrx: number of the TX antennas.* |
| 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 specified combinations of modulation modes, code rates and spatial multiplexing layers, the scheduler can control the effective data rates of users by allocating different resource unit (subcarrier set) quantities. When there are multiple services, the allocable resources and the available resource-based data rates can be shared by all the services.* |
| 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.  *The protocol data unit of EUHT system includes MPDU and GMPDU. The data payload of the MPDU supports the size variation and the application layer protocol and services completely based on IP. The GMPDU (EUHT transport block) consists of several MPDUs and MPDU segmentations. The number of the MPDUs is determined by the wireless resources distributed by the current frame.* |
| 5.2.3.2.4.5 | *Signalling transmission scheme:*  Describe how transmission schemes are different for signalling/control from that of user data.  *- Downlink:*  *The L1/L2 control signalling can be separated from user data and transmitted in separated time and frequency resources. It can be multiplexed with user data within the DL-TCH. The control signalling is limited to BPSK/QPSK modulation (data modulation for QPSK, 16QAM, 64QAM, 256QAM and 1024QAM). The L1/L2 control signalling error correcting codes are convolutional codes (LDPC codes can be used for user data).*  *- Uplink:*  *The L1/L2 control signalling can be separated from user data and transmitted in separated time and frequency resources. It can be multiplexed with user data within the UL-TCH. The control signalling is limited to QPSK modulation (data modulation for QPSK, 16QAM, 64QAM, 256QAM and 1024QAM). The L1/L2 control signalling error correcting codes are convolutional codes (LDPC codes can be used for user data).*  *- For both downlink and uplink, some higher-layer signalling can be multiplexed with data MPDU and thus transmitted using the same physical-layer transmitter processing mechanism as user data.* |
| 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.  *As describe in 5.2.3.2.4.5, the time- frequency resources occupied by the small signalling of EUHT and the time-frequency resources occupied by user service data can be allocated separately, and the Layer 2 protocol header for the small signalling is only used to distinguish different signalling. Therefore, it can be set as small as possible.* |
| **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, STA or CAP assisted handover, type of handover measurements).  What other IMT system (other than IMT-2020) could be supported by the handover mechanism?  ***Terminology:***  *To ease understanding of specific terms/abbreviations used in this item here after, few main acronyms and definitions are introduced:*  -     *EUHT: Enhanced Ultra High Throughput*  -     *CAP: Central Access Point*  -     *STA: Station*  -    *CN: Core Network*  *Inter-System handover:*  *EUHT system can support interwork with LTE system. The STA of EUHT system can integrate LTE terminal system. According to the wireless coverage of EUHT and LTE system, and combined with the traffic load of the two systems, the appropriate wireless system can be selected for communication. Mobility management between two systems can be supported. The main processes are as follows:*  *STA receives the "Inter system selection rules" issued by the source system base station, and starts the measurement at the appropriate time according to the specified rules.*  *According to the Inter system selection rules of the base station of the source system, when STA meets the criteria of measurement reporting, it will report the results of "Inter system measurement" to the base station of the source system*  *The base station of the source system chooses to send "Handover to Inter system command" to STA if it needs to handover to other system according to the result of STA reporting.*  *STA executes synchronized target system base station and accesses target system network.*  *Intra-system handover:*  *EUHT system supports mobility by using the network control and STA-assisted handover mechanism.*  *The network provides measurement configuration information to STA. According to the network configuration information, when the STA detects that the threshold of start-up measurement is satisfied, the STA initiates measurements of neighboring cells; when the STA detects that the threshold of measurement report is satisfied, the STA reports the measurement results to the network.*  *In the handover process, the source CAP decides whether to initiate the handover procedure based on the measured results reported by the STA. The source CAP initiates a handover procedure and sends a "CAP Handover Request" message to the target CAP when the source CAP judges that the handover condition is satisfied. The message carries service flow info, security info, etc. The info helps the target CAP establish Radio Bearer and restore Air Interface data transmission.*  *The target CAP provides some information to help the STA have access to the target CAP. The target CAP sends the information to the source CAP through the "CAP Handover Response" message. Then the source CAP sends the information that can be used in the target CAP to the STA by sending the "Handover Command" message through the air interface so as to help the STA access the target CAP when it hands over.*  *For some data flow services that are required to support lossless handover, in the handover process, the source CAP will forward the buffer memory of the target CAP the data packets that have been sent to the STA through the air interface and have not received ACK from the STA. Meanwhile, the source CAP also forwards the buffer memory of the target CAP the data packets newly received from the network side in the handover process.*  *The STA synchronizes and accesses the target CAP according to the information received from the source CAP in the "Handover Command" message.*  *The target CAP sends a “Path Update" message to the CN to notify the path of the change. The source CAP receives a “Path Release” message from the network and releases the STA information.*  *Through the above control plane and user plane procedure, the STA completes the handover procedure and establishes a new radio connection with the target CAP for data transmission.*    *The system supports the distribution of the cellular networks working at the same frequency. One site may consist of three sectors or two sectors. Preamble, SICH and CCH are respectively in their special sub-bands and TCH can schedule based on the time division multiplexing in a special sub-band or the full band. The CAP can start power control according to the user’s near and far filed, that will reduce the interference between adjacent CAPs.*  *Complete the bandwidth and power control, etc. through the inter-coordination between the CAPs to support distributed, dynamic and flexible radio resource management.* |
| 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.  *EUHT supports the multi-user concurrent communication and the communication of the high-speed mobile scenarios. It supports the handling of mobile handover for a large number of users in a high-speed mobile state.*  *By installing two CPEs (Customer Premise Equipment) terminal on the high-speed train, the users in the train access the network through the CPE agent, so that only the CPEs handover request, reducing the number of terminals that are simultaneously request handover.* |
| **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.  *The RRM mechanism is implemented based on the following methods*  *General*  *The RRM functions in EUHT system include:*  *- Radio connection control: CAPs can establish, modify and release radio connection.*  *- Admission Control: The CAPs can manage admission control by the priority access control and the load balancing strategy.*  *- Mobility Management: The CAPs can support mobility by cell reselection, handover and multi-connection.*  *Dynamic/flexible radio resource management*  *EUHT supports the dynamic and flexible radio resource management. It allocates the resources to data and controls the transmission of the plane packets by scheduling the packets.*  *Load balancing (LB)*  *EUHT supports load balancing functions. When a cell is overloaded, the access control can be realized by means of RACH back off, or by connecting, releasing and redirecting it to other cells.*  *mmWave bands can support load balancing among different beams, which is mainly implemented by scheduling.* |
| 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.  *It is not available for EUHT RIT.* |
| 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.  *EUHT supports the following states:*  *- MAC\_IDLE:*  *- System message broadcast;*  *- Cell re-selection;*  *- DRX* *for CN paging;*  *- MAC\_INACTIVE;*  *- System message broadcast;*  *- Cell re-selection;*  *- DRX* *for RAN paging;*  *- The STA AS context is stored in the STA and RAN.*  *- MAC\_CONNECTED:*  *- The radio resource connection is established for STA;*  *- The STA AS context is stored in the STA and RAN;*  *- Transfer of unicast data to/from the STA, etc.;*  *- Mobility of the network control.*  *Transition between MAC states:*  *‐From MAC\_IDLE to MAC\_CONNECTED: Radio resource connection setup*  *‐From MAC\_CONNECTED to MAC\_IDLE: Radio resource connection release*  *‐From MAC\_INACTIVE to MAC\_CONNECTED: Radio resource connection recovery*  *‐From MAC\_CONNECTED to MAC\_INACTIVE: Radio resource connection suspension*  *‐From MAC\_INACTIVE to MAC\_IDLE: Radio resource connection release*  *‐From MAC\_IDLE to MAC\_INACTIVE: not supported* |
| **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 frame structure related information is as follows:*  *For Sub-6GHz bands:*   * *The physical frame length can be dynamically adjusted within the permissible range (0.1-14ms). Typical frame length can be: 1, 1.25, 1.6, 2, 2.5, 4, 5, 6.25, 8 and 10ms.* * *Typical physical frame consists of a downlink scheduling period and an uplink scheduling period. The downlink scheduling period consists of one short preamble symbol, one long preamble symbol, one SICH symbol, the CCHs, the DL-TCH, DL-SCH and the DGI. The uplink scheduling period consists of the UL-SCH, the UL-SRCH, the UL-TCH, UL-RACH and the UGI. The system information channel broadcasts frame structure. It can allocate the uplink and downlink service channels and short signalling resources in the frame. The minimum resource allocation unit is resource unit (RU), which is 16 sub-carriers in single OFDM symbol.* * *The sub-carrier spacing is 78.125KHz (39.0625KHz/19.53KHz is optional).* * *The ratio of the cyclic prefix is 1/8 or 1/4 of DFT length, so the time length of CP is correspondingly 1.6us or 3.2us for 78.125KHz sub-carrier spacing.* * *The DL/UL ratio can be adjusted flexibly according to the real scenarios. The typical values of the uplink and downlink guard interval time lengths respectively occupy two symbols. However, other different symbol lengths can be used too.* * *The length of the CCH is also variable, and contains at least 2 OFDM symbols.*   *No specific power control rate is defined. However, the power control signalling, which supports the open-loop power control and the close-loop power control, can be transmitted in any frame. Maximum power control rate is 10 kHz for 0.1ms frame.*  *For mmWave bands:*   * *Each radio frame length is 20ms. It consists of two types of sub-frames. The length of the SICH/RACH sub-frame is 1ms and the length of the TCH sub-frame is 1ms. The sub-frames use the single carrier mode and the OFDM mode to transmit. In the OFDM mode, the number of the DFT points is 1024. The sub-carrier spacing is 390.625 kHz. The cycle prefix (CP) ratio is 1/4 or 1/8. The D-SICH/RACH sub-frame uses the single carrier transmission mode and it is used in the beam training and the communication connection establishment. The D-SICH/RACH sub-frame uses at most 64 different beams to transmit. The D-SICH/RACH sub-frame contains a frame header (which is used in frame detection, synchronization, frequency offset estimation, AGC and STA RX beam training, AGC) and the information part of the D-SICH.* * *The TCH sub-frame uses the OFDM mode to transmit. The TCH sub-frame is used in the transmission of the uplink and downlink data. Meanwhile, it is used for channel tracking and beam tracking.* * *The TCH sub-frame length can be dynamically adjusted within the permissible range (0.1-10ms). Typical frame length can be: 1,2,5,10ms.* * *The TCH sub-frame contains the downlink transmission period (DL-preamble, DL-DRS, CCH, DL-TCH, DL-TRN), the uplink transmission period (UL-DRS, UL-TCH, UL-TRN) and the guard intervals. The DL/UL ratio is configured through the CCH. The guard interval occupies two symbols.*   *Control channel structure:*   * *The CCH is transmitted in a specified time-frequency domain, which spans over 2-30 OFDM symbols.* * *Power control bit rate:*   *No specific power control rate is defined. However, the power control signalling, which supports the open-loop power control and the close-loop power control, can be transmitted in any frame. Maximum power control rate is 1 kHz for 1ms TCH sub-frame.* |
| **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.  *EUHT supports flexible spectrum use by using one or multiple component carriers. Multiple component carriers can be aggregated to achieve up to 6.4GHz of transmission bandwidth. The aggregated component carriers can be either contiguous or non-contiguous in the frequency domain, including be located in separate spectrum (“spectrum aggregation”).*  *EUHT addresses the uplink and downlink traffic asymmetry with flexible allocating spectrum resources by allowing TDD operation on an unpaired spectrum. DL/UL ratio can be changed in unit of OFDM symbol per frame basis.* |
| 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 mmWave 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.  *One component carrier can support a scalable bandwidth of 5, 10, 15, 20, 25, 30, 40, 50, 60, 80 or 100MHz with a frequency range from 450 MHz to 6000 MHz and a guard interval ratio from 10% to 2.5%.*  *One component carrier can support 50, 100, 200 or 400MHz bandwidth for frequency range above 24250MHz and a guard interval ratio from 10% to 2.5%.*  *By aggregating multiple component carriers, a transmission bandwidth of up to 6.4GHz is supported to provide high data rates. The multiple component carriers can be either contiguous or non-contiguous in the frequency domain.* |
| 5.2.3.2.8.3 | What are the frequency bands supported by the RIT/SRIT? Please list.  *For Sub-6GHz bands:*   |  |  | | --- | --- | | Uplink (UL) and Downlink (DL) *operating band* | Duplex Mode | | 450 - 470 MHz | TDD | | 470 - 698 MHz | TDD | | 694/698 - 960 MHz | TDD | | 1427 - 1518 MHz | TDD | | 1710 - 2025 MHz | TDD | | 2110 - 2200 MHz | TDD | | 2300 - 2400 MHz | TDD | | 2500 - 2690 MHz | TDD | | 3300 - 3400 MHz | TDD | | 3400 - 3600 MHz | TDD | | 3600 - 3700 MHz | TDD | | 4800 - 4990 MHz | TDD |   *For mmWave bands:*   |  |  | | --- | --- | | Uplink (UL) and Downlink (DL) *operating band* | Duplex Mode | | 26500 MHz – 29500 MHz | TDD | | 24250 MHz – 27500 MHz | TDD | | 37000 MHz – 40000 MHz | TDD | | 27500 MHz – 28350 MHz | TDD | |
| 5.2.3.2.8.4 | What is the minimum amount of spectrum required to deploy a contiguous network, including guardbands (MHz)?  *For Sub-6GHz bands:*  *The minimum spectrum bandwidth is 5MHz.*  *For mmWave bands:*  *The minimum spectrum bandwidth is 50MHz.* |
| 5.2.3.2.8.5 | What are the minimum and maximum transmission bandwidth (MHz) measured at the 3 dB down points?  *For Sub-6GHz bands:*  *The 3dB bandwidth is*  *BW=20MHz: 9.3\*2=18.6MHz.*  *BW=40MHz: 19.3\*2=38.6MHz*  *BW=80MHz: 39.3\*2=78.6MHz*  *For mmWave bands:*  *BW = 400MHz: The 3dB bandwidth is 392MHz.* |
| 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- an 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?   * *EUHT supports the TDD mechanism in both paired and unpaired spectrum.* * *The TDD guard time interval is configurable to meet different usage scenarios.* * *The DL/UL ratio is configurable in unit of OFDM symbol per frame basis.* |
| **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., analog, digital, hybrid).  *EUHT system multi-antenna system supports the following MIMO transmission mechanisms at both the STA and the CAP:*   * *The spatial multiplexing of the DRS-based closed loop and semi-open loop transmission schemes is supported. For both DL and UL, the precoding based on CSI feedback and reciprocity is supported.* * *The CAP supports the transmit diversity.* * *For mmWave bands, hybrid beamforming including both digital beamforming and analog beamforming is supported. Both the periodic beam refinement and the aperiodic beam refinement are supported at the STA side and the CAP side.* |
| 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)?  *The EUHT RIT support 1~8 antenna ports for both DL and UL.*  *The CAP and STA support rectangular antenna arrays. The antennas of the rectangular panel array can be described in the following figure. Mg is the number of panels in a column; Ng is the number of panels in row. In a panel, M represents the number of the vertical antenna elements and N represents the number of the horizontal antenna elements. M\*N is the number of polarizations per antenna panel. The vertical spacing and horizontal spacing of the panels are specified by dV and dH*.    *The EUHT RIT can flexibly support various antenna spacing, various antenna element quantities, various antenna port layouts and various antenna virtualization approaches.* |
| 5.2.3.2.9.3 | Provide details on the antenna configuration that is used in the self-evaluation.  *The details on the antenna configuration are described in the self-evaluation report.* |
| 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.  *For both DL and UL in the EUHT, the spatial multiplexing supports the following options:*   * *The single codeword transmission is supported if the number of the layers is less than or equal to 4. The transmission of two codewords is supported if the number of the layers is greater than 4 and less than or equal to 8.* * *The closed-loop MIMO is supported in the EUHT, where for demodulation of data, receiver does not require knowledge of the precoding matrix used by the transmitter.* * *Both the single-user MIMO and the multi-user MIMO are supported. For the single-user MIMO transmission, at most 8 streams are supported. For both DL and UL, the multi-user MIMO supports at most 8 orthogonal DM-RS ports and each STA supports at most 4 orthogonal ports.* |
| 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.  *EUHT supports the remote antennas and distributed antennas.* |
| 5.2.3.2.9.6 | Provide the antenna tilt angle used in the self-evaluation.  *The details on the antenna tilt angle are described in the self-evaluation report.* |
| **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?  *For Sub-6GHz bands:*  *At the data level, the modulation modes supported by EUHT include BPSK, QPSK, 16 QAM, 64 QAM, 256QAM and 1024QAM, with the code rates being between approximately 0.5 and 0.9. There are about 100 combinations of different modulation modes/code rates. These combinations are useful for both downlink and uplink.*  *In both the downlink and the uplink, the link self-adaptation information (modulation scheme selection, code rates, and numbers of repetition times) is computed by the STA and reported to the CAP, and then the CAP sends the configuration information to the STA. The downlink modulation scheme/code rate is selected according to the information on the Channel Quality Indicators (CQIs) reported by the STAs. Several different CQI modes exist, including the frequency selection and broadband modes, periodic and aperiodic modes (frequency and granularity). The CQI mode is configured by the CAP. In the uplink, the CAP can measure the signals of the traffic channel or sounding reference channel and use these signals as the input of the uplink self-adaptation.*  *On the MAC layer, ARQ is supported. The modulation scheme may be re-configured according to the retransmission information. In order to minimize the delay, the retransmission information needs fast and timely feedback.*  *For mmWave bands:*  *To support the link self-adaptation, the modulation coding mode and the radio time-frequency resources determined by mmWave bands through dynamic scheduling instructions can simultaneously and self-adaptively select the best beam according to the beam training results.*  *-* *The terminal STA determines the transmission block size of the current transmission time slot according to the dynamically allocated MCS indications and radio resources. There are about 100 combinations of different modulation modes/code rates. The number of the multi-antenna MIMO transmission layers is 1-4, and the code rate range is 0.03~0.875.*  *- The CAP controls the uplink and downlink MCS. The downlink MCS is the CQI reported based on the STA. mmWave bands adopt the TDD. The uplink MCS can select the report based on the measurement of sounding signals or the downlink CQI. Meanwhile, the uplink and downlink MCS can be corrected by using the statistical BLER. The CQI reporting supports aperiodic and periodic mode. The trigger of aperiodic reporting and the periodic granularity of periodic reporting are completely based on the dynamic configuration and scheduling of CAP.*  *-- The DL-TCH and UL-TCH channels are configured with beam training sequences, which can complete tracking and training of beams in real time, and the training results are reported together with CQI.* |
| 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.  *The uplink power control is independent of the uplink data (UL-TCH) and the sounding reference signals. The uplink power control is based on both the signal strength measurement of the STA itself (open-loop power control) and the measurements of the CAP. The latter measurements (CAP measurements) are used to generate power control commands that are subsequently fed back to the STAs as a part of the downlink control signal (closed-loop power control). Both absolute and relative power-control commands are supported by EUHT. There are four kinds of available step size adjustments to be determined in case of the relative power control. For the uplink data, EUHT can configure multiple closed-loop power control processes, including the separate processes that may contain transmission beam indications.*  *For example, a real implementation is as below:*  *The power control step size is 1dB.*  *The power control cycle is 20 times per second.*  *The dynamic range of the power control is from -4 to 26dB.*  *The downlink power control is specific to network implementation. Therefore, it is outside the scope of the standard protocol. A simple and effective power control strategy is to transmit with a constant output power. The scheduling and link self-adaptation are used to adapt to the variations in channel conditions and interference levels.* |
| **5.2.3.2.11** | **Power classes** |
| 5.2.3.2.11.1 | *STA emitted power* |
| 5.2.3.2.11.1.1 | What is the radiated antenna power measured at the antenna (dBm)?  *For Sub-6GHz bands:*  *For Frequency Range 1, the maximum output power is the sum of the powers of all the antenna connectors of the terminal. The maximum output power is defined by the power class of the terminal, as shown in the following table:*  <STA maximum output power >   |  |  |  | | --- | --- | --- | | Power class | PPowerClass (dBm) | Tolerance | | 2 | 26 | and 2/-3 | | 3 | 23 | and 2/-3~-2 | | Note 1: PPowerClass is the maximum *STA* power specified without taking into account the tolerance  The maximum output power corresponding to a power class does not include the tolerance shown in the table. | | |   *For mmWave bands:*  <STA minimum peak EIRP >   |  |  |  |  | | --- | --- | --- | --- | | Min peak EIRP (dBm) | | | | | Power class 1 | Power class 2 | Power class 3 | Power class 4 | | 40.0 | 29 | 22.4 | 34 | | NOTE 1: Minimum peak EIRP is defined as the lower limit without tolerance | | | |   < STA minimum spherical coverage EIRP >   |  |  |  |  | | --- | --- | --- | --- | | Min spherical coverage EIRP (dBm) | | | | | Power class 1 | Power class 2 | Power class 3 | Power class 4 | | 32.0@85% | 18@60% | 11.5@50% | 25@20% | | NOTE 1: Minimum spherical coverage EIRP is defined as the lower limit without tolerance at x% of the distribution of radiated power measured over the full sphere around the STA. | | | |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | Power class 1 | | Power class 2 | | Power class 3 | | Power class 4 | | | Max TRP (dBm) | Max EIRP  (dBm) | Max TRP (dBm) | Max EIRP  (dBm) | Max TRP (dBm) | Max EIRP  (dBm) | Max TRP (dBm) | Max EIRP  (dBm) | | 35 | 55 | 23 | 43 | 23 | 43 | 23 | 43 |   < STA maximum output power limits |
| 5.2.3.2.11.1.2 | What is the maximum peak power transmitted while in active or busy state?  *See item 5.2.3.2.11.1.1.* |
| 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.  *For Sub-6GHz bands:*  *The time averaged power transmitted in active state is subject to the type of signal/channel, STA channel condition, allocated bandwidth, and deployment scenario, etc. One example of estimate averaged transmit power is to take median of minimum STA output power and maximum STA output power (e.g. around -10dBm).*  <Minimum *STA* output power for Sub-6GHz bands>   |  |  |  | | --- | --- | --- | | Channel bandwidth  (MHz) | Minimum output  power  (dBm) | Measurement  bandwidth  (MHz) | | 20 | -40 | 17.96875 | | 40 | -37 | 37.96875 | | 80 | -34 | 77.96875 |   *For mmWave bands:*  *The time averaged power transmitted in active state is subject to the type of signal/channel,* STA *channel condition, allocated bandwidth, and deployment scenario, etc. One example of estimate averaged transmit power is to take median of minimum STA output power and maximum STA output power (e.g. around -10dBm).*  <Minimum STA output power for mmWave bands >   |  |  |  |  | | --- | --- | --- | --- | | STA power class | Channel bandwidth  (MHz) | Minimum output  power  (dBm) | Measurement  bandwidth  (MHz) | | Power class 1 | 400 | 4 | 390 | | Power class 2, 3, 4 | 400 | -13 | 390 | |
| 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 maximum transmit power of the base station per RF carrier is limited by the regional regulatory requirements.* |
| 5.2.3.2.11.2.2 | What is the maximum peak transmitted power per RF carrier radiated from antenna?  *The maximum peak transmit power of the base station per RF carrier is limited by the regional regulatory requirements.* |
| 5.2.3.2.11.2.3 | What is the average transmitted power per RF carrier radiated from antenna?  *The averaged transmitted carrier power depends on the type of signal to be transmitted, bandwidth, and deployment scenario, etc.* |
| **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.  *EUHT QoS model is a model based on a service type. It generally includes two major categories (GBR service and non-GBR service) consisting of 8 service types. Each service flow has multiple QoS parameters, such as service type index, resource type, priority level, service guarantee rate, maximum service rate, delay budget and packet loss rate budget.*  *When services are established, the IP gateway and EUHT access gateway map different services onto the fid* *of the access network representing different services according to the QoS parameters of the service flow.*  *During the handover of the radio access network, the QoS of each service is guaranteed through the fast handover and lossless handover supported by EUHT.*  *In order to support multiple services of users with different QoS, EUHT adopts the multi-FID service flow multiplexing and the dynamic scheduling of multiple services.* |
| 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.  *EUHT adopts the TDD mode. The uplink and the downlink are dynamically scheduled respectively. The supported scheduling algorithms include the proportional fair scheduling algorithm and the semi-static scheduling algorithm:*  *-- The dynamic scheduling requires determining the measurement report and self-adaptive mechanism described in Section 5.2.3.2.10.1 such as MIMO antennas, modulation codes and beams.*  *-- The proportional fair algorithm also requires considering the priorities of different users, the QoS requirements of services, and the current service cache situation, which is suitable for full-buffer services.*  *-- For non-full buffer services, such as VOIP and signal control, semi-static scheduling can be adopted; the burst model of services can be referred to, and a small amount of resources can be reserved periodically to ensure various service quality requirements and the radio resource utilization rate.*  *– In addition, the time slot resources of the DL-TCH and UL-TCH support dynamic configuration, which can be optimized and configured according to the current service type and cache situation.* |
| **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 channels  Transport channels and/or physical channels.  *For Sub-6GHz bands:*  *Radio Protocols:*  *The protocol stack for the user plane includes the MADP (MAC adaptive sublayer), the MAC sublayer and the PHY sublayer (terminated in UE and BS).*  *On the control plane, the following protocol sublayers are defined:*  *- MAC and PHY sublayers (terminated in STA and CAP);*  *Radio Channels (Physical, Transport and Logical Channels)*  *The physical channels defined in the downlink are:*  *-     the System　Information　Channel (SICH)*  *-     the Control　Channel (CCH)*  *-     the Downlink　Sounding　Channel (DL-SCH)*  *-     the Downlink　Traffic Channel (DL-TCH)*  *-the Downlink　Guard　Interval (DGI)*    *The physical channels defined in the uplink are:*  *-     the Uplink　Sounding　Channel(UL-SCH)*  *-     the Uplink　Schedule　Request　Channel (UL-SRCH)*  *-     the Uplink　Random　Access　Channel (UL-RACH)*  *-     the Uplink　Transmission　Channel (UL-TCH)*  *-the Uplink　Guard　Interval (UGI)*    *The following transport channels are defined:*  *Uplink:*  *-          Uplink Signalling Channel (USCH), mapped to UL-TCH*  *-          Uplink Data Channel (UDC), mapped to UL-TCH*  *-          Random Access Channel (RACH), mapped to UL-RACH*  *-*  *Downlink:*  *-          Downlink Signalling Channel (DSCH), mapped to DL-TCH*  *-          Downlink Data Channel (DDC), mapped to DL-TCH*  *-          Downlink System Info(DSI), mapped to SICH*    *Logical channels are classified into two groups: Control Channels and Traffic Channels.*  *Control channels:*  -          *Broadcast Control Channel (BCCH): a downlink channel for broadcasting system control information.*  -          *Paging Control Channel (PCCH): a downlink channel that transfers paging information and system information change notifications.*  -          *System Info Channel (SI): a channel for transmitting control information between UEs and network.*  -          *Dedicated Control Channel (DCCH): a point-to-point bi-directional channel that transmits dedicated control information between a UE and the network.*  *Traffic channels:**Traffic Channel (DTCH/UTCH), which can exist in both UL and DL.*  *In Downlink, the following connections between logical channels and transport channels exist:*  -          *BCCH can be mapped to DDC;*  -          *PCCH can be mapped to DDC;*  -          *DCCH can be mapped to DSCH;*  -          *DTCH can be mapped to DDC;*  -          *SI can be mapped to DSI*  *In Uplink, the following connections between logical channels and transport channels exist:*  *- DCCH can be mapped to USCH*  *- UTCH can be mapped to UDC.* |
| 5.2.3.2.13.2 | What is the bit rate required for transmitting feedback information?  *For Sub-6GHz bands:*  *EUHT system can complete sending data packet confirmation signalling (ACK) within a frame. The confirmation signalling can be sent in every frame (For example, if the frame length is 2 milliseconds, the frame length can be configured). The signalling has few octets, e.g. 120 bits. This results in a rate of 120/0.002=60000bit/s.*  *For mmWave bands:*  *– mmWave bands adopt the implicit acknowledgement mode and the immediate/group acknowledgement mode:*  *-- Non-broadcast control signalling needs acknowledgement and can be confirmed according to the received response message;*  *-- For service data and unresponsive control signalling, an immediate/group acknowledgement (multi-FID) mode is adopted. Since resources are independent of service data scheduling, less L2 packet header overhead can be adopted, with a typical length of 120 bits.*  *In addition, the time slot length of mmWave bands can be configured. Taking 0.5ms for an example, the bit rate of the feedback is 120/0.5ms = 240 Kbit/s.* |
| 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).  *For Sub-6GHz bands:*  *EUHT system can complete the initial access through a random-access process.*  *EUHT system supports "the contention-based random access" mode and "the non-contention access process".*  *The contention-based random access is mainly used in the initial access process. The STA uses random PN code to access. The CAP allocates the STA the resources used to transmit the random-access request signalling. The STA sends the random-access request signalling. After receiving the random-access response signalling, the initial access process is completed.*  *The non-contention access is mainly used in a handover process. The CAP can provide dedicated resources to the STA, which can avoid contention, reduce the time delay of the access of the STA to the target CAP, and quickly complete the process of the access to the target CAP.*  *For mmWave bands:*  *The channel access of the mmWave bands includes the initial channel access (contention-based random access) and the handover channel access (non-contention access).*  *- The initial channel access of mmWave bands is based on a fully competitive mode, including the corresponding RACH channel resources and the preamble. The available random-access resources and preamble sets can be obtained by receiving the system information D-SICH.*  *- The initial random access process includes scanning different beams to obtain relevant D-SICH information, selecting the RACH channel corresponding to the most appropriate beam, randomly selecting a preamble in the alternative set to initiate the access and waiting to receive a random access response (DL-CCH) message which carries the initial TA, allocated uplink transmission resources, etc., and then the STA uses the allocated resources to send the first uplink message (connection establishment request) while opening a window to wait for the connection establishment response message. If the access fails, the STA can continuously try to initiate an access for several times.*  *-- Viewing from the physical layer, first, multiple beams need to be scanned to achieve synchronization, train downlink beams and obtain the D-SICH information. The random-access preamble is sent in the RACH channel of the corresponding beam; the random-access response is a downlink broadcast CCH, and the others are short control signalling.* |
| **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.  *For Sub-6GHz bands~~:~~*  *EUHT system can complete the cell selection through the following processes:*  *The STA scans and searches all the frequency bands it supports, measures the signal strength of* *specific frequency points, chooses the cell that meets the signal strength threshold, and selects the appropriate cell to reside after reading the system messages broadcasted by the cell.*  *For mmWave bands:*  *The cell selection of mmWave bands is based on the following procedures and criteria:*  *-- The STA first confirms the currently supported frequency points.*  *-- For each supported frequency point, scanning multiple beams need to be completed; the synchronization SYNC needs to be achieved; the system information D-SICH needs to be read, the alternative set of the best beam of the current frequency point needs to be confirmed, and the corresponding RSSI and RACH resources need to be recorded.*  *-- After the STA completes scanning multiple frequency points, it needs to select a suitable cell, i.e. a candidate cell the measured RSSI of which has met the cell selection threshold, and the corresponding cell candidate beam does not prohibit access due to overload or other reasons.*  *-- Among multiple suitable cells, the STA selects the strongest cell to reside or initiate access in the corresponding RACH resources.*  *-- Of course, in the system information D-SICH, the cell with a specific frequency point can be configured as a preferred cell to reside.* |
| **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.  *For Sub-6GHz bands:*  *EUHT provides mechanisms to support or assist the determination of the geographical location of a STA. The geographical location of the STA can be used in radio resource management, and the location- based services of operators, subscribers and third-party service providers.*  *The supported positioning methods include:*  *- enhanced cell ID methods;*  *- network-assisted GNSS methods;*  *- observed time difference of arrival (OTDOA) positioning methods.*  *The system uses one or several above-mentioned methods. It also uses the hybrid positioning by using multiple STA-based and STA assistance/RAN-based methods.*  *In the future evolved versions, EUHT system will be further studied to have richer positioning service methods.*  *For mmWave bands:*  *mmWave bands supports an accurate positioning mechanism based on preamble ranging and beam tracking assistance.*  *- This positioning information is conducive to efficient radio resource management of the network;*  *- Accurate location services are provided for network providers, subscribers and third parties with relevant qualifications.*  *- The accuracy of the preamble-based ranging can be sub-meters level.*  *- The assist beam tracking provides three-dimensional coordinate information by obtaining the angle information of each antenna array element after a large number of calculations are conducted.*  *Of course, by selecting the module's external interface, mmWave bands can also be used to obtain the meter-level accurate positioning information provided by the positioning module of EUHT.* |
| **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).  *For Sub-6GHz bands:*  *EUHT system has priority access control and load balancing functions. In a cell with overload, the access control can be completed by means of RACH back off, or Connection Release and redirecting to other cells.*  *For different priorities of the users in the system, some CAPs with special operational needs and reserved uses are not allowed to access the STA with lower priorities. In addition, EUHT system also supports emergency communication services. It will schedule and allocate radio resources according to the highest priority to ensure the emergency communication services.*  *For mmWave bands:*  *For special users or special service requirements, such as the access initiated by emergency services, mmWave bands has a corresponding mechanism to ensure their priority access to wireless networks to obtain network resources:*  *- The two-level load control based on cells and beams is supported, and the system information broadcasts the current cell and beam load conditions and controls the access.*  *- A variety of access control functions, the RACH access collision fallback mechanism, connection establishment rejection, and request on withdrawing from a network are provided.*  *- In idle state, initial access can be initiated and the corresponding connection establishment request message can carry triggering service identifications and priorities, so that the network can judge whether to give priority to access.*  *- For connection statuses and handover, there are two modes: the competitive mode and the non-competitive mode. For priority users or those with priority services, resources such as preambles, STAID and beams can be allocated in advance to avoid collision and ensure priority access.* |
| **5.2.3.2.17** | **Unicast, multicast and broadcast** |
| 5.2.3.2.17.1 | *EUHT supports unicast data transmission among different users and point-to-multipoint multicast data transmission.*  *The supported broadcast data transmission includes the system information and parameter configuration information of the cell, as well as the service information broadcast within the whole gateway.*  *All the three use shared carriers, and they coexist mainly through the following mechanism:*   * 1. *The broadcast STA identification (BSTAID) and the STA unique identification (STAID) distinguish the unicast and broadcast data.*   2. *The broadcast target IP address and the address learning function are configured.* |
| 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?  *EUHT helps any user provide multiple services at the same time:*  *- It sets up a multi-FID service flow based on the service QoS attribute for each user.*  *- In the services with similar types or QoS attributes, the same FID service flow can be reused.*  *- The multi-service dynamic scheduling based on a proportional fair scheduling algorithm provides appropriate channel capacity allocation.*  *For more details, please refer to the descriptions in the previous 5.2.3.2.12 and 5.2.3.2.13.* |
| 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 EUHT RIT can support a variety of voice and video codecs. In fact, this RIT is a transmission technology that is not perceived by codecs, which can provide the transmission bandwidth, real-time and QoS performance requirements required by various types, various code rate and various operation(fixed/dynamic/adaptive) codecs. This RIT not only satisfies the codecs used and defined today, but also has enough margin to support future codecs upgrades.* |
| **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 confidentiality  Describe how the RIT/SRIT may be protected against attacks, for example:  – passive,  – man in the middle,  – replay,  – denial of service.  *EUHT can satisfy the privacy protection requirements of the users (STAs). EUHT supports the concealment of the permanent user identifiers in the aerial communications. This feature is mainly used against active attacks.*  *EUHT guarantees regular refreshment of the temporary user identifiers. This feature is mainly used against passive attacks.*  *EUHT supports multiple connections and the slicing function, which can help improve the stability of wireless networks.*  *EUHT supports the identification/authentication and it has built a strong encryption and security feature.*  *EUHT supports bidirectional identification, i.e. it simultaneously helps the CAP identify and authenticate the STA and the STA identify and authenticate the network of the CAP, which can effectively prevent illegal STA or CAP.*  *EUHT provides protection against eavesdropping, modification, and replay attacks.*  *EUHT has implemented the following ciphering algorithms: AES, ZUC, and SMS4. It conducts the CRC verification on the MAC layer, which can ensure the integrity of payload.*  *Therefore, all the transmission channels of the control signals and user data have been encrypted and protected. The integrity has been protected too.* |
| **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.  *EUHT reserves 7 bits for the physical cell identity. It adopts three kinds of preamble sequences and two types of CRS. Thus, it supports 768 cells. It also supports configurability.* |
| **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.  *For Sub-6GHz bands:*  *With enough DL/UL intervals, it works in the half-duplex TDD to avoid receiving and transmitting interferences. In addition, EUHT has several types of S-Preamble and CRS, which are used to distinguish different cells. The 7-bit cell ID is used to scramble the control channel to further lower the interference.*  *For mmWave bands:*  *Interference reduction scheme:*  *-- With enough DL/UL intervals, it works in the half-duplex TDD to avoid receiving and transmitting interferences.*  *-- The synchronous codes, system information and control information are transmitted in different beams. Meanwhile, in the mmWave bands, relatively great propagation losses and random directional transmission have made the interference between cells be avoided.*  *--The dynamic configurability of the STA-specific DL-DRS and UL-DRS corresponds to the directional transmission of beams and effectively reduces the interference.* |
| 5.2.3.2.20.2 | What is the signalling, if any, which can be used for intercell interference mitigation?  *The CAPs can exchange signalling to support inter-cell interference mitigation.* |
| 5.2.3.2.20.3 | *Link level interference mitigation*  Describe the feature or features used to mitigate intersymbol interference.  *The use of the OFDM transmission with a cyclic prefix in the uplink and downlink and synchronization in the time and frequency can mitigate intersymbol interference.*  *Also see 5.2.3.2.20.4.* |
| 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 use of the OFDM transmission with a cyclic prefix in the uplink and downlink and equalization in the frequency domain can cope with multipath propagation effects.* |
| 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.  *EUHT adopts the following several diversity modes:*   * *Space diversity: It is implemented by increasing the number of the transmitting and receiving antennas and beamforming.*   *Number of TX-antenna ports: This depends on the deployment. To implement the multi-layer transmission, however, at most 8 antenna ports have been defined. The mapping of the ports onto the physical antennas is a specific implementation problem.*  *Number of RX antenna ports: It depends on the specific reception implementation.*   * *Frequency diversity: It is implemented by transmitting data in all the transmission bandwidth (Data are repeatedly transmitted for multiple times in a frequency domain).* * *Time diversity: It is implemented by adopting the fast retransmissions of the ARQ protocol or repeatedly transmitting data in the same frame.* * *Multi-user diversity: The multi-user diversity gain is obtained by using the random fluctuation of the fading channels of different users, always selecting the users with the best channel conditions and making them work together.* |
| **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.  *EUHT system supports three synchronization modes: the network synchronization based on the IEEE 1588v2 protocol, the GPS synchronization and the independently researched and developed photoelectric synchronization mechanism. These three modes backup each other. They can be switched flexibly and very high reliability can be achieved. Different base stations can reach the time synchronization accuracy of less than 1 us by adopting the network synchronization based on the IEEE 1588 V2 protocol. If the number of the arcades is small, the accuracy of 500 ns can be reached. The synchronization accuracy of the GPS mode is 500 ns. If the independently researched and developed photoelectric synchronization scheme is adopted, the synchronization accuracy of less than 1us can be reached. In short, the deployment of the current EUHT synchronization scheme is simple, reliable and accurate. In addition, the synchronization requirement of EUHT is also lower, no more than 4us.*  *EUHT adopts the half-duplex TDD mode. The synchronization between base stations and the synchronization mechanism between the base station and the network are needed.*  *EUHT adopts the PPS (plus per second) to achieve the inter-base-station frame synchronization and resist inter-cell Interference.*  *-- It provides the common system frame number SFN to achieve the frame-level synchronization of the air interfaces and assist some operations such as network entry and handover.*  *-- It achieves the BS time synchronization through the Ethernet synchronization and provides absolute clock information for the system.*  *Accuracy requirements:*  *CAP transmit signal accuracy:*   * *Frequency accuracy: The frequency deviation is within ±0.5 ppm. The observation time is 1ms.*   *The cell phase synchronization accuracy measured at the CAP antenna connector is better than 3us.* |
| 5.2.3.2.21.2 | Describe the synchronization mechanisms used in the proposal, including synchronization between a user terminal and a base station.  *For Sub-6GHz bands:*  *Cell search is the process in which a STA achieves the time and frequency synchronization with a cell and detects the physical layer cell ID of the cell. In the downlink, the STA obtains frequency offset estimation through the autocorrelation of long and short preambles. Short preambles are for coarse synchronization and long preambles are for fine synchronization. The second synchronization is implemented by cell reference signals. In the uplink, the STA pre-compensates for the uplink transmission according to the downlink frequency offset estimation.*  *The STA receives the following synchronization signals (SS) to perform cell search: the short preamble (S-Preamble) and the common reference signal (CRS). S-Preamble is (at least) used in the initial symbol boundary, cyclic prefix, sub frame boundary, and initial frequency synchronization with the cell. CRS is used in radio frame boundary identification and fine synchronization. S-Preamble and CRS are together used for cell ID detection.*  *Other synchronization mechanisms are defined e.g., monitoring, transmission timing adjustment, cell activation/deactivation timing used in radio links.*  *For mmWave bands:*  *A STA achieves the time and frequency synchronization with the initial frequency of the CAP in the whole process of cell search and initial access:*  *In each D-SICH beam training period, the STA achieves the downlink frame synchronization and frequency offset according to the reference signals of the D-SICH header. It also conducts the TX and RX beam training by using different D-SICH transmit beam modes and STA reception beam modes.*  *After the D-SICH information is decoded, the STA selects a proper TX beam mode (from the D-SICH RX beam training) and specifies a time (from the D-SICH TX beam training) to initiate the random channel access (RACH) and the uplink synchronization.*  *It keeps the uplink time synchronization by implementing the periodic ranging.*  *It guarantees the beam alignment by tracking the beam of the TCH subframe.* |
| 5.2.3.2.22 | Link budget template  Proponents should complete the link budget template in § 45.2.3.3 to this description template for the environments supported in the RIT.  *The information is provided with link budget template.* |
| **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).  *According to Recommendation ITU-R M.2083, the EUHT RIT has a variety of use forms in many scenarios such as eMBB, URLLC, and mMTC.*  *According to Recommendation ITU-R M.1822, the application scope of the EUHT RIT is shown as follows:*  *- The application of the eMBB includes high-speed mobility, high data rates (including the passing back of the videos to the ground from the high-speed train and the internet access of the passengers in high-speed trains), interactive services (including multi-party video conferences),broadcast services (including television broadcasting signals), telephone communication services (including basic/rich telephone communication services), and other high data rate services. It can meet the application requirements of stationary users, pedestrian users and high-speed train/vehicle users.*  *- The application of the URLLC includes highly reliable and short-delay services such as remote medical services, smart traffic and smart power grids.*  *- The application of the mMTC includes smart cities, smart home and the communications between other machines.* |
| 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).  *In different application scenarios, EUHT has multiple flexible configuration attributes, which facilitate the performance improvement of the RIT.*  *- The eMBB services can benefit from the following components.*  *- The maximum aggregated bandwidth supported by EUHT is 1600MHz for Sub-6GHz bands, 6400MHz for mmWave bands, which can improve the data transmission rate.*  *- EUHT supports 8\*8 MIMO. Its maximum modulation mode is 1024 QAM, which can improve the data transmission rate.*  *- The URLLC services can benefit from the following components.*  *The following low latency structures can effectively improve the characteristics of the URLLC.*  *- The scheduling unit of EUHT is the resource unit and the time interval is less than 1ms. The reduced processing time budget at the STA side can lower the time delay.*  *- Front loaded DRS can be used to complete the channel estimation before valid data arrive.*  *- Instantly returning ACK/NACK can reduce the user plane delay.*  *- The mMTC services can benefit from the following components.*  *- Reducing the PAPR can increase the Tx power and facilitate the better coverage.*  *- Flexible frame length configuration facilitates the better coverage.*  *- The high aggregation level of the downlink control channel facilitates the better coverage.*  *- The super long DRX cycle in the MAC\_ACTIVE state can reduce the power consumption of the terminal and extend the battery service life.*  *- A few data can be transmitted when they are randomly received. They needn’t be transformed into the MAC \_CONNECT state, which can reduce the signalling overhead.*  *- The OFDMA (low power consumption) STAs to a broadband system is supported. The resource unit in OFDMA is as narrow as 312.5KHz.*  *- The retransmission mechanism can increase the control channel and the service channel coverage.* |
| **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.  *EUHT CAP can broadcast the band information and spectrum mask of specific region to STAs. If STA is not able to comply with the requirements provided by the network, it is not allowed to initiate connection towards the CAP.* |
| **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.  ***Network energy efficiency***  *In the wireless transmission, the BCF frame must be transmitted periodically. The BCF frame is used in the STA to detect the CAP and obtain the basic information on the CAP. The BCF interval and the physical frame length can be configured through the network. The BCF frame is transmitted in a sub-frequency band. The physical frame length is one of the sets of {0.5, 1, 1.6, 2, 2.5, 4, other} ms.*  *The minimum system information carried by a BCF frame can at least ensure the establishment of the connection between the STA and the network. After the STA receives a BCF frame and joins the CAP, it is not necessary to read. The CAP has its energy saving measure. Its hibernation rate can reach 60%-99.5%.*  *Device energy efficiency*  *The operation of the STA has two power states.*  *- Active state: full-power communication mode.*  *- Sleep mode: In the energy saving half communication mode, the STA cannot transmit and receive data.*  *The handover between the activated state and the sleep state has the following two modes according to the energy efficiency management :*  *- Active mode: The STA can receive frames at any time.*  *- Sleep mode: The purpose that the STA operates under the sleep mode is to save power and air interface resources to the maximum extent.*  *In the sleep mode, the STA should listen to the synchronization frame and DTF\_IND in the listening window of each sleep cycle. Its hibernation rate can reach 80%-99.9%.*  绘图1  *Sleep cycle : It includes a sleep window and a listening window.*  *Sleep window: Duration of sleep,measured in milliseconds. Its value is variable and a multiple of the physical frame length. It does not receive the downlink data to save energy.*  *Listening window: Duration of listening, measured in milliseconds. Its value is fixed. It is the length of one physical frame. It listens to synchronous interrupts and DTF\_IND.*  *DTF\_IND: A management frame. The CAP transmits DTF\_IND frames in the listening window and asks the STA if there are any data that need to be received. If there are some data that need to be received, it puts an end to the sleep mode, otherwise it continues the sleep mode.*  *SLP\_REQ: A management frame. The STA sends SLP\_REQ to request to enter the sleep mode.*  *SLP\_RSP: A management frame. The STA receives a SLP\_RSP frame and the frame contains some parameters such as duration of sleep and accurate sleep start time.* |
| **5.2.3.2.26** | **Other items** |

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| --- | --- |
| 5.2.3.2.26.1 | *Coverage extension schemes*  Describe the capability to support/ coverage extension schemes, such as relays or repeaters.  *The RIT supports the use of the following mechanisms to improve the coverage.*   * *It uses the CFR algorithm to limit the PAR, increase the average Tx power and achieve a better coverage.* * *It uses low modulation and low coding to achieve a better coverage.* * *Beam management is used to increase the coverage in case of massive MIMO.*   *It supports the use of different types of repeating (amplifying and forwarding) functions. Because the STA and the network fail to perceive the existence of repeaters, the functions will not be described in detail.* |
| 5.2.3.2.26.2 | *Self-organisation*  Describe any self-organizing aspects that are enabled by the RIT/SRIT.  *The self-organizing network (SON) is a part of EUHT. Several application examples benefiting from the SON will be introduced as follows. This part of the work is continuing.*  *EUHT system supports the following functions of the self-organizing network (SON):*  *Self-configuration:*   * *Automatic identification of interference cells: Under the control of the Network Management System, a CAP can receive signals from its surrounding cells and calculate the corresponding RSSI. The CAP can add neighbors to the interference cell list accord to the strength of the RSSI.* * *Physical cell identity (PCI) selection: The Network Management System can allocate a physical cell identity to each CAP according to the capacity, scope and other factors. The Network Management System allocates PCIs for each CAP according to a centralized physical cell identity algorithm.*   *Self-optimization:*   * *Automatic optimization of handover parameters: The STA submits the acquired parameters such as RSSI, SNR and TA of the source CAP and target CAP to the Network Management System in the handover process. Then the Network Management System optimizes the handover parameters according to the relevant algorithms.* * *Dynamic allocation of downlink and uplink resources: The Network Management System automatically adjusts the downlink and uplink resource allocation according to the current service situation.* * *Mobility load balancing: The CAP with congested services can transfer its services to another CAP according to the actual conditions and tell the STA to access the CAP and continue the service transfer.* * *Energy Saving: Carry out the power control according to the service situation to facilitate the operation expense reduction.* |
| 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.  *Uncoordinated frequency reuse one is used in the performance evaluations.* |
| 5.2.3.2.26.4 | Is the RIT/component RIT an evolution of an existing IMT technology? Provide the detail.  *This EUHT RIT is new radio developed by NUFRONT, and will be evolved to be a more advanced mmWave bands version.* |
| 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.)  *Yes, it satisfies the specific spectrum mask.*  *For STA and CAP in Sub-6GHz bands and mmWave bands:*  *The frequency spectrum mask is specified according to a normative (general) frequency spectrum emission mask and an additional frequency spectrum mask. Please refer to EUHT standard.* |
| 5.2.3.2.26.6 | Describe any UE power saving mechanisms used in the RIT/SRIT.  *The STA neither receives nor sends any signals when it is in a sleep mode.*  *The STA will immediately enter the low power consumption mode after it receives a DTF frame. The same will occur when it is in the listening mode.* |
| 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.  *As described in Section 7.1 of M.2412, system simulations are iterated over M independent ‘drops’ of user locations. Statistics, mean and 5th percentiles, are calculated over all drops, and confidence intervals are estimated by comparing the results of the different drops. The number of drops is up to each evaluator.* |
| 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  *- More highly efficient sleep-listening ratio.*  *- Less TA scheduling consumption.*  *- The STA will not be awaked when it receives MAC frame from application layer.* |
| 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.  *To quickly awaken sleeping devices from the highest battery efficiency state, EUHT supports the following features:*   * *When a STA starts its data transmission, restore a previous connection to reduce the resource scheduling frequency and reduce the connection delay.* |
| 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).  *Please refer to self-evaluation report.* |
| 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).  *According to the reliability results in self-evaluation report, EUHT RIT can achieve over 99.99999% reliability for 32byte packet size. Therefore, EUHT RIT can support required reliability up to 100byte packet size.* |
| 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).  *According to uplink mobility results in self-evaluation report, EUHT RIT can achieve much better performance than ITU required. The downlink performance in EUHT RIT is better than uplink. Therefore, EUHT RIT can support required downlink mobility performance.* |
| **5.2.3.2.27** | **Other information**  Please provide any additional information that the proponent believes may be useful to the evaluation process.  *N/A* |

## Abbreviation

For the purposes of this document, the following abbreviations apply.

ACK: Acknowledgement

BCC: Binary Convolutional Code

BCF: Broadcasting Control Frame

BFM: Beam forming Matrix

BPSK: Binary Phase Shift Keying

BS: Buffer Size

RSTAID: Broadcasting STAID

CAP: Central Access Point (Base Station)

CCH: Control Channel

CP: Cyclic Prefix

CQI: Channel Quality Information

CRC: Cyclic Redundancy Check

CSI: Channel State Information

DL-SCH: Downlink Sounding Channel

DL-TCH: Downlink Transmission Channel

DSA: Dynamic Service Addition

DSC: Dynamic Service Change

DSD: Dynamic Service Delete

EQM: Equal Modulation

EUHT: Enhanced Ultra High Throughput

FCS: Frame Check Sequence

FFT: Fast Fourier Transform

FID: Flow ID

PTI: Feedback Pilot Interval

FSN: Fragment Sequence Number

GBR: Guaranteed Bit Rate

G-MPDU: Group MPDU

Group Ack: Group Acknowledgement

IFFT: Inverse Fast Fourier Transform

IP: Internet Protocol

IACK:Instant Acknowledgement

LDPC: Low Density Parity Code

L-Preamble: Long Preamble

LSB: Least Significant Bit

MAC: Media Access Control

MCS: Modulation and Coding Scheme

MIMO: Multiple Input Multiple Output

MME: Mobility Management Entity

MMPDU: MAC Management Protocol Data Unit

MPDU: MAC Protocol Data Unit

MSB: Most Significant Bit

MSDU: MAC Service Data Unit

MU-MIMO: Multiple User MIMO

OFDM: Orthogonal Frequency Division Multiplexing

OFDMA: Orthogonal Frequency Division Multiple Access

PDU: Protocol Data Unit

PHY: Physical layer

PICS: Protocol implementation consistent assertion

PN: Pseudo Noise

QAM: Quadrature Amplitude Modulation

QoS: Quality of Service

QPSK: Quadrature Phase Shift Keying

RA: Random Access

REQ: Request

RMS: Root Mean Square

RSP: Response

SAP: Service Access Point

SBC: STA Basic Capability

SCG: Service Control Gateway

SDU: Service Data Unit

SICH: System Information Channel

SINR: Signal To Interference Noise Ratio

SN: Sequence Number

SNR: Signal To Noise Ratio

S-Preamble: Short Preamble

SSN: Starting Sequence Number

STA: Station (UE)

STAID: STA Identifier

STBC: Space Time Block Code

SU-MIMO: Single User MIMO

TDD: Time Division Duplexing

TSTAID: Temporary STAID

UEQM: Unequal Modulation

UGI: Uplink Guard Interval

UL-RACH: Uplink Random Access Channel

UL-SCH: Uplink Sounding Channel

UL-SRCH: Uplink Schedule Request Channel

UL-TCH: Uplink Transmission Channel

WAPI: WLAN Authentication and Privacy Infrastructure