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| **Radiocommunication Study Groups** |  |
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| Received: 10 February 2020 | **Document 5D/49-E** |
| **10 February 2020** |
| **English only  TECHNOLOGY ASPECTS** |
| Director, Radiocommunication Bureau[[1]](#footnote-1) | |
| Evaluation of IMT-2020 candidate technology by TTA spg33 | |
|  | |

# 1 Introduction

The period from October 2018 (the 31st meeting of Working Party 5D) to February 2020 (the 34th meeting of Working Party 5D) has been designated for the evaluation of the IMT-2020 candidate technology submissions by Independent Evaluation Groups. The TTA SPG33 is a registered Independent Evaluation Group.

# 2 Proposal

At the 33rd meeting of Working Party 5D, TTA SPG33 submitted an interim evaluation report on IMT-2020 candidate technology submission in document IMT-2020/3. At the 34th meeting of Working Party 5D, TTA SPG33 would like to submit the final evaluation report on the same technology submission

**Attachment**: 1

Attachment

evaluation report on 3GPP 5G NR RIT

Part I

Administrative aspects of the Independent Evaluation Group

# I.1 Name of the independent evaluation group

Telecommunications Technology Association Special Project Group 33 (TTA SPG33).

# I.2 Background of the TTA SPG33

In order to promote the development and early deployment of 5G technology, a special technical committee (STC3) was formed under the Telecommunications Technology Association (TTA) in July 2017. STC3 consists of five special project groups and one of them (TTA SPG33) is responsible for the evaluation of IMT-2020 candidate technology submitted in ITU-R WP 5D. TTA SPG33 was registered as an independent evaluation group right after its establishment.

Like other technical committee and project groups in TTA, TTA SPG33 consists of individual members representing mobile industry, academia and research institute.

# I.3 Method of Work

Since the establishment of TTA SPG33 in July 2017, our meetings have been held on a regular basis – four-to-five times a year. Agenda for the meeting include, information sharing on the ITU-R WP 5D activity focused on the candidate technology submission and evaluation, review of liaison statements from ITU-R WP 5D, discussion of evaluation report development and so on. We also held open workshops in October 2017 and 2018 to share our progress and get some feedback from the audience.

We have actively participated in the evaluation discussion in ITU-R WP 5D and CJK (China-Japan-Korea) IMT Evaluation Special Interest Group. Our activity updates have been presented as contributions in both meetings.

Our evaluation report is made based on the contributions from members. The members who contribute to the evaluation report are:

* Korea University
* Ericsson
* Intel
* LG Electronics
* Nokia
* Qualcomm
* Samsung Electronics

TTA SPG33 submits the final evaluation report in February 2020 and will continue its evaluation activity until the end of IMT-2020 development process.

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Part II

Technical aspects of the work of the Independent Evaluation Group

# II.1 Evaluated candidate IMT-2020 RIT/SRIT

This contribution is the final evaluation report on the submissions in Docs. [IMT-2020/3](https://www.itu.int/md/R15-IMT.2020-C-0003/en), “3GPP 5G NR RIT” and its following revisions.

# II.2 Utilization of ITU-R documents

TTA SPG33 confirms that the evaluation report in this contribution is conducted according to the evaluation guideline described in Report ITU‑R M.2412 [3] and the results are compared against the minimum technical requirements described in Report ITU‑R M.2410 [1].

# II.3 Documentation of any additional evaluation methodologies

One of the members in TTA SPG33, Korea University, has provided system-level simulation (SLS) source codes and the description of the source code usage including SLS tutorial presentation. These can be found at its website (wnl.korea.ac.kr/evaluation.html), which has been informed by the earlier contribution from TTA SPG33. It should be noted that the provision of source code and the related material is solely the best effort from Korea University, but it is not of the TTA SPG33 nor the results from the provided source code and methodology.

# II.4 Verification

TTA SPG33 checks that the technology submissions in Documents [IMT‑2020/3](https://www.itu.int/md/R15-IMT.2020-C-0003/en), “3GPP 5G NR RIT” and its following revisions include complete compliance templates for service, spectrum and technical performance as specified in Chapter 4.2.4 of Report ITU-R M.2411 [2].

# II.5 Assessment

This section summarizes the evaluation by TTA SPG33. Detailed evaluation results can be found as an embedded document shown in conclusion.

## II.5.1 Compliance template for service

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| --- | --- | --- |
|  | Service capability requirements | TTA SPG33’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) | 3GPP 5G NR RIT supports all three usage scenarios. |
| (1) Refer to the process requirements in IMT-2020/2. | | |

## II.5.2 Compliance template for spectrum

|  |  |  |
| --- | --- | --- |
|  | Spectrum capability requirements | TTA SPG33’s comments |
| **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. | 3GPP 5G NR utilizes frequency band identified for IMT in the ITU Radio Regulations from TS38.101-1/2 and TS38.104. |
| **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. | 3GPP 5G NR utilizes frequency band above 24.25 GHz from TS38.101-2 and 38.104. |

## II.5.3 Compliance template for technical performance

| 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 | >20 | 🗹 Yes  No |  |
| Uplink | 10 | >10 | 🗹 Yes  No |
| **5.2.4.3.2** Peak spectral efficiency (bit/s/Hz) *(4.2)* | eMBB | Not applicable | Downlink | 30 | >30 | 🗹 Yes  No |  |
| Uplink | 15 | >15 | 🗹 Yes  No |
| **5.2.4.3.3** User experienced data rate (Mbit/s) *(4.3)* | eMBB | Dense Urban – eMBB | Downlink | 100 | >100 | 🗹 Yes  No |  |
| Uplink | 50 | > 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 | > 0.33 | 🗹 Yes  No |  |
| Uplink | 0.21 | > 0.3 | 🗹 Yes  No |
| eMBB | Dense Urban – eMBB | Downlink | 0.225 | > 0.289 | 🗹 Yes  No |  |
| Uplink | 0.15 | > 0.163 | 🗹 Yes  No |
| eMBB | Rural – eMBB | Downlink | 0.12 | > 0.12 | 🗹 Yes  No |  |
| Uplink | 0.045 | > 0.073 | 🗹 Yes  No |
| **5.2.4.3.5** Average spectral efficiency (bit/s/Hz/ TRxP) *(4.5)* | eMBB | Indoor Hotspot – eMBB | Downlink | 9 | > 9.8 | 🗹 Yes  No |  |
| Uplink | 6.75 | > 6.9 | 🗹 Yes  No |
| eMBB | Dense Urban – eMBB | Downlink | 7.8 | > 8.966 | 🗹 Yes  No |  |
| Uplink | 5.4 | > 5.513 | 🗹 Yes  No |
| eMBB | Rural – eMBB | Downlink | 3.3 | > 9.7 | 🗹 Yes  No |  |
| > 5.4 | 🗹 Yes  No | LMLC |
| Uplink | 1.6 | > 3.52 | 🗹 Yes  No |  |
| > 4.7 | 🗹 Yes  No | LMLC |
| **5.2.4.3.6** Area traffic capacity (Mbit/s/m2) *(4.6)* | eMBB | Indoor-Hotspot – eMBB | Downlink | 10 | >10 | 🗹 Yes  No |  |
| **5.2.4.3.7** User plane latency (ms) *(4.7.1)* | eMBB | Not applicable | Uplink and Downlink | 4 | < 4 | 🗹 Yes  No |  |
| URLLC | Not applicable | Uplink and Downlink | 1 | < 1 | 🗹 Yes  No |  |
| **5.2.4.3.8** Control plane latency (ms) *(4.7.2)* | eMBB | Not applicable | Not applicable | 20 | < 20 | 🗹 Yes  No |  |
| URLLC | Not applicable | Not applicable | 20 | < 20 | 🗹 Yes  No |  |
| **5.2.4.3.9** Connection density (devices/km2) *(4.8)* | mMTC | Urban Macro – mMTC | Uplink | 1 000 000 | > 1,269,767 | 🗹 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 | Have the capability | 🗹 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 | It can be supported | 🗹 Yes  No |  |
| **5.2.4.3.12** Mobility classes *(4.11)* | eMBB | Indoor Hotspot – eMBB | Uplink | Stationary, Pedestrian | Supported | 🗹 Yes  No |  |
| eMBB | Dense Urban – eMBB | Uplink | Stationary, Pedestrian,  Vehicular (up to 30 km/h) | Supported | 🗹 Yes  No |  |
| eMBB | Rural – eMBB | Uplink | Pedestrian, Vehicular, High speed vehicular | Supported | 🗹 Yes  No |  |
| **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) | > 1.5 | 🗹 Yes  No |  |
| eMBB | Dense Urban – eMBB | Uplink | 1.12 (30 km/h) | > 1.28 | 🗹 Yes  No |  |
| eMBB | Rural – eMBB | Uplink | 0.8 (120 km/h) | > 0.8 | 🗹 Yes  No |  |
| 0.45 (500 km/h) | > 0.68 | 🗹 Yes  No |  |
| **5.2.4.3.14** Mobility interruption time (ms)  *(4.12)* | eMBB and URLLC | Not applicable | Not applicable | 0 | 0 ms can be achieved | 🗹 Yes  No |  |
| **5.2.4.3.15** Bandwidth and Scalability *(4.13)* | Not applicable | Not applicable | Not applicable | At least 100 MHz | > 100 MHz is supported | 🗹 Yes  No |  |
| Up to 1 GHz | > 1GHz supported using 16 CA | 🗹 Yes  No |  |
| Support of multiple different bandwidth values(4) | Scalable | 🗹 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. | | | | | | | |

# II.6 Questions and Feedback to WP 5D and/or the proponents or other Independent Evaluation Groups

TTA SPG33 will keep exchanging evaluation related information with proponents and other IEGs until the end of IMT-2020 development process.

PartIII

Conclusion

# Annex 1: Details of evaluation report

Details of technical performance evaluation



# Annex 2: Details of simulation configurations

Simulation configuration tables



# Annex 3: Details of calibration information

Calibration results



# References

[1] Report [ITU-R M.2410](https://www.itu.int/en/publications/ITU-R/pages/publications.aspx?parent=R-REP-M.2410), “Minimum requirements related to technical performance for IMT-2020 radio interface(s)”, 2017.

[2] Report [ITU-R M.2411](https://www.itu.int/en/publications/ITU-R/pages/publications.aspx?parent=R-REP-M.2411), “Requirements, evaluation criteria and submission template for the development of IMT-2020”, 2017.

[3] Report [ITU-R M.2412](https://www.itu.int/en/publications/ITU-R/pages/publications.aspx?parent=R-REP-M.2412), “Guidelines for evaluation of radio interface technologies for IMT-2020”, 2017.

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1. Submitted on behalf of TTA SPG33. [↑](#footnote-ref-1)