International Telecommunication Union

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Radiocommunication Sector of ITU

Report ITU-R M.2411-0
(11/2017)

Requirements, evaluation criteria and submission templates for the development of IMT-2020

M Series

Mobile, radiodetermination, amateur and related satellite services

International Telecommunication Union

Foreword

The role of the Radiocommunication Sector is to ensure the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including satellite services, and carry out studies without limit of frequency range on the basis of which Recommendations are adopted.

The regulatory and policy functions of the Radiocommunication Sector are performed by World and Regional Radiocommunication Conferences and Radiocommunication Assemblies supported by Study Groups.

Policy on Intellectual Property Right (IPR)

ITU-R policy on IPR is described in the Common Patent Policy for ITU-T/ITU-R/ISO/IEC referenced in Annex 1 of Resolution ITU-R 1. Forms to be used for the submission of patent statements and licensing declarations by patent holders are available from http://www.itu.int/ITU-R/go/patents/en where the Guidelines for Implementation of the Common Patent Policy for ITU-T/ITU-R/ISO/IEC and the ITU-R patent information database can also be found.

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***Note**: This ITU-R Report was approved in English by the Study Group under the procedure detailed in Resolution ITU-R 1.*

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REPORT ITU-R M.2411-0

Requirements, evaluation criteria and submission templates for the development of IMT-2020

(2017)

1 Introduction

This Report deals with on the requirements, evaluation criteria and submission templates for the development of Recommendations and Reports on IMT-2020, such as the detailed specifications of IMT-2020, and provides:

a) the service, spectrum and technical performance requirements for candidate Radio Interface Technologies (RITs)/Set of Radio Interface Technologies (SRITs) for IMT-2020;

b) evaluation guidelines including evaluation criteria and procedures to evaluate technology submissions for IMT-2020;

c) submission templates that proponents must utilize to organize the information that is required in a submission of a candidate technology for evaluation. Proponents must provide the required information.

Additional specific details, including the process, the steps and the relevant timelines may be found on the ITU-R IMT-2020 web page (http://www.itu.int/en/ITU-R/study-groups/rsg5/rwp5d/imt-2020/Pages/submission-eval.aspx) under the link "Web page for the IMT-2020 submission and evaluation process" (see also Document IMT-2020/2(Rev.1) – Submission and evaluation process and consensus building for IMT-2020).

2 Scope

This Report supports the submission and evaluation process for IMT-2020 initiated by Circular Letter 5/LCCE/59 and its Addenda. It addresses the requirements, evaluation criteria, as well as submission templates required for a complete submission of RITs and SRITs for IMT-2020.

3 IMT-2020 minimum requirements

The requirements established in this section relate to services, spectrum and technical performance aspects of IMT-2020.

The intent of the requirements is to ensure that IMT-2020 technologies are able to fulfil the objectives of IMT-2020 and to set a specific level of performance that each proposed technology need to achieve in order to be accepted within ITU-R for IMT-2020. It is to be noted that the requirements are not intended to restrict the full range of capabilities or performance that candidate technologies for IMT-2020 might achieve, nor are intended to describe how the IMT-2020 technologies might perform in actual deployments under operating conditions that could be different from those presented in ITU-R Recommendations and Reports on IMT-2020.

3.1 Services

Recommendation ITU-R M.2083 – IMT Vision – Framework and overall objectives of the future development of IMT for 2020 and beyond, envisaged three usage scenarios for IMT-2020:

– Enhanced Mobile Broadband (eMBB).

– Ultra-reliable and low latency communications (URLLC).

– Massive machine type communications (mMTC).

Diverse services and applications for the three usage scenarios are envisaged, as shown in Fig. 2 in Recommendation ITU-R M.2083.

IMT-2020 RIT/SRIT shall support a wide range of services across different usage scenarios, for which the evaluation methodology is found in § 7.3.3 of Report ITU-R M.2412-0.

The requirements related to services are indicated in the compliance templates in § 5.2.4.1 below. The proponents are encouraged to provide the relevant information in the description template (§ 5.2.3.2.23).

3.2 Spectrum

The following frequency bands have been identified for IMT in the ITU Radio Regulations by WARC-92, WRC-2000, WRC-07, WRC-12 and WRC-15:

450-470 MHz (see No. **5.286AA** of the Radio Regulations (RR))

470-698 MHz (see RR Nos. **5.295**, **5.308**, **5.296A**)

694/698-960 MHz (see RR Nos. **5.313A**, **5.317A**)

1 427-1 518 MHz (see RR Nos. **5.341A**, **5.346**, **5.341B**, **5.341C**, **5.346A**)

1 710-2 025 MHz (see RR Nos. **5.384A**, **5.388**)

2 110-2 200 MHz (see RR No. **5.388**)

2 300-2 400 MHz (see RR No. **5.384A**)

2 500-2 690 MHz (see RR No. **5.384A**)

3 300-3 400 MHz (see RR Nos. **5.429B**, **5.429D**, **5.429F**)

3 400-3 600 MHz (see RR Nos. **5.430A**, **5.431B**, **5.432A**, **5.432B**, **5.433A**)

3 600-3 700 MHz (see RR No. **5.434**)

4 800-4 990 MHz (see RR Nos. **5.441A**, **5.441B**)

Frequency arrangements for these bands identified before WRC-15 are incorporated in Recommendation ITU-R M.1036-5. Work on frequency arrangements for the frequency bands that were identified by WRC-15 is currently ongoing in ITU-R.

Administrations would endeavour to make spectrum available from the frequency bands listed above.

Recommendation ITU-R M.2083 indicates a need of higher frequency bands to support the different usage scenarios with a requirement of several hundred MHz up to at least 1 GHz bandwidth corresponding wider and contiguous spectrum ability. Further, the development of IMT-2020 is expected to enable new use cases and applications associated with radio traffic growth.

Taking into account the IMT-2020 deployment to be expected from the year 2020 onwards, Administrations would endeavour to make spectrum available from the higher frequency bands in a timely manner.

The requirements related to spectrum are in the compliance templates in § 5.2.4.2.

3.3 Technical performance

Report ITU-R M.2410-0 – Minimum requirements related to technical performance for IMT-2020 radio interface(s), describes the key requirements related to minimum technical performance for IMT-2020 candidate radio interface technologies and also provides the necessary background information about the individual requirements, the justification for the items and the values chosen.

The requirements related to technical performance are in the compliance templates in § 5.2.4.3.

4 IMT-2020 evaluation

Candidate RITs or SRITs will be evaluated according to the guidelines in this section.

4.1 Guidelines, evaluation criteria and methodology

Report ITU-R M.2412-0 provides guidelines for both the procedure and the criteria (technical, spectrum and service) to be used in evaluating the candidate IMT-2020 RITs or SRITs for a number of test environments for evaluation. The evaluation procedure is designed in such a way that the overall performance of a candidate RIT/SRIT is fairly and consistently assessed on a technical basis.

5 IMT-2020 submission guidelines and templates for details of submission[1]

5.1 Completeness of submissions

A complete submission under Step 3 of the IMT-2020 process in Document IMT-2020/2(Rev.1) is one that provides the three major components of the submission as referenced below. All components of the complete submission for the first invitation must be received by the final deadline specified in document IMT-2020/2. Proponents must provide all required information within each of the major components:

1 The submission of each candidate RIT or SRIT shall consist of the completed templates as specified in § 5.2 together with any additional inputs which the proponent may consider relevant to the evaluation. Each proposal must also indicate the version of the minimum technical requirements and evaluation criteria of the IMT-2020 currently in force that it is intended for and make reference to the associated requirements. In particular, for a candidate SRIT, the completed templates as requested in this item should be provided for each component RIT within the composite SRIT and/or for the composite SRIT.

2 The entity that proposes a candidate RIT or SRIT to the ITU-R (the proponent) shall include with it either an initial self-evaluation or the proponents' endorsement of an initial evaluation submitted by another entity and based on the compliance templates in § 5.2.4. The submission will not be considered complete without an initial self-evaluation or the proponents' endorsement of an initial evaluation submitted by another entity. It is noted that the initial self-evaluation or the proponents' endorsement of an initial evaluation submitted by another entity is an evaluation performed using the same guidelines and criteria established for the evaluations under Step 4 of the process as provided in Document IMT-2020/2, based on the RIT/SRIT compliance template in § 5.2.4. In particular, for a candidate SRIT, the completed initial self-evaluation or the proponents' endorsement of an initial evaluation submitted by another entity as requested in this item should be provided for each component RIT within the composite SRIT and/or for the composite SRIT.

3 Proponents and IPR holders should indicate their compliance with the ITU policy on intellectual property rights (see NOTE 2 in section A2.6 of Resolution ITU-R 1-7), as specified in the Common Patent Policy for ITU-T/ITU-R/ISO/IEC available at http://www.itu.int/ITU-T/dbase/patent/patent-policy.html.

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[1] Additional specific details, including the process, the steps and relevant timelines may be found on the ITU-R IMT-2020 web page (http://www.itu.int/en/ITU-R/study-groups/rsg5/rwp5d/imt-2020/Pages/default.aspx) under the link "Submission and evaluation process and consensus building".

5.2 Submission guidelines and templates

5.2.1 Submission guidelines

Submission of the ITU-R requested information and voluntary supplementary information addressing the description template and compliance template on the candidate RITs or SRITs by proponents in the form of completed templates shown in § 5.2.2 can be made electronically or by other means to the ITU-R.

5.2.2 Templates for submission

Templates required for submission of IMT-2020 candidate RITs or SRITs are divided into two categories: an RIT/SRIT description template and RIT/SRIT compliance templates. Each set of responses:

a) must complete the RIT/SRIT description template and RIT/SRIT compliance templates – this is information developed in a template format in order to provide a common base of information across the submissions and therefore follows a defined format, asks certain questions, and proposes the responses be provided in a suggested format to the questions determined by ITU-R; and

b) may include voluntary supplementary information – this is additional information deemed relevant by the proponent to provide further understanding of the submission. This information may be formatted as desired by the proponent.

5.2.3 RIT/SRIT description template

This section provides a template for the description of the characteristics of a candidate RIT or SRIT.

Information should be provided for each test environment for which the candidate RIT or SRIT is proposed to operate. This can be done by preparing:

– a separate template submission for each test environment; or

– a single submission that includes multiple answers for those technical parameters impacted by a test environment.

5.2.3.1 Description template background

The description template is a template for the description of the characteristics of a candidate RIT or SRIT. It shall be used by the proponents to describe their proposal for a radio interface for IMT-2020 to a level of detail that will facilitate a sufficient understanding of the proposed technology in order to enable an independent technical assessment of compliance with the IMT-2020 requirements as specified in this Report.

The inclusion of an item in this template shall not imply that it is a minimum requirement of IMT-2020. Proponents are encouraged to extend beyond the template if additional information would assist in the assessment.

Further, where an item is not relevant to or for a proposal, it should be answered N/A (Not Applicable); optionally with an explanation of why the item is not applicable. However, the proponents should be aware that providing sufficient information relevant to the assessment will assist in the evaluation of their proposal by avoiding requests for additional information.

5.2.3.2 Description template – characteristics template

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?
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.
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?
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.
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.
5.2.3.2.2.3.2	Describe the bit interleaving scheme 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.**
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.
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.
5.2.3.2.4.3	*Variable bit rate capabilities:* Describe how the proposal supports different applications and services with various bit rate requirements.
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.
5.2.3.2.4.5	*Signalling transmission scheme:* Describe how transmission schemes are different for signalling/control from that of user data.

Item	Item to be described
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.
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?
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.
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.
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.
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.
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.

Item	Item to be described
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.
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.
5.2.3.2.8.3	What are the frequency bands supported by the RIT/SRIT? Please list.
5.2.3.2.8.4	What is the minimum amount of spectrum required to deploy a contiguous network, including guardbands (MHz)?
5.2.3.2.8.5	What are the minimum and maximum transmission bandwidth (MHz) measured at the 3 dB down points?
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?
5.2.3.2.9	**Support of Advanced antenna capabilities**

Item	Item to be described
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).
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)?
5.2.3.2.9.3	Provide details on the antenna configuration that is used in the self-evaluation.
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.
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.
5.2.3.2.9.6	Provide the antenna tilt angle used in the self-evaluation.
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?
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.
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)?
5.2.3.2.11.1.2	What is the maximum peak power transmitted while in active or busy state?
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.
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?

Item	Item to be described
5.2.3.2.11.2.2	What is the maximum peak transmitted power per RF carrier radiated from antenna?
5.2.3.2.11.2.3	What is the average transmitted power per RF carrier radiated from antenna?
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.
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.
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.
5.2.3.2.13.2	What is the bit rate required for transmitting feedback information?
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).
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.
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.
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).
5.2.3.2.17	**Unicast, multicast and broadcast**

Item	Item to be described
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.
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?
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.
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.
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.
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.
5.2.3.2.20.2	What is the signalling, if any, which can be used for intercell interference mitigation?
5.2.3.2.20.3	*Link level interference mitigation* Describe the feature or features used to mitigate intersymbol interference.
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.).

Item	Item to be described
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.
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.
5.2.3.2.21.2	Describe the synchronization mechanisms used in the proposal, including synchronization between a user terminal and a base station.
5.2.3.2.22	Link budget template Proponents should complete the link budget template in § 5.2.3.3 to this description template for the environments supported in the RIT.
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).
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).
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.
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.
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.

Item	Item to be described
5.2.3.2.26.2	*Self-organisation* Describe any self-organizing aspects that are enabled by the RIT/SRIT.
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.
5.2.3.2.26.4	Is the RIT/component RIT an evolution of an existing IMT technology? Provide the detail.
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.)
5.2.3.2.26.6	Describe any UE power saving mechanisms used in the RIT/SRIT.
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.
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
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.
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).
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).
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).
5.2.3.2.27	**Other information** Please provide any additional information that the proponent believes may be useful to the evaluation process.

5.2.3.3 Description template – link budget template

Proponents of IMT-2020 RIT/SRITs proposals should provide information on the link budget according to this template when they submit the proposals for each test environment in the target set of test environments. The test environments are specified in § 8 of Report ITU-R M.2412-0.

For a given test environment many of the parameter values called out in the tables below are given in, or are given constraints in § 8 of Report ITU-R M.2412-0. The corresponding parameter entries in the below template follow those sets of values or constraints. When providing link budget information, the proponent should use the same configuration and parameters of each test environment as ones in its self-evaluation or an evaluation from another entity which is endorsed by

the proponent. The parameter entries for which there is no guidance in the template should be provided by the proponent.

In the use of these tables, the convention utilized is that the relevant values or formulas to be employed in a given part of the calculation are represented by (X) where X refers to the cell or formula of that corresponding number.

For example, formula (9a) which is Control channel e.i.r.p. = (3) + (4) + (5) + (6) – (8) (dBm) is to be taken as:

> "Control channel e.i.r.p. equals the value in cell (3) plus the value in cell (4) plus the value in cell (5) plus the value in cell (6) minus the value in cell (8) expressed in dBm".

Link budget templates for the five test environments which are defined in § 8 of Report ITU-R M.2412-0 are shown in the following Tables.

The proponent can report information on the link budget for multiple carrier frequencies by replicating the relevant Table(s).

TABLE 1

Link budget template for Indoor Hotspot-eMBB

Item	Downlink	Uplink
System configuration		
Carrier frequency (GHz)	4 or 30 or 70	4 or 30 or 70
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)		
Transmission bit rate for data channel (bit/s)		
Target packet error ratio for the required SNR in item (19a) for control channel		
Target packet error ratio for the required SNR in item (19b) for data channel		
Spectral efficiency(2) (bit/s/Hz)		
Pathloss model(3) (select from LOS or NLOS)		
UE speed (km/h)		
Feeder loss (dB)		
Transmitter		
(1) Number of transmit antennas (The number shall be within the indicated range in § 8.4 of Report ITU-R M.2412-0)		
(2) Maximal transmit power per antenna (dBm)		
(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)		

TABLE 1 (*continued*)

Item	Downlink	Uplink
(4) Transmitter antenna gain (dBi)		
(5) Transmitter array gain (depends on transmitter array configurations and technologies such as adaptive beam forming, CDD (cyclic delay diversity), etc.) (dB)		
(6) Control channel power boosting gain (dB)		
(7) Data channel power loss due to pilot/control boosting (dB)		
(8) Cable, connector, combiner, body losses, etc. (enumerate sources) (dB) (feeder loss must be included for and only for downlink)		
(9a) Control channel e.i.r.p. = (3) + (4) + (5) + (6) – (8) dBm		
(9b) Data channel e.i.r.p. = (3) + (4) + (5) – (7) – (8) dBm		
Receiver		
(10) Number of receive antennas (The number shall be within the indicated range in § 8.4 of Report ITU-R M.2412-0)		
(11) Receiver antenna gain (dBi)		
(12) Cable, connector, combiner, body losses, etc. (enumerate sources) (dB) (feeder loss must be included for and only for uplink)		
(13) Receiver noise figure (dB)	4 GHz: 7 or 30/70 GHz:10	4 GHz: 5 or 30/70 GHz: 7
(14) Thermal noise density (dBm/Hz)	−174	−174
(15) Receiver interference density (dBm/Hz)		
(16) Total noise plus interference density = 10 log (10^(((13) + (14))/10) + 10^((15)/10)) dBm/Hz		
(17) Occupied channel bandwidth (for meeting the requirements of the traffic type) (Hz)		
(18) Effective noise power = (16) + 10 log((17)) dBm		
(19a) Required SNR for the control channel (dB)		
(19b) Required SNR for the data channel (dB)		
(20) Receiver implementation margin (dB)		
(21a) H-ARQ gain for control channel (dB)		
(21b) H-ARQ gain for data channel (dB)		
(22a) Receiver sensitivity for control channel = (18) + (19a) + (20) – (21a) dBm		
(22b) Receiver sensitivity for data channel = (18) + (19b) + (20) – (21b) dBm		
(23a) Hardware link budget for control channel = (9a) + (11) − (22a) dB		

TABLE 1 (*end*)

Item	Downlink	Uplink
(23b) Hardware link budget for data channel = (9b) + (11) − (22b) dB		
Calculation of available pathloss		
(24) Lognormal shadow fading std deviation (dB)		
(25) Shadow fading margin (function of the cell area reliability and (24)) (dB)		
(26) BS selection/macro-diversity gain (dB)		
(27) Penetration margin (dB)		
(28) Other gains (dB) (if any please specify)		
(29a) Available path loss for control channel = (23a) – (25) + (26) – (27) + (28) – (12) dB		
(29b) Available path loss for data channel = (23b) – (25) + (26) – (27) + (28) – (12) dB		
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)		
(30b) Maximum range for data channel (based on (29b) and according to the system configuration section of the link budget) (m)		
(31a) Coverage Area for control channel = (π (30a)^2) (m^2/site)		
(31b) Coverage Area for data channel = (π (30b)^2) (m^2/site)		

(1) Cell area reliability is defined as the percentage of the cell area over which coverage can be guaranteed. It is obtained from the cell edge reliability, shadow fading standard deviation and the path loss exponent. The latter two values are used to calculate a fade margin. Macro diversity gain may be considered explicitly and improve the system margin or implicitly by reducing the fade margin.

(2) The spectral efficiency of the chosen modulation scheme.

(3) The pathloss models are summarized in § 9.1 of Report ITU-R M.2412-0.

TABLE 2

Link budget template for Dense Urban-eMBB[2]

Item	Downlink	Uplink
System configuration		
Carrier frequency (GHz)	4 or 30	4 or 30
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)		
Transmission bit rate for data channel (bit/s)		
Target packet error ratio for the required SNR in item (19a) for control channel		
Target packet error ratio for the required SNR in item (19b) for data channel		
Spectral efficiency(2) (bit/s/Hz)		
Pathloss model(3) (select from LOS, NLOS or O-to-I)		
UE speed (km/h)		
Feeder loss (dB)		
Transmitter		
(1) Number of transmit antennas (The number shall be within the indicated range in § 8.4 of Report ITU-R M.2412-0)		
(2) Maximal transmit power per antenna (dBm)		
(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)		
(4) Transmitter antenna gain (dBi)		
(5) Transmitter array gain (depends on transmitter array configurations and technologies such as adaptive beam forming, CDD (Cyclic delay diversity), etc.) (dB)		
(6) Control channel power boosting gain (dB)		
(7) Data channel power loss due to pilot/control boosting (dB)		
(8) Cable, connector, combiner, body losses, etc. (enumerate sources) (dB) (Feeder loss must be included for and only for downlink)		
(9a) Control channel e.i.r.p. = (3) + (4) + (5) + (6) – (8) dBm		
(9b) Data channel e.i.r.p. = (3) + (4) + (5) – (7) – (8) dBm		

2 Link budget information should be provided for macro layer.

TABLE 2 (*continued*)

Item	Downlink	Uplink
Receiver		
(10) Number of receive antennas (The number shall be within the indicated range in § 8.4 of Report ITU-R M.2412-0)		
(11) Receiver antenna gain (dBi)		
(12) Cable, connector, combiner, body losses, etc. (enumerate sources) (dB) (feeder loss must be included for and only for uplink)		
(13) Receiver noise figure (dB)	4 GHz: 7 or 30 GHz: 10	4 GHz: 5 or 30 GHz: 7
(14) Thermal noise density (dBm/Hz)	−174	−174
(15) Receiver interference density (dBm/Hz)		
(16) Total noise plus interference density = 10 log (10^(((13) + (14))/10) + 10^((15)/10)) dBm/Hz		
(17) Occupied channel bandwidth (for meeting the requirements of the traffic type) (Hz)		
(18) Effective noise power = (16) + 10 log((17)) dBm		
(19a) Required SNR for the control channel (dB)		
(19b) Required SNR for the data channel (dB)		
(20) Receiver implementation margin (dB)		
(21a) H-ARQ gain for control channel (dB)		
(21b) H-ARQ gain for data channel (dB)		
(22a) Receiver sensitivity for control channel = (18) + (19a) + (20) – (21a) dBm		
(22b) Receiver sensitivity for data channel = (18) + (19b) + (20) – (21b) dBm		
(23a) Hardware link budget for control channel = (9a) + (11) – (22a) dB		
(23b) Hardware link budget for data channel = (9b) + (11) – (22b) dB		
Calculation of available pathloss		
(24) Lognormal shadow fading std deviation (dB)		
(25) Shadow fading margin (function of the cell area reliability and (24)) (dB)		
(26) BS selection/macro-diversity gain (dB)		
(27) Penetration margin (dB)		
(28) Other gains (dB) (if any please specify)		
(29a) Available path loss for control channel = (23a) – (25) + (26) – (27) + (28) – (12) dB		

TABLE 2 (*end*)

Item	Downlink	Uplink
(29b) Available path loss for data channel = (23b) – (25) + (26) – (27) + (28) – (12) dB		
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)		
(30b) Maximum range for data channel (based on (29b) and according to the system configuration section of the link budget) (m)		
(31a) Coverage Area for control channel = (π (30a)^2) (m^2/site)		
(31b) Coverage Area for data channel = (π (30b)^2) (m^2/site)		

(1) Cell area reliability is defined as the percentage of the cell area over which coverage can be guaranteed. It is obtained from the cell edge reliability, shadow fading standard deviation and the path loss exponent. The latter two values are used to calculate a fade margin. Macro diversity gain may be considered explicitly and improve the system margin or implicitly by reducing the fade margin.

(2) The spectral efficiency of the chosen modulation scheme.

(3) The pathloss models are summarized in § 9.1 of Report ITU-R M.2412-0.

TABLE 3

Link budget template for Rural-eMBB

Item	Downlink	Uplink
System configuration		
Carrier frequency (GHz)	0.7 or 4	0.7 or 4
BS antenna heights (m)	35	35
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)		
Transmission bit rate for data channel (bit/s)		
Target packet error ratio for the required SNR in item (19a) for control channel		
Target packet error ratio for the required SNR in item (19b) for data channel		
Spectral efficiency(2) (bit/s/Hz)		
Pathloss model(3) (Select from LOS, NLOS or O-to-I)		
UE speed (km/h)		
Feeder loss (dB)		

TABLE 3 (*continued*)

Item	Downlink	Uplink
Transmitter		
(1) Number of transmit antennas (The number shall be within the indicated range in § 8.4 of Report ITU-R M.2412-0)		
(2) Maximal transmit power per antenna (dBm)		
(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)		
(4) Transmitter antenna gain (dBi)		
(5) Transmitter array gain (depends on transmitter array configurations and technologies such as adaptive beam forming, CDD (Cyclic delay diversity), etc.) (dB)		
(6) Control channel power boosting gain (dB)		
(7) Data channel power loss due to pilot/control boosting (dB)		
(8) Cable, connector, combiner, body losses, etc. (enumerate sources) (dB) (Feeder loss must be included for and only for downlink)		
(9a) Control channel e.i.r.p. = (3) + (4) + (5) + (6) - (8) dBm		
(9b) Data channel e.i.r.p. = (3) + (4) + (5) - (7) - (8) dBm		
Receiver		
(10) Number of receive antennas. (The number shall be within the indicated range in § 8.4 of Report ITU-R M.2412-0)		
(11) Receiver antenna gain (dBi)		
(12) Cable, connector, combiner, body losses, etc. (enumerate sources) (dB) (feeder loss must be included for and only for uplink)		
(13) Receiver noise figure (dB)	7	5
(14) Thermal noise density (dBm/Hz)	−174	−174
(15) Receiver interference density (dBm/Hz)		
(16) Total noise plus interference density = 10 log (10^(((13) + (14))/10) + 10^((15)/10)) dBm/Hz		
(17) Occupied channel bandwidth (for meeting the requirements of the traffic type) (Hz)		
(18) Effective noise power = (16) + 10 log((17)) dBm		
(19a) Required SNR for the control channel (dB)		
(19b) Required SNR for the data channel (dB)		
(20) Receiver implementation margin (dB)		
(21a) H-ARQ gain for control channel (dB)		
(21b) H-ARQ gain for data channel (dB)		

TABLE 3 (*end*)

Item	Downlink	Uplink
(22a) Receiver sensitivity for control channel = (18) + (19a) + (20) – (21a) dBm		
(22b) Receiver sensitivity for data channel = (18) + (19b) + (20) – (21b) dBm		
(23a) Hardware link budget for control channel = (9a) + (11) – (22a) dB		
(23b) Hardware link budget for data channel = (9b) + (11) – (22b) dB		
Calculation of available pathloss		
(24) Lognormal shadow fading std deviation (dB)		
(25) Shadow fading margin (function of the cell area reliability and (24)) (dB)		
(26) BS selection/macro-diversity gain (dB)		
(27) Penetration margin (dB)		
(28) Other gains (dB) (if any please specify)		
(29a) Available path loss for control channel = (23a) – (25) + (26) – (27) + (28) – (12) dB		
(29b) Available path loss for data channel = (23b) – (25) + (26) – (27) + (28) – (12) dB		
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)		
(30b) Maximum range for data channel (based on (29b) and according to the system configuration section of the link budget) (m)		
(31a) Coverage Area for control channel = (π (30a)^2) (m^2/site)		
(31b) Coverage Area for data channel = (π (30b)^2) (m^2/site)		

(1) Cell area reliability is defined as the percentage of the cell area over which coverage can be guaranteed. It is obtained from the cell edge reliability, shadow fading standard deviation and the path loss exponent. The latter two values are used to calculate a fade margin. Macro diversity gain may be considered explicitly and improve the system margin or implicitly by reducing the fade margin.

(2) The spectral efficiency of the chosen modulation scheme.

(3) The pathloss models are summarized in § 9.1 of Report ITU-R M.2412-0.

TABLE 4

Link budget template for Urban Macro–mMTC

Item	Downlink	Uplink
System configuration		
Carrier frequency (GHz)	0.7	0.7
BS antenna heights (m)	25	25
UE antenna heights (m)	1.5	1.5
Cell area reliability(1) (%) (Please specify how it is calculated.)		
Transmission bit rate for control channel (bit/s)		
Transmission bit rate for data channel (bit/s)		
Target packet error ratio for the required SNR in item (19a) for control channel		
Target packet error ratio for the required SNR in item (19b) for data channel		
Spectral efficiency(2) (bit/s/Hz)		
Pathloss model(3) (Select from LOS, NLOS or O-to-I)		
UE speed (km/h)		
Feeder loss (dB)		
Transmitter		
(1) Number of transmit antennas (The number shall be within the indicated range in § 8.4 of Report ITU-R M.2412-0)		
(2) Maximal transmit power per antenna (dBm)		
(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)		
(4) Transmitter antenna gain (dBi)		
(5) Transmitter array gain (depends on transmitter array configurations and technologies such as adaptive beam forming, CDD (Cyclic delay diversity), etc.) (dB)		
(6) Control channel power boosting gain (dB)		
(7) Data channel power loss due to pilot/control boosting (dB)		
(8) Cable, connector, combiner, body losses, etc. (enumerate sources) (dB) (feeder loss must be included for and only for downlink)		
(9a) Control channel e.i.r.p. = (3) + (4) + (5) + (6) – (8) dBm		
(9b) Data channel e.i.r.p. = (3) + (4) + (5) – (7) – (8) dBm		
Receiver		
(10) Number of receive antennas (The number shall be within the indicated range in § 8.4 of Report ITU-R M.2412-0)		
(11) Receiver antenna gain (dBi)		
(12) Cable, connector, combiner, body losses, etc. (enumerate sources) (dB) (feeder loss must be included for and only for uplink)		

TABLE 4 (*continued*)

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

TABLE 4 (*end*)

Item	Downlink	Uplink
(31a) Coverage Area for control channel = (π (30a)^2) (m^2/site)		
(31b) Coverage Area for data channel = (π (30b)^2) (m^2/site)		

(1) Cell area reliability is defined as the percentage of the cell area over which coverage can be guaranteed. It is obtained from the cell edge reliability, shadow fading standard deviation and the path loss exponent. The latter two values are used to calculate a fade margin. Macro diversity gain may be considered explicitly and improve the system margin or implicitly by reducing the fade margin.

(2) The spectral efficiency of the chosen modulation scheme.

(3) The pathloss models are summarized in § 9.1 of Report ITU-R M.2412-0.

TABLE 5

Link budget template for Urban Macro–URLLC

Item	Downlink	Uplink
System configuration		
Carrier frequency (GHz)	0.7 or 4	0.7 or 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)		
Transmission bit rate for data channel (bit/s)		
Target packet error ratio for the required SNR in item (19a) for control channel		
Target packet error ratio for the required SNR in item (19b) for data channel		
Spectral efficiency(2) (bit/s/Hz)		
Pathloss model(3) (Select from LOS, NLOS or O-to-I)		
UE speed (km/h)		
Feeder loss (dB)		
Transmitter		
(1) Number of transmit antennas (The number shall be within the indicated range in § 8.4 of Report ITU-R M.2412-0)		
(2) Maximal transmit power per antenna (dBm)		
(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)		
(4) Transmitter antenna gain (dBi)		
(5) Transmitter array gain (depends on transmitter array configurations and technologies such as adaptive beam forming, CDD (cyclic delay diversity), etc.) (dB)		

TABLE 5 (*continued*)

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

TABLE 5 (*end*)

Item	Downlink	Uplink
(26) BS selection/macro-diversity gain (dB)		
(27) Penetration margin (dB)		
(28) Other gains (dB) (if any please specify)		
(29a) Available path loss for control channel = (23a) – (25) + (26) – (27) + (28) – (12) dB		
(29b) Available path loss for data channel = (23b) – (25) + (26) – (27) + (28) – (12) dB		
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)		
(30b) Maximum range for data channel (based on (29b) and according to the system configuration section of the link budget) (m)		
(31a) Coverage Area for control channel = (π (30a)^2) (m^2/site)		
(31b) Coverage Area for data channel = (π (30b)^2) (m^2/site)		

(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.

5.2.4 RIT/SRIT compliance templates

This section provides templates for the responses that are needed to assess the compliance of a candidate RIT or SRIT with the minimum requirements of IMT-2020.

The compliance templates are:

– Compliance template for services;

– Compliance template for spectrum; and,

– Compliance template for technical performance.

5.2.4.1 Compliance template for services[3]

	Service capability requirements	Evaluator's comments
5.2.4.1.1	**Support for wide range of services** Is the proposal able to support a range of services across different usage scenarios (eMBB, URLLC, and mMTC)?: □YES / □NO Specify which usage scenarios (eMBB, URLLC, and mMTC) the candidate RIT or candidate SRIT can support.(1)	

(1) Refer to the process requirements in IMT-2020/2.

5.2.4.2 Compliance template for spectrum[3]

	Spectrum capability requirements
5.2.4.2.1	**Frequency bands identified for IMT** Is the proposal able to utilize at least one frequency band identified for IMT in the ITU Radio Regulations?: □ YES / □ NO Specify in which band(s) the candidate RIT or candidate SRIT can be deployed.
5.2.4.2.2	**Higher Frequency range/band(s)** Is the proposal able to utilize the higher frequency range/band(s) above 24.25 GHz?: □YES / □ NO Specify in which band(s) the candidate RIT or candidate SRIT can be deployed. NOTE 1 – In the case of the candidate SRIT, at least one of the component RITs need to fulfil this requirement.

5.2.4.3 Compliance template for technical performance[3]

Minimum technical performance requirements item (5.2.4.3.x), units, and Report ITU-R M.2410-0 section reference(1)	**Category**			**Required value**	**Value(2)**	**Requirement met?**	**Comments (3)**
	Usage scenario	**Test environment**	**Downlink or uplink**				
5.2.4.3.1 Peak data rate (Gbit/s) *(4.1)*	eMBB	Not applicable	Downlink	20		□ Yes □ No	
			Uplink	10		□ Yes □ No	

[3] If a proponent determines that a specific question does not apply, the proponent should indicate that this is the case and provide a rationale for why it does not apply.

Minimum technical performance requirements item (5.2.4.3.x), units, and Report ITU-R M.2410-0 section reference[1]	Category			Required value	Value[2]	Requirement met?	Comments[3]
	Usage scenario	Test environment	Downlink or uplink				
5.2.4.3.2 Peak spectral efficiency (bit/s/Hz) *(4.2)*	eMBB	Not applicable	Downlink	30		☐ Yes ☐ No	
			Uplink	15		☐ Yes ☐ No	
5.2.4.3.3 User experienced data rate (Mbit/s) *(4.3)*	eMBB	Dense Urban – eMBB	Downlink	100		☐ Yes ☐ No	
			Uplink	50		☐ Yes ☐ No	
5.2.4.3.4 5th percentile user spectral efficiency (bit/s/Hz) *(4.4)*	eMBB	Indoor Hotspot – eMBB	Downlink	0.3		☐ Yes ☐ No	
			Uplink	0.21		☐ Yes ☐ No	
	eMBB	Dense Urban – eMBB	Downlink	0.225		☐ Yes ☐ No	
			Uplink	0.15		☐ Yes ☐ No	
	eMBB	Rural – eMBB	Downlink	0.12		☐ Yes ☐ No	
			Uplink	0.045		☐ Yes ☐ No	
5.2.4.3.5 Average spectral efficiency (bit/s/Hz/ TRxP) *(4.5)*	eMBB	Indoor Hotspot – eMBB	Downlink	9		☐ Yes ☐ No	
			Uplink	6.75		☐ Yes ☐ No	
	eMBB	Dense Urban – eMBB	Downlink	7.8		☐ Yes ☐ No	
			Uplink	5.4		☐ Yes ☐ No	
	eMBB	Rural – eMBB	Downlink	3.3		☐ Yes ☐ No	
						☐ Yes ☐ No	
			Uplink	1.6		☐ Yes ☐ No	
						☐ Yes ☐ No	
5.2.4.3.6 Area traffic capacity (Mbit/s/m^2) *(4.6)*	eMBB	Indoor-Hotspot – eMBB	Downlink	10		☐ Yes ☐ No	

Minimum technical performance requirements item (5.2.4.3.x), units, and Report ITU-R M.2410-0 section reference[1]	Category			Required value	Value[2]	Requirement met?	Comments[3]
	Usage scenario	Test environment	Downlink or uplink				
5.2.4.3.7 User plane latency (ms) *(4.7.1)*	eMBB	Not applicable	Uplink and Downlink	4		☐ Yes ☐ No	
	URLLC	Not applicable	Uplink and Downlink	1		☐ Yes ☐ No	
5.2.4.3.8 Control plane latency (ms) *(4.7.2)*	eMBB	Not applicable	Not applicable	20		☐ Yes ☐ No	
	URLLC	Not applicable	Not applicable	20		☐ Yes ☐ No	
5.2.4.3.9 Connection density (devices/km^2) *(4.8)*	mMTC	Urban Macro – mMTC	Uplink	1 000 000		☐ Yes ☐ No	
5.2.4.3.10 Energy efficiency *(4.9)*	eMBB	Not applicable	Not applicable	Capability to support a high sleep ratio and long sleep duration		☐ Yes ☐ No	
5.2.4.3.11 Reliability *(4.10)*	URLLC	Urban Macro –URLLC	Uplink or Downlink	1-10^{-5} success probability of transmitting a layer 2 PDU (protocol data unit) of size 32 bytes within 1 ms in channel quality of coverage edge		☐ Yes ☐ No	
5.2.4.3.12 Mobility classes *(4.11)*	eMBB	Indoor Hotspot – eMBB	Uplink	Stationary, Pedestrian		☐ Yes ☐ No	
	eMBB	Dense Urban – eMBB	Uplink	Stationary, Pedestrian, Vehicular (up to 30 km/h)		☐ Yes ☐ No	
	eMBB	Rural – eMBB	Uplink	Pedestrian, Vehicular, High speed vehicular		☐ Yes ☐ No	

Minimum technical performance requirements item (5.2.4.3.x), units, and Report ITU-R M.2410-0 section reference[1]	Category			Required value	Value[2]	Requirement met?	Comments [3]
	Usage scenario	Test environment	Downlink or uplink				
5.2.4.3.13 Mobility Traffic channel link data rates (bit/s/Hz) *(4.11)*	eMBB	Indoor Hotspot – eMBB	Uplink	1.5 (10 km/h)		☐ Yes ☐ No	
	eMBB	Dense Urban – eMBB	Uplink	1.12 (30 km/h)		☐ Yes ☐ No	
	eMBB	Rural – eMBB	Uplink	0.8 (120 km/h)		☐ Yes ☐ No	
				0.45 (500 km/h)		☐ Yes ☐ No	
5.2.4.3.14 Mobility interruption time (ms) *(4.12)*	eMBB and URLLC	Not applicable	Not applicable	0		☐ Yes ☐ No	
5.2.4.3.15 Bandwidth and Scalability *(4.13)*	Not applicable	Not applicable	Not applicable	At least 100 MHz		☐ Yes ☐ No	
				Up to 1 GHz		☐ Yes ☐ No	
				Support of multiple different bandwidth values[4]		☐ Yes ☐ No	

(1) As defined in Report ITU-R M.2410-0.

(2) According to the evaluation methodology specified in Report ITU-R M.2412-0.

(3) Proponents should report their selected evaluation methodology of the Connection density, the channel model variant used, and evaluation configuration(s) with their exact values (e.g. antenna element number, bandwidth, etc.) per test environment, and could provide other relevant information as well. For details, refer to Report ITU-R M.2412-0, in particular, § 7.1.3 for the evaluation methodologies, § 8.4 for the evaluation configurations per each test environment, and Annex 1 on the channel model variants.

(4) Refer to § 7.3.1 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

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
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.