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| **Radiocommunication Study Groups** |  |
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| **4 December 2019** |
| **English only**  **TECHNOLOGY ASPECTS** |
| Director, Radiocommunication Bureau[[1]](#footnote-1) | |
| INITIAL EVALUATION REPORT FROM AEG FOR 3GPP PROPONENT SUBMISSIONS OF SRIT & RIT | |
|  | |

# 1 Introduction

In accordance to the ITU-R Submission, Evaluation Process and Consensus Building for IMT-2020 (Doc. [IMT-2020/2](https://www.itu.int/md/R15-IMT.2020-C-0002/en)), the Africa Evaluation Group (AEG) has been established as an independent evaluation group open to all African administrations, industry and academia. This initial/interim report focuses of the “inspection approach” of the 3GPP proponent submission of the SRIT and RIT. The inspection was conducted by reviewing the functionality and parameter provided by 3GPP. The following were inspected; (1) *energy efficiency*, (2) *bandwidth,* (3) *support of wide range of services* and (4) *supported spectrum band(s)/range(s).*

This preliminary submission covers only items labelled “Inspection” in Table 1 *“Summary of evaluation methodologies*” of Report ITU-R M.2412-0. The assessment criteria from Reports ITU‑R M.2410-0 (11/2017), ITU-R M.2411-0 (11/2017) and ITU-R M.2412-0 (10/2017) have been followed.

Work is in progress to expand the evaluation for further submission in time for the 34th Working Party 5D meeting to include items labelled “Analytical” in Table 1 of Report ITU-R M.2412-0.

# 2 Evaluation of Technical Performance Requirements (TPR)

This section evaluates TPR and Other Requirements via “inspection” of the 3GPP submission for IMT-2020.

## 2.1 Energy Efficiency

This requirement is defined for the purpose of evaluation in the eMBB usage scenario.

Energy efficiency describes how the RIT/SRIT supports a high sleep ratio and long sleep duration. It describes other mechanisms of the RIT/SRIT that improve the support of energy efficiency operation for both network and device.

| Minimum technical performance requirements item (5.2.4.3.x), units, and Report ITU-R M.2410-0 section reference | Category | | | Required value | Value(2) | Requirement met? | Comments(3) |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Usage scenario | Test environment | Downlink or uplink |
| **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** | See notes below |

From the characteristics template for 3GPP 5G SRIT, subsection 5.2.3.2.25:

**For NR:**

**Network efficiency:** SS/PBCK block transmission intervals can be configured. Longer periods result in greater energy efficiency, with longer cell detection time. During operation, intervals of between 5 and 160 ms can be agreed between cell and device.

**Device efficiency:** Discontinuous reception (DRX) is available on devices, to reduce duty cycle. Bandwidth adaptation and RRC-Inactive state provide further power reduction.

**For LTE:**

Network efficiency: Certain cells can be deactivated under low-demand conditions to save energy.

Device efficiency: Device efficiency: Discontinuous reception (DRX) is available on devices, to reduce duty cycle. Extended DRX in idle mode further reduces duty cycle, with a maximum duration of approximately three hours. There is also an idle mode, where the device only wakes up when an uplink transmission is required.

**From Document TR37.910:**

This document provides a self-evaluation by 3GPP. Energy efficiency is addressed in Section 8.

**For NR:**

**Network efficiency:** Their sleep ratio analysis for unloaded networks lists figures of 80 to 99,38% at slot level and to 99,64% at symbol level. Typically, the sleep ratio increases with increased frame period.

**Device efficiency:** In connected mode, sleep ratios of 84 to 95% are shown, with longer sleep cycles resulting in lower sleep ratios. Sleep duration of up to 10,2 s is possible.

**For LTE:**

**Network efficiency:** Sleep duration of up to 39 ms is possible. Sleep ratios at subframe level are listed as 80 and 94% as a function of the cell type, with MBMS-only cells providing higher sleep ratios in this case.

**Device efficiency:** At subframe level, sleep ratios vary from 93 to 99% in idle and 84 to 96% in connected mode. In idle, longer paging cycles result in higher sleep ratios, while in connected mode, there is no simple relationship between paging cycle and sleep ratio. Again, the maximum paging cycle is 10,2 s.

The energy efficiency for both network and device is verified by inspection by demonstrating that the candidate RITs/SRITs can support high sleep ratio and long sleep duration as defined in Report ITU‑R M.2410-0 when there is no data.

Inspection can also be used to describe other mechanisms of the candidate RITs/SRITs that improve energy efficient operation for both network and device.

## 2.2 Bandwidth

| 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 |  |  |  |  |
| **5.2.4.3.15** Bandwidth and Scalability *(4.13)* | Not applicable | Not applicable | Not applicable | At least 100 MHz |  | Yes | See notes below. |
| Up to 1 GHz |  | NR: Yes LTE: No |
| Support of multiple different bandwidth values(4) |  | Yes |

From the characteristics template for 3GPP 5G SRIT, subsection 5.2.3.2.8.2:

**For NR:**

NR supports multiple non-contiguous data carriers with bandwidth of between 5 and 100 MHz in the 450 MHz to 6 GHz range, and up to 400 MHz in the 24,25 to 52,6 GHz range.

Aggregated carriers can support bandwidths of up to 6,4 GHz.

Aggregation can change in real time, making bandwidth fully scalable.

**For LTE:**

Scalable bandwidth from 1,4 to 20 MHz. Aggregation can produce bandwidth up to 640 MHz.

For NB-IoT, bandwidth is not scalable.

For eMTC, bandwidth is scalable up to 20 MHz.

## 2.3 Support of wide range of services

|  |  |  |
| --- | --- | --- |
|  | 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** | The 3GPP proposal claims full compliance with all three usage scenarios. See quote below from Doc. 5D/1216. |

**For Component RIT: NR** (ITU-R criteria: Fulfils at least 2 test environments)

TABLE 4

(Source Report ITU-R M.2412)

Mapping of test environments and usage scenarios

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Usage Scenarios** | **eMBB** | | | **mMTC** | **URLLC** |
| **Test Environments** | **Indoor Hotspot – eMBB** | **Dense Urban – eMBB** | **Rural – eMBB** | **Urban Macro – mMTC** | **Urban Macro – URLLC** |
| ***COMPONENT RIT: NR*** | *fulfils* | *fulfils* | *fulfils* | *fulfils* | *fulfils* |

**For Component RIT: E-UTRA/LTE** (ITU-R Criteria: Fulfils at least 2 test environments)

TABLE 4

(Source Report ITU-R M.2412)

Mapping of test environments and usage scenarios

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Usage Scenarios** | **eMBB** | | | **mMTC** | **URLLC** |
| **Test Environments** | **Indoor Hotspot – eMBB** | **Dense Urban – eMBB** | **Rural – eMBB** | **Urban Macro – mMTC** | **Urban Macro – URLLC** |
| ***COMPONENT RIT: E-UTRA/LTE*** | *fulfils* | *fulfils* | *fulfils* | *fulfils* | *User plane latency: fulfils (\*)*  *Reliability: not assessed (\*)* |

(\*) Specific requirements for URLLC. The other technical performance requirements for URLLC in LTE (control plane latency and mobility interruption) are fulfilled.

**For Complete SRIT** (ITU-R Criteria: fulfils at least four test environments comprising the three usage scenarios)

TABLE 4

(Source Report ITU-R M.2412)

Mapping of test environments and usage scenarios

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Usage Scenarios** | **eMBB** | | | **mMTC** | **URLLC** |
| **Test Environments** | **Indoor Hotspot – eMBB** | **Dense Urban – eMBB** | **Rural – eMBB** | **Urban Macro – mMTC** | **Urban Macro – URLLC** |
| ***COMPLETE SRIT*** | *fulfils* | *fulfils* | *fulfils* | *fulfils* | *fulfils* |

This 3GPP Proponent submission for IMT-2020 is based upon the following currently in force

## 2.4 Supported Bands/Ranges

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| --- | --- |
|  | 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**  From the submitted Characteristics Template for 3GPP 5G SRIT, section 5.2.3.2.8.3:  **For NR RIT:**  *450-6000 MHz*   |  |  |  |  | | --- | --- | --- | --- | | NR *operating band* | Uplink (UL) *operating band* BS receive / UE transmit  FUL\_low – FUL\_high | Downlink (DL) *operating band* BS transmit / UE receive  FDL\_low – FDL\_high | Duplex Mode | | n1 | 1920 MHz – 1980 MHz | 2110 MHz – 2170 MHz | FDD | | n2 | 1850 MHz – 1910 MHz | 1930 MHz – 1990 MHz | FDD | | n3 | 1710 MHz – 1785 MHz | 1805 MHz – 1880 MHz | FDD | | n5 | 824 MHz – 849 MHz | 869 MHz – 894 MHz | FDD | | n7 | 2500 MHz – 2570 MHz | 2620 MHz – 2690 MHz | FDD | | n8 | 880 MHz – 915 MHz | 925 MHz – 960 MHz | FDD | | n12 | 699 MHz – 716 MHz | 729 MHz – 746 MHz | FDD | | n20 | 832 MHz – 862 MHz | 791 MHz – 821 MHz | FDD | | n25 | 1850 MHz – 1915 MHz | 1930 MHz – 1995 MHz | FDD | | n28 | 703 MHz – 748 MHz | 758 MHz – 803 MHz | FDD | | n34 | 2010 MHz – 2025 MHz | 2010 MHz – 2025 MHz | TDD | | n38 | 2570 MHz – 2620 MHz | 2570 MHz – 2620 MHz | TDD | | n39 | 1880 MHz – 1920 MHz | 1880 MHz – 1920 MHz | TDD | | n40 | 2300 MHz – 2400 MHz | 2300 MHz – 2400 MHz | TDD | | n41 | 2496 MHz – 2690 MHz | 2496 MHz – 2690 MHz | TDD | | n50 | 1432 MHz – 1517 MHz | 1432 MHz – 1517 MHz | TDD | | n51 | 1427 MHz – 1432 MHz | 1427 MHz – 1432 MHz | TDD | | n66 | 1710 MHz – 1780 MHz | 2110 MHz – 2200 MHz | FDD | | n70 | 1695 MHz – 1710 MHz | 1995 MHz – 2020 MHz | FDD | | n71 | 663 MHz – 698 MHz | 617 MHz – 652 MHz | FDD | | n74 | 1427 MHz – 1470 MHz | 1475 MHz – 1518 MHz | FDD | | n75 | N/A | 1432 MHz – 1517 MHz | SDL | | n76 | N/A | 1427 MHz – 1432 MHz | SDL | | n77 | 3300 MHz – 4200 MHz | 3300 MHz – 4200 MHz | TDD | | n78 | 3300 MHz – 3800 MHz | 3300 MHz – 3800 MHz | TDD | | n79 | 4400 MHz – 5000 MHz | 4400 MHz – 5000 MHz | TDD | | n80 | 1710 MHz – 1785 MHz | N/A | SUL | | n81 | 880 MHz – 915 MHz | N/A | SUL | | n82 | 832 MHz – 862 MHz | N/A | SUL | | n83 | 703 MHz – 748 MHz | N/A | SUL | | n84 | 1920 MHz – 1980 MHz | N/A | SUL | | n86 | 1710 MHz – 1780 MHz | N/A | SUL |   **For LTE RIT:**  *450-6000 MHz*   | LTE (E‑UTRA) Operating Band | | Uplink (UL) operating band BS receive UE transmit | | | | | Downlink (DL) operating band BS transmit  UE receive | | | | | Duplex Mode | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | FUL\_low – FUL\_high | | | | | FDL\_low – FDL\_high | | | | | | 1 | | 1920 MHz | | – | | 1980 MHz | 2110 MHz | | – | | 2170 MHz | FDD | | 2 | | 1850 MHz | | – | | 1910 MHz | 1930 MHz | | – | | 1990 MHz | FDD | | 3 | | 1710 MHz | | – | | 1785 MHz | 1805 MHz | | – | | 1880 MHz | FDD | | 4 | | 1710 MHz | | – | | 1755 MHz | 2110 MHz | | – | | 2155 MHz | FDD | | 5 | | 824 MHz | | – | | 849 MHz | 869 MHz | | – | | 894MHz | FDD | | 61 | | 830 MHz | | – | | 840 MHz | 875 MHz | | – | | 885 MHz | FDD | | 7 | | 2500 MHz | | – | | 2570 MHz | 2620 MHz | | – | | 2690 MHz | FDD | | 8 | | 880 MHz | | – | | 915 MHz | 925 MHz | | – | | 960 MHz | FDD | | 9 | | 1749.9 MHz | | – | | 1784.9 MHz | 1844.9 MHz | | – | | 1879.9 MHz | FDD | | 10 | | 1710 MHz | | – | | 1770 MHz | 2110 MHz | | – | | 2170 MHz | FDD | | 11 | | 1427.9 MHz | | – | | 1447.9 MHz | 1475.9 MHz | | – | | 1495.9 MHz | FDD | | 12 | | 699 MHz | | – | | 716 MHz | 729 MHz | | – | | 746 MHz | FDD | | 13 | | 777 MHz | | – | | 787 MHz | 746 MHz | | – | | 756 MHz | FDD | | 14 | | 788 MHz | | – | | 798 MHz | 758 MHz | | – | | 768 MHz | FDD | | 17 | | 704 MHz | | – | | 716 MHz | 734 MHz | | – | | 746 MHz | FDD | | 18 | | 815 MHz | | – | | 830 MHz | 860 MHz | | – | | 875 MHz | FDD | | 19 | | 830 MHz | | – | | 845 MHz | 875 MHz | | – | | 890 MHz | FDD | | 20 | | 832 MHz | | – | | 862 MHz | 791 MHz | | – | | 821 MHz | FDD | | 21 | | 1447.9 MHz | | – | | 1462.9 MHz | 1495.9 MHz | | – | | 1510.9 MHz | FDD | | 22 | | 3410 MHz | | – | | 3490 MHz | 3510 MHz | | – | | 3590 MHz | FDD | | 231 | | 2000 MHz | | – | | 2020 MHz | 2180 MHz | | – | | 2200 MHz | FDD | | 24 | | 1626.5 MHz | | – | | 1660.5 MHz | 1525 MHz | | – | | 1559 MHz | FDD | | 25 | | 1850 MHz | | – | | 1915 MHz | 1930 MHz | | – | | 1995 MHz | FDD | | 26 | | 814 MHz | | – | | 849 MHz | 859 MHz | | – | | 894 MHz | FDD | | 27 | | 807 MHz | | – | | 824 MHz | 852 MHz | | – | | 869 MHz | FDD | | 28 | | 703 MHz | | – | | 748 MHz | 758 MHz | | – | | 803 MHz | FDD | | 29 | | N/A | | | | | 717 MHz | | – | | 728 MHz | FDD1 | | 3015 | | 2305 MHz | | – | | 2315 MHz | 2350 MHz | | – | | 2360 MHz | FDD | | 31 | | 452.5 MHz | | – | | 457.5 MHz | 462.5 MHz | | – | | 467.5 MHz | FDD | | 32 | |  | | N/A | |  | 1452 MHz | | – | | 1496 MHz | FDD1 | | 33 | | 1900 MHz | | – | | 1920 MHz | 1900 MHz | | – | | 1920 MHz | TDD | | 34 | | 2010 MHz | | – | | 2025 MHz | 2010 MHz | | – | | 2025 MHz | TDD | | 35 | | 1850 MHz | | – | | 1910 MHz | 1850 MHz | | – | | 1910 MHz | TDD | | 36 | | 1930 MHz | | – | | 1990 MHz | 1930 MHz | | – | | 1990 MHz | TDD | | 37 | | 1910 MHz | | – | | 1930 MHz | 1910 MHz | | – | | 1930 MHz | TDD | | 38 | | 2570 MHz | | – | | 2620 MHz | 2570 MHz | | – | | 2620 MHz | TDD | | 39 | | 1880 MHz | | – | | 1920 MHz | 1880 MHz | | – | | 1920 MHz | TDD | | 40 | | 2300 MHz | | – | | 2400 MHz | 2300 MHz | | – | | 2400 MHz | TDD | | 41 | | 2496 MHz | |  | | 2690 MHz | 2496 MHz | |  | | 2690 MHz | TDD | | 42 | | 3400 MHz | | – | | 3600 MHz | 3400 MHz | | – | | 3600 MHz | TDD | | 43 | | 3600 MHz | | – | | 3800 MHz | 3600 MHz | | – | | 3800 MHz | TDD | | 44 | | 703 MHz | | – | | 803 MHz | 703 MHz | | – | | 803 MHz | TDD | | 45 | | 1447 MHz | | – | | 1467 MHz | 1447 MHz | | – | | 1467 MHz | TDD | | 46 | | 5150 MHz | | – | | 5925 MHz | 5150 MHz | | – | | 5925 MHz | TDD1 | | 47 | | 5855 MHz | | – | | 5925 MHz | 5855 MHz | | – | | 5925 MHz | TDD1 | | 48 | | 3550 MHz | | – | | 3700 MHz | 3550 MHz | | – | | 3700 MHz | TDD | | 49 | | 3550 MHz | | – | | 3700 MHz | 3550 MHz | | – | | 3700 MHz | TDD1 | | 50 | | 1432 MHz | | - | | 1517 MHz | 1432 MHz | | - | | 1517 MHz | TDD1 | | 51 | | 1427 MHz | | - | | 1432 MHz | 1427 MHz | | - | | 1432 MHz | TDD1 | | 52 | | 3300 MHz | | - | | 3400 MHz | 3300 MHz | | - | | 3400 MHz | TDD | | 65 | 1920 MHz | | – | | 2010 MHz | | 2110 MHz | – | | 2200 MHz | | FDD | | 66 | 1710 MHz | | – | | 1780 MHz | | 2110 MHz | – | | 2200 MHz | | FDD1 | | 67 |  | | N/A | |  | | 738 MHz | – | | 758 MHz | | FDD1 | | 68 | 698 MHz | | – | | 728 MHz | | 753 MHz | – | | 783 MHz | | FDD | | 69 | N/A | | | | | | 2570 MHz | – | | 2620 MHz | | FDD1 | | 70 | 1695 MHz | | – | | 1710 MHz | | 1995 MHz | – | | 2020 MHz | | FDD1 | | 71 | 663 MHz | | – | | 698 MHz | | 617 MHz | – | | 652 MHz | | FDD | | 72 | 451 MHz | | – | | 456 MHz | | 461 MHz | – | | 466 MHz | | FDD | | 73 | 450 MHz | | – | | 455 MHz | | 460 MHz | – | | 465 MHz | | FDD | | 74 | 1427 MHz | | – | | 1470 MHz | | 1475 MHz | – | | 1518 MHz | | FDD | | 75 |  | | N/A | |  | | 1432 MHz | – | | 1517 MHz | | FDD1 | | 76 |  | | N/A | |  | | 1427 MHz | – | | 1432 MHz | | FDD1 | | 85 | 698 MHz | | – | | 716 MHz | | 728 MHz | – | | 746 MHz | | FDD | | NOTE 1: See details in Table 8.2.2-1 in TS 36.101. | | | | | | | | | | | | | |
|  | **Note:**  Below is a list of frequencies specifically mentioned in the ITU-R guidance documents, with an assessment of whether or not they are addressed by the submission:   |  |  |  | | --- | --- | --- | | **Band in Regulations** | **Addressed by proposal?** | | | **NR** | **LTE** | | 450-470 MHz | **No** | Yes | | 470-698 MHz | **No** | **No** | | 694/698-960 MHz | Yes | Yes | | 1 427-1 518 MHz | Yes | Yes | | 1 710-2 025 MHz | Yes | Yes | | 2 110-2 200 MHz | Yes | Yes | | 2 300-2 400 MHz | Yes | Yes | | 2 500-2 690 MHz | Yes | Yes | | 3 300-3 400 MHz | Yes | **No** | | 3 400-3 600 MHz | Yes | Yes | | 3 600-3 700 MHz | Yes | Yes | | 4 800-4 990 MHz | Yes | **No** | |
| **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**  From the submitted Characteristics Template for 3GPP 5G SRIT, section 5.2.3.2.8.3:  **For NR RIT:**  *24250-52600 MHz*   |  |  |  | | --- | --- | --- | | NR *operating band* | Uplink (UL) and Downlink (DL) *operating band* BS transmit/receive UE transmit/receive  FUL\_low – FUL\_high  FDL\_low – FDL\_high | Duplex Mode | | n257 | 26500 MHz – 29500 MHz | TDD | | n258 | 24250 MHz – 27500 MHz | TDD | | n260 | 37000 MHz – 40000 MHz | TDD | | n261 | 27500 MHz – 28350 MHz | TDD | |

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1. Submitted on behalf of [Africa Evaluation Group](https://www.itu.int/oth/R0A06000085/en) (AEG). [↑](#footnote-ref-1)