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**APT REPORT ON**

**TRENDS AND SPECTRUM DEVELOPMENTS FOR IMT USAGE IN**

**2025 ~ 2030 IN ASIA-PACIFIC REGION**

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1. Introduction

IMT technologies, such as 5G, enable a wide range of new applications and services that transform all industries and economies, but the sustainable success and effectiveness depend on timely and affordable availability of spectrum.

The focus of this report is on future spectrum of terrestrial component of IMT in the period 2025-2030. To get the most out of 5G, spectrum is needed across low-, mid- and high-bands to deliver widespread coverage and support all use cases.

Low-band spectrum (below 1 GHz) supports wide area coverage and promotes digital equality by giving greater access to mobile broadband services in all areas is important for covering less-populated areas. High-band spectrum (above 24.25 GHz) will be used for the highest capacity, lowest latency applications.

Mid-band spectrum, which lies in the 1-7 GHz range, is necessary for the increases in bandwidth and capacity that 5G applications will require for city-wide coverage. New mobile broadband use cases such as enhanced mobile broadband (eMBB), fixed wireless access (FWA), IoT and Industry 4.0 depend on mid-band spectrum. These use cases will greatly enhance the impact of mobile services on society and economies.

Mid-band spectrum resources include both lower mid-bands (e.g. 1500 MHz, 1800 MHz, 2100 MHz, 2300 MHz and 2600 MHz) and upper mid-bands (e.g. 3.3–3.8 GHz, 4.8–4.99 GHz and 6.425-7.125 GHz).

1.1 WRC-23 outcomes for IMT identification

WRC-23 decided to make new identification to IMT or update existing IMT footnotes at regional/country level in a few frequency bands (or portions thereof), see the detail summary in bands and in Table 1 below.

1. **3.3-3.4 GHz**: 3.3-3.4 GHz is identified for IMT in 8 Region 3 countries, 49 Region 1 countries and in Region 2.
2. **3.6-3.8 GHz:**

* 3.6-3.8 GHz is identified for IMT in a large number countries of Region 1;
* 3.6-3.7 GHz is identified for IMT in Region 2; 3.7-3.8 GHz is identified for IMT in 15 countries / territories in Region 2.

1. **4.8-4.99 GHz**: 4.8-4.99 GHz is identified for IMT in 47 countries from different regions.
2. **6.425-7.125 GHz**:

* 6425-7125 MHz is identified for IMT in Region 1.
* 7025-7125 MHz is identified for IMT in Region 3. The 6425-7025 MHz band is also identified for IMT in three Region 3 countries.
* 6425-7125 MHz is identified for IMT in two Region 2 countries.

1. **10-10.5 GHz**: 10-10.5 GHz is identified for IMT in 12 countries in R2.

**Table 1. The creation/update of IMT footnotes at WRC-23**

|  |  |  |  |
| --- | --- | --- | --- |
| **Band (GHz)** | **Footnotes identifying the band for IMT** | | |
| **Region 1** | **Region 2** | **Region 3** |
| 3 300-3 400 MHz | **5.429B** | **5.429D** | **5.429F** |
| 3 600-3 800 MHz | **5.A13C, 5.A13D** | **5.434, 5.36A12** | **/** |
| 4 800 – 4990 MHz | **5.441B** | | |
| 6 425-7 125MHz | **5.6A12** | **5.6C12** | **5.6A12, 5.6B12** |
| 10-10.5 GHz | **/** | **5.10B12** | **/** |

Note: the number of IMT footnotes in Table 1 should be consistent with ITU Radio Regulations (Edition of 2024).

With WRC-23 decision, the 3.3-3.4 GHz, 4.8-4.99 GHz and 6.425-7.025 GHz frequency bands are identified for IMT in some Region 3 countries. The frequency band 7.025-7.125 GHz is identified for IMT in Region 3. 3GPP has developed the technical specifications for the three bands under band n77&n78, n79, and n104 separately. Some Region 3 countries may consider to make the bands ready for IMT at their national level according to their needs.

Since there is a lead time between the allocation of frequency bands by WRCs and the deployment of systems for IMT bands, WRC-23 further agreed on WRC-27 AI 1.7 to study 4 400-4 800 MHz, 7 125-8 400 MHz and 14.8-15.35 GHz for IMT identification.

Table 2 shows the total amount of spectrum identified for IMT in Region 3 after WRC-23. Figure 1 shows the evolution of IMT spectrum identifications since WARC-92/WRC-97.

Table 2: IMT Spectrum identified as of WRC-23 in Region 3

|  |  |
| --- | --- |
| **Frequency Range** | **Spectrum identified for IMT** |
| Below 1 GHz | 510 MHz |
| 1-7 GHz | 1 976 MHz |
| Above 24.25 GHz | 17.25 GHz |

A graph with different colored bars

Description automatically generated

Figure 1: Total amount of spectrum identified for IMT (Region 3)

The original data used for Figure 1 originates from ITU and aims to present a general overview of the history of IMT identifications at WRCs.

It should be noted that the identifications in the bands above 24.25 GHz were made only by WRC-19 with the amount of spectrum for Region 3 equal to 17 250 MHz. The remaining amount of identified IMT spectrum lies in the bands between 450 MHz and 7 125 MHz.

Figure 1 may not fully represent the IMT harmonization level. Some of the countries in Region 3 have yet to identify some of the frequencies presented in Figure 1. For example, the bands 2 500 – 2 690 MHz (190 MHz) and 6 425 – 7 025 MHz (600 MHz) are both included in the statistics. However, the first band is identified in all countries of Region 3, while the second band is identified in some countries of Region 3 (see Table 1).

1. Questionnaire and Responses from APT Members
   1. Questionnaire

The questionnaire on future spectrum planning for advanced IMT coverage and capacity improvements in 2025 ~ 2030 in Asia Pacific region is available at [AWG-30/OUT-27](https://www.apt.int/sites/default/files/2022/09/AWG-30-OUT-27_Questionnaire_on_future_spectrum_planning_2025-2030...._0.docx)

* 1. Responses received from APT Members

|  |  |  |
| --- | --- | --- |
| **No.** | **Source** | **Input document** |
| 1 | Bhutan (Kingdom of) | [AWG-31/INP-12](https://www.apt.int/sites/default/files/2023/05/AWG-31-INP-12_Bhutan_Response_to_Questionnaire_on_future_spectrum_planning_for_advanced_IMT_coverage_and_capacity_improvements_in_2025__2030_in_Asia_Pacific_region.docx) |
| 2 | Nepal (Federal Democratic Republic of) | [AWG-31/INP-17](https://www.apt.int/sites/default/files/2023/05/AWG-31-INP-17_Nepal_Response_to_Questionnaire_on_future_spectrum_planning_for_advanced_IMT_coverage_and_capacity_improvements_in_2025__2030_in_Asia_Pacific_region.docx) |
| 3 | Thailand (Kingdom of) | [AWG-31/INP-23](https://www.apt.int/sites/default/files/2023/05/AWG-31-INP-23_Thailand_Response_to_Questionnaire_on_future_spectrum_planning_for_advanced_IMT_coverage_and_capacity_improvements_in_2025__2030_in_Asia_Pacific_region.docx) |
| 4 | Palau (Republic of) | [AWG-31/INP-44](https://www.apt.int/sites/default/files/2023/05/AWG-31-INP-44_Palau_Response_to_Questionnaire_on_future_spectrum_planning_for_advanced_IMT_coverage_and_capacity_improvements_in_2025__2030_in_Asia_Pacific_region.docx), [AWG-32/INP-24](https://www.apt.int/sites/default/files/2024/02/AWG-32-INP-24_Response_to_Questionnaire_on_future_spectrum_planning_for_advanced_IMT_coverage_and_capacity_improvements_in_2025-2030_in_Asia-Pacific_region.docx) |
| 5 | Viet Nam (Socialist Republic of) | [AWG-31/INP-83](https://www.apt.int/sites/default/files/2023/05/AWG-31-INP-83_Vietnam_Response_to_Questionnaire_on_future_spectrum_planning_for_advanced_IMT_coverage_and_capacity_improvements_in_2025__2030_in_Asia_Pacific_region.docx) |
| 6 | China (People’s Republic of) | [AWG-31/INP-89](https://www.apt.int/sites/default/files/2023/05/AWG-31-INP-89_China_Response_to_Questionnaire_on_future_spectrum_planning_for_advanced_IMT_coverage_and_capacity_improvements_in_2025__2030_in_Asia_Pacific_region.docx) |
| 7 | Korea (Republic of) | [AWG-31/INP-102](https://www.apt.int/sites/default/files/2023/05/AWG-31-INP-102_Korea_Response_to_Questionnaire_on_future_spectrum_planning_for_advanced_IMT_coverage_and_capacity_improvements_in_2025__2030_in_Asia_Pacific_region.docx) |
| 8 | Sri Lanka (Democratic Socialist Republic of) | [AWG-32/INP-10Rev1](https://www.apt.int/sites/default/files/2024/03/AWG-32-INP-10Rev.1_Response_to_Questionnaire_on_future_spectrum_planning_for_advanced_IMT_coverage_and_capacity_improvements_in_2025-2030_in_Asia-Pacific_region.docx) |
| 9 | Brunei Darussalam | [AWG-32/INP-15](https://www.apt.int/sites/default/files/2024/02/AWG-32-INP-15_Response_to_Questionnaire_on_future_spectrum_planning_for_advanced_IMT_coverage_and_capacity_improvements_in_2025-2030_in_Asia-Pacific_region.pdf) |
| 10 | Pakistan | [AWG-32/INP-19](https://www.apt.int/sites/default/files/2024/02/AWG-32-INP-19_Response_to_Questionnaire_on_future_spectrum_planning_for_advanced_IMT_coverage_and_capacity_improvements_in_2025-2030_in_Asia-Pacific_region.docx) |
| 11 | Nepal (Federal Democratic Republic of) | [AWG-32/INP-30](https://www.apt.int/sites/default/files/2024/02/AWG-32-INP-30_Response_to_Questionnaire_on_future_spectrum_planning_for_advanced_IMT_coverage_and_capacity_improvements_in_2025-2030_in_Asia-Pacific_region.docx) |
| 12 | Indonesia (Republic of) | [AWG-32/INP-35](https://www.apt.int/sites/default/files/2024/02/AWG-32-INP-35_Response_to_Questionnaire_on_future_spectrum_planning_for_advanced_IMT_coverage_and_capacity_improvements_in_2025-2030_in_Asia-Pacific_region.docx) |

* 1. Details of responses
     1. Status of 5G deployment

**Q1:** Has your country deployed 5G services? Please provide the details on 5G services deployment in your country (e.g. in which stage).

**Answers**

|  |  |
| --- | --- |
| Bhutan | Yes. 5G services are currently deployed in selected areas especially in the cities. It is currently Non-Standalone 5G. |
| Nepal | Yes, 5G network has been deployed in Nepal. But the services are in trial phase, such services have not been deployed commercially. |
| Thailand | 5G has been deployed in low band, mid band, and high band spectrum. Low band and mid band are in commercialized stage, but high band is in testing stage and not yet commercialized |
| Palau | No. |
| Viet Nam | Viet Nam has granted trial licenses for 5G networks on the 2.6 GHz, 3.5 GHz and mmWave to provide some trail services: - eMBB services: smart TV 4K/8K, AR/VR; - uRLLC services: robot controlling;  - mMTC services: smart city, smart parking, smart electric meter measurement, smart metering; |
| China | Yes, 5G is widely deployed in China.  The number of 5G subscriber reached 561 million, accounting for 33.3% of mobile subscriber. https://www.miit.gov.cn/jgsj/yxj/xxfb/art/2023/art\_69798e71872c407ab677fd1c73885337.html |
| Korea | 5G commercialization services in the frequency bands 3 400-3 700 MHz and 26.5-28.9 GHz have been provided by three major telecommunication carriers since 2019. In addition, Local 5G services called “e-Um 5G” in the frequency bands 4 720-4 820 MHz and 28.9-29.5 GHz have been provided by more than 50 entities since 2021. The E-Um 5G provides customized services tailored to each industrial sector and coverage within a specific geographical area, such as a manufacturing center or a campus premise. |
| Sri Lanka | No, it has been planned to deploy in Q2 2024. Already started the 5G trials in 3.5 GHz and 27 GHz bands from year 2021. |
| Brunei | - 5G non-standalone services has been commercially deployed since June 2023.  - Utilized 700MHz, 1800MHz and 3.5 GHz |
| Pakistan | 5G Test/Trials are being conducted by the telecom operators in Pakistan in various frequency bands. Commercial launch shall be allowed in the light of policy of the Federal Government. |
| Nepal | Nepal has not deployed 5G services but spectrum in 2600MHz band has been allocated to an operator for 5G trial purpose. |
| Indonesia | Yes, Indonesia started to deploy 5G commercially in 2021. 5G services in Indonesia using the frequency bands 1800 MHz (FDD), 2100 MHz (FDD), and 2300 MHz (TDD) with 5G NSA configuration using DSS in FDD and static for TDD. Currently in early 2024, 5G is already deployed in 56 cities in selected areas. Most of 5G services are used for enhanced mobile broadband (eMBB) and some of them for industrial use cases. |

* + 1. Status of IMT spectrum assignment and challenges

**Q2:** Among frequency bands that are identified for IMT in ITU Radio Regulations, what are the reasons, challenges, and/or limitations for not having assigned some of them, if any, in your country?

**Answers**

|  |  |
| --- | --- |
| Bhutan | We have assigned the frequency in mid 3.5GHz only. The telecom operators have not demanded in other bands at the moment. Other bands are also not deployed due to technological and geographical limitations. |
| Nepal | • The frequency band 470 MHz – 698 MHz has been allocated for Digital Terrestrial Television Broadcasting and television distribution networks. Therefore, this band is not allocated for IMT services. • Similarly, 1427 MHZ – 1518 MHz, 4800 MHz – 4990 MHz and all bands in mmWave are not assigned for IMT. • Among the bands already allocated for IMT services, the demand for 700 MHz band and C-band is gradually emerging, but these bands are unassigned as of now. • Plans are made for prompt release of spectrum in all allocated bands. But, a portion of the spectrum in C-band is being used by broadcasting service (Satellite), and refarming plans are being prepared. |
| Thailand | Challenge is in the 3500 MHz frequency band, in order to be able to co-exist with TVRO systems. |
| Palau | Palau is not a member of ITU and the reasons, challenges is limited information for IMT in ITU Regulations.  In progress. |
| Viet Nam | In National Frequency Allocation Table, 3560-4000 MHz band is identified for IMT, however the 3400-3700 MHz band is being licensed for Vinasat-1 satellite. Therefore, Viet Nam has a challenge in re-framing this band for IMT, especially the TT&C frequency of Vinasat-1&2 at 3700 MHz. |
| China | - |
| Korea | IMT identification with these provisions in the RR gives flexibility for Members to use the identified IMT frequency bands in accordance with their own national spectrum policies. Therefore, it is encouraged that ITU (collectively representing Members) should continue exploring new identification of IMT spectrum in order not only to keep providing a way of efficient use of spectrum but also to assist Members to use/select those identified frequency bands for IMT according to their own national spectrum policies. |
| Sri Lanka | Existing services / Economic situations /Use cases |
| Brunei | No issues at the moment, current assigned bands are adequate to cater the current market and technology. |
| Pakistan | Almost all of the IMT bands identified for IMT services in Radio Regulations for Region-3 are being considered for IMT services in Pakistan. |
| Nepal | * The frequency band 470 MHz - 698 MHz has been allocated for Digital Terrestrial Television Broadcasting and television distribution networks. Therefore, this band is not allocated for IMT services. * Similarly, 1427 MHZ - 1518 MHz, 4800 MHz – 4990 MHz and all bands in mmWave are not assigned for IMT. * Among the bands already allocated for IMT services, the demand for 700 MHz band and C-band is gradually emerging, but these bands are unassigned as of now. * Plans are made for prompt release of spectrum in all allocated bands. But, a portion of the spectrum in C-band is being used by broadcasting service (Satellite), and reframing plans are being prepared. |
| Indonesia | Some frequency bands identified for IMT in ITU Radio Regulations have not been assigned for such use in Indonesia, such as the 2.6 GHz and 3.5 GHz. This is due to their current usage for Broadcasting Satellite Service and Fixed Satellite Service, respectively. |

* + 1. Spectrum planning and roadmap

**Q3:** In your spectrum planning roadmap, which frequency bands are being considered or will be considered to be used for IMT in the coming years?

**Answers**

|  |  |
| --- | --- |
| Bhutan | Mostly mmWave for 5G services. |
| Nepal | The frequency bands 700 MHz, 2100 MHz, 2300 MHz, 2600 MHz and C-band are being considered to be used for IMT in coming years. |
| Thailand | The 1500 MHz, 3500 MHz, and 28 GHz frequency bands are being considered. |
| Palau | Planning stage  In progress |
| Viet Nam | In spectrum planning roadmap, Viet Nam has considered the band 694-806 MHz, 2300-2400 MHz; 2500-2690 MHz and 3560-4000 MHz for IMT (IMT-Advanced IMT-2020 and beyond). Others incumbent bands, such as 900/1800/2100 MHz are being refarmed for advanced IMT technologies. For 2030 timeframe, Viet Nam would like to work with other countries to discover potential bands for IMT in the range of 7-24 GHz. |
| China | China is considering to identify the band 6425-7125 MHz or portions thereof, for IMT in the new version of the Regulations on the Radio Frequency Allocation of China. China is considering to identify the band 24.75-27.5GHz and 37-43.5GHz or portions thereof, for IMT in the new version of the Regulations on the Radio Frequency Allocation of China. |
| Korea | The frequency band 3 700-4 000 MHz will be provided according to the national spectrum plan in the coming year. |
| Sri Lanka | * 3.2 -3.4 GHz * 3.6 -3.8 GHz * 26/28 GHz |
| Brunei | Currently there is no demand and as per normal practice, this all depends on  current network provider needs and demands. |
| Pakistan | Frequency bands including 700 MHz, 900 MHz, 850 MHz, 1427 – 1518 MHz, 1800 MHz, 2300 MHz, 2600 MHz, 3300 – 3600 MHz, 24 GHz and 39 GHz are being used/ considered for IMT use in Pakistan. |
| Nepal | * 2600MHz * 700MHz * 26GHz * 2300GHz * 3500/3700MHz * 7025-7125MHz (WRC-23) |
| Indonesia | Indonesia has considered and prioritized the frequency band 700 MHz, 2.6 GHz, 3.5 GHz, and 26 GHz for IMT, while other IMT frequency bands are still under study. |

* + 1. IMT technology evolution in 2025-2030 timeframe

**Q4:** In the 2025-2030 time frame, what is the expected dominant IMT technology (4G or 5G) in your country/territory? What are the expected market shares by technology in 2025 and 2030?[[1]](#footnote-1)

**Answers**

|  |  |
| --- | --- |
| Bhutan | Have not projected it till 2025-2030. However, with more awareness and with the demand of higher throughput capacities, 5G services is expected to be the most dominant in 2030. |
| Nepal | In 2025, it is expected that 4G will be the dominant technology with 90% market share compared to 10% of 5G. But by 2030, 5G is expected to overtake 4G and have market share of 60% and 4G will have a market share of 40%. |
| Thailand | - |
| Palau | do not know |
| Viet Nam | There are approximately 130 million mobile subscribes in Viet Nam, of which the majority is 4G account for 72%, followed by 2G with 20% and the others. Forecast of Vietnamese mobile operators that 4G subscribers will reach their peak around 2026 and then gradually decrease. By 2030, 4G will still be the dominant technology with majority of subscriber (~50%), then 5G will gradually increase and replace. |
| China | - |
| Korea | The mobile traffic data over 5G (IMT-2020) network per day is now around 3.5 times more than the traffic data over LTE network in February 2023 according to the MSIT statistical data . In the 2025-2030 time frame, 5G market shares would be continuously increased. In addition, the Republic of Korea has an intermediate plan for pre-IMT-2030 demonstration around 2026. |
| Sri Lanka | 4G |
| Brunei | Current dominant for IMT technology is cellular network. Expected market  shares to be more focus towards enhanced mobile technology i.e., FWA |
| Pakistan | The expected dominant IMT Technology in 2025-2030 in Pakistan shall be 4G LTE as per the prevailing market situation, along with proliferation of 5G services in major cities. Input on expected market shared by different technologies may also be requested from PTA. |
| Nepal | * 4G * Expected market shares by technology needs to be studied. |
| Indonesia | Indonesia implements neutral technology policy based on IMT standard which give the MNO flexibility to choose technologies to be deployed. |

* + 1. Mobile connectivity targets

**Q5**: Has your country/territory defined specific mobile connectivity targets to be met in the 2025-2030 time frame? Have targets been defined within a national broadband plan? Such targets include (but not limited to):

* Speed/data-rate, throughput, latency
* Connectivity along transport routes (e.g. highways, high speed railways)
* Coverage (percentage of population and/or geographic area)
* Connectivity ratio (number of end users, or end user ratio)
* Number of base stations
* Affordability of devices
* Defined milestones to meet the above targets (within 2025-2030 time frame), if any

What is the current status in respect of meeting these targets?

**Answers**

|  |  |
| --- | --- |
| Bhutan | Yes, we intend to cover the nation with 100% mobile coverage within 2025-2030. |
| Nepal | No such targets are defined for 2025-2030 timeframe. But similar targets relating to throughput, coverage, number of base stations etc. were defined as rollout obligation for 2020-2025 timeframe while providing additional spectrum for 4G expansion |
| Thailand | Network coverage rollout is defined as a target Network rollouts are currently in line with the planned target |
| Palau | In progress.  Speed/data-rate, throughput, latency  Coverage (percentage of population and/or geographic area)  Number of base stations  Affordability of devices |
| Viet Nam | According to the draft of Digital Infrastructure Strategy to 2025 with a vision to 2030 of Vietnam, digital infrastructure shall be developed with high quality, broadband and security to meet the development needs of the e-government, digital economy and digital society; ensure that all people can approach and use advanced services on digital infrastructure with high quality and reasonable rates, some of the key indicators as follows:  By 2025: - Broadband telecommunications infrastructure (mobile, fixed) covers 100% of villages nationwide. - 100% of the population is covered by high-speed, broadband mobile with an average speed of 70 Mbps . - 95% of households have a fixed broadband connection. - 100% of households in urban areas have access to an Internet connection with a minimum speed of 200 Mbps and can reach speeds of 1 Gbps; 95% of households in rural areas have access to speeds up to 100 Mbps. - 100% of the adult population has a smartphone. By 2030:  - 5G network covers 100% of the population.  - 100% of households have GBps fiber-optic broadband. - 100% of enterprises have IoT application with low-speed connectivity to deploy advanced services of the Industrial Internet of Things. |
| China | In our contribution to AWG-30, AWG-30/INP-48 provided reply to this question, copied below:  China published 《5G application “sail” action plan》 in 2021, indicating that by the year 2023, the development level of 5G applications in China will be significantly improved, and the comprehensive strength will continue to increase. A new ecosystem of deep integration of IT (information technology), CT (communication technology), and OT (operation technology) will be created, breakthroughs in the depth and breadth of 5G applications in key areas will be achieved, the dual pillars of technology industry and standard system will be built, and the basic capabilities of network, platform, and security will be further improved. The situation of 5G application “sail and voyage” will be gradually formed. There are four goals for 5G application in this plan: 1. The key indicators of 5G applications will be greatly improved. The penetration rate of 5G personal users will exceed 40%, the number of 5G users will exceed 560 million, the access traffic accounts of 5G network will be more than 50%, the efficiency of 5G network usage will be significantly improved and the average annual growth rate of 5G IoT users will exceed 200%. 2. 5G applications in key areas will achieve outstanding results. In the field of personal consumption, a number of new businesses, new models and new formats based on “5G+” new consumption will be created, and the user acquisition has been significantly improved. In the field of vertical industries, the penetration rate of 5G applications in large industrial enterprises will exceed 35%, and 5G applications in power, mining and other fields will achieve large-scale replication and promotion. In the field of social and people’s livelihood, a number of 5G+ smart education, 5G+ smart medical care, 5G+ cultural tourism model projects will be created, and the level of 5G+ smart city construction will be further improved. There will be more than 100 5G application benchmarks created for each key industry. 3. The 5G application ecological environment will continue to improve. A cross-department, cross-industry, and cross-field collaborative linkage mechanism will be initially established, and an innovative model of 5G application integration will be formed, guided by government departments, driven by leading enterprises, and coordinated by small and medium-sized enterprises. A group of 5G application solution suppliers with extensive influence will be cultivated, and more than 100 5G application solutions will be formed. The framework of 5G application standards for basic commonalities and key industries will be completed, and more than 30 key industry standards will be developed. 4. The key basic support capabilities will be significantly enhanced. The 5G network coverage level will be continuously improved, there will be more than 18 5G base stations per 10,000 people, and more than 3,000 5G industry virtual private networks will be built. To further enhance the capabilities of public service platforms for application innovation, a number of 5G integrated application innovation centers will be built. 5G application security assurance capabilities will be further improved, 10-20 5G application security innovation demonstration centers will be built, 3-5 regional demonstration benchmarks will be established, and a security assurance system compatible with 5G application development will be basically formed |
| Korea | TBD |
| Sri Lanka | Sri Lanka is in the process of preparing a National Digital Economy Strategy. One of the objectives of this strategy is to achieve Universal Broadband Access at an affordable cost targeting;  • Minimum 100 Mbps for all Institutions  • Minimum 20 Mbps for every citizen in the country by the end of 2030.  5 years period from the Assignment. |
| Brunei | Currently there are no specific target for the period of 2025-2030. |
| Pakistan | Federal Government is revising Telecom Policy 2015, which shall be replaced by National Broadband Policy. The National Broadband Policy may include all these connectivity targets. Similarly, PTA may be in a better position to provide answer to this question as rollout obligations are part of the licenses issued by PTA. |
| Nepal | No there are not any specific mobile connectivity targets to be met. But previously NTA had set some rollout obligations to the operators while assigning spectrum through auction. Some of the rollout obligations includes   * The operator shall ensure that it shall provide national 4G coverage (in all 7 provinces and 77 districts) by the end of 2020 * 4G coverage in urban area shall be 95% (by population) by end of2022. * 4G coverage in rural areas of municipalities and rural municipalities shall be 90% (by population) by end of 2022. * 4G coverage in Tourist Areas/Specified National parks/Highway shall be 95% by end of 2022. * All installed 4G sites shall be of LTE advance standard. * User experience (Download Speed) shall be of minimum of 20Mbps in urban and 10Mbps in rural areas.   As per the reports, most of the obligations set by NTA has been met by the operators except minimum download speed of 20Mbps in urban and 10Mbps in rural areas. |
| Indonesia | According to [Indonesia Digital Vision (VID) 2045](https://drive.google.com/file/d/1BF0f-vkQRuqfFCb-tHCn6tCT3wHYgD2l/view?usp=drive_link),   |  |  |  |  | | --- | --- | --- | --- | | No | Digital Infrastructure Indicator | Baseline (year) | Target\* (2025-2030) | | 1 | Mobile broadband (min. 4G) coverage per population | 89% (2022) | 98% | | 2 | Number of gigabit city | N/A | 98 cities | | 3 | Download Speed of mobile broadband | 38.91 Mbps (2023) | 100 Mbps |   \*this target might be reviewed as needed |

* + 1. Current and forecast data usage

**Q6:** What is the current and forecast data usage by 2030 for various types of human and non-human usage (Gbyte / month) using IMT technology in your country/territory?

**Answers**

|  |  |
| --- | --- |
| Bhutan | No such forecast has been made. |
| Nepal | There are two major IMT operators in Nepal, and their combined traffic is approximately 80,000,000 Gigabyte/ month. The forecast data usage by 2030 (Year to Year, YoY) for various types of human and non-human usage using IMT technology in Nepal is as below:   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **Description** | **2023** | **2024** | **2025** | **2026** | **2027** | **2028** | **2029** | **2030** | | YoY Data Traffic Growth, % | 45% | 16% | 35% | 20% | 25% | 20% | 22% | 25% | | YoY Machine Type Data Traffic Growth, % | 0.05% | 1% | 2% | 4% | 7% | 9% | 15% | 20% | |
| Thailand | - |
| Palau | In progress. |
| Viet Nam | No public report in this regard. |
| China | Mobile Internet access traffic reached 261.8 billion GB in 2022, an increase of 18.1% over the previous year. The average monthly access traffic (DOU) reached 15.2 GB/household/month, an increase of 1.84 GB/household/month over the previous year. The access traffic of IoT terminals increased by 64.4%. Digital consumption carried by data traffic has penetrated into all fields of production and life services, and has continuously innovated consumption content and forms.  Mobile IoT is entering into an important development period. By the end of 2022, the total number of terminal connections in China’s mobile networks has reached 3.528 billion, among which 1.845 billion are cellular IoT end users, representing the number of “thing” (non-human) connections. Since the end of August 2022, the number of “things” connections has surpassed the number of “human” connections, and the proportion of “things” connections has risen to 52.3%. The foundation of Internet of Everything (IoE) has been continuously consolidated. Cellular IoT terminals are used in public services with 496 million terminals, Internet of Vehicles with 375 million terminals, smart retail with 250 million terminals, and smart home with 192 million terminals. <https://www.miit.gov.cn/gxsj/tjfx/txy/art/2023/art_77b586a554e64763ab2c2888dcf0b9e3.html> |
| Korea | TBD |
| Sri Lanka | - |
| Brunei | As of Q3 of 2023, the current usage for fixed network are 41,370 TB derived from usage of various application by users in the country. Forecast data usage by 2030 are currently not available. |
| Pakistan | Mobile data usage in Pakistan for the last five years is provided in the following graph:    Projections for 2030 is under estimation and will be provided later on. |
| Nepal | *There are two major IMT operators in Nepal, and their combined traffic is approximately 80,000,000 Gigabyte/ month. The forecast data usage by 2030 (Year to Year, YoY) for various types of human and non-human usage using IMT technology in Nepal is as below:*   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **Description** | **2023** | **2024** | **2025** | **2026** | **2027** | **2028** | **2029** | **2030** | | YoY Data Traffic Growth, % | 45% | 16% | 35% | 20% | 25% | 20% | 22% | 25% | | YoY Machine Type Data Traffic Growth, % | 0.05% | 1% | 2% | 4% | 7% | 9% | 15% | 20% | |
| Indonesia | N/A |

* + 1. Role of FWA

**Q7:** What role do you expect will be played by FWA, regardless of technology, to help meeting the connectivity targets for fixed users (including residential households and enterprise users)?[[2]](#footnote-2)

**Answers**

|  |  |
| --- | --- |
| Bhutan | FWA will decongest the mobile networks and will help in ensuring the QoS of Mobile services. |
| Nepal | The fixed wireless access (FWA) has not been successful as expected. The service providers are starting to provide FWA services using IMT 4G technology and will be provided with 5G too. The success of such initiative will depend on many factors including identifying the appropriate market, offered throughput, price and quality. |
| Thailand | FWA will be an inexpensive connectivity alternative for rural areas. |
| Palau | - |
| Viet Nam | Regarding to the fixed broadband infrastructure, by the end of 2022 in Viet Nam, FTTx connection has been deployed to 100% of communes/wards/ townships, 91% of villages, 100% of schools, 72.4% of household (20 million houses). In this circumstance, FWA could play a supplementary role to fill in the un-connected or hard-to-deploy areas. |
| China | - |
| Korea | TBD |
| Sri Lanka | It is expected involve FWA technologies for extending connectivity to rural areas. |
| Brunei | To cater for area where FTTH are unable to penetrate, in other words as a  backhaul to FTTH network. |
| Pakistan | FWA can play a vital role in Pakistan to help meeting the connectivity targets for fixed users in view of the very low fixed wired connectivity options/ penetration. |
| Nepal | The fixed wireless access (FWA) is expected to fulfil the connectivity target in coming year. |
| Indonesia | FWA is expected as complementary service to Fiber to the “x” (FTTx) to facilitate faster market penetration. It will expand the penetration especially in urban and rural areas, for both residential households and enterprise users. |

* + 1. Forecast availability of network resources

**Q8:** What is the forecast availability of new base station site resources and the degree of increased densification (e.g., distance between sites) between 2025-2030 in your country/territory? Is there any plan to reuse the current site resources for future IMT deployment?

**Answers**

|  |  |
| --- | --- |
| Bhutan | No such forecast has been made. However, the existing resources will be used in densification for IMT deployment and also riding the new services over current base station infrastructures. |
| Nepal | Currently, there are more than 8500 physical base stations throughout the Country. Site densification of the service providers are currently based on the need basis. Each operator builds hundreds of towers every year to expand the network footprint as well as to enhance the customer experience. Regarding future IMT deployment, the current site resources will be reused whenever possible. In addition, infrastructure sharing is also planned for optimal reuse of the resources. But no specific plans and forecast have been made for 2025-2030. |
| Thailand | Information is not available |
| Palau | In progress. |
| Viet Nam | Most of mobile operators plan to reuse the current 4G site resource for 5G deployment. To adapt the increase of mobile data traffic, together with secure new spectrums and employ advance technology, operators also consider densifying their base station sites |
| China | The site resource is a limited resource. The general target is to reuse the current site resources as much as possible for future IMT deployment |
| Korea | TBD |
| Sri Lanka | Current sites will be reused for IMT deployment; further densification will be required. |
| Brunei | Current station has been reused and being put together as Single Radio Access  Network (SRAN) compromise of 3G, 4G and 5G. |
| Pakistan | The rollout of 5G technology shall require installation of much more base stations as compared to existing 3G/4G technologies between the during of 2025 – 30 in Pakistan. The current site resources shall be utilized for future IMT deployment as per the current prevailing practice of using 2G base stations for deployment of 3G & 4G systems. |
| Nepal | Currently, there are more than 8500 physical base stations throughout the Country. Site densification of the service providers are currently based on the need basis. Each operator builds hundreds of towers every year to expand the network footprint as well as to enhance the customer experience. Regarding future IMT deployment, the current site resources will be reused whenever possible. In addition, infrastructure sharing is also planned for optimal reuse of the resources. But no specific plans and forecast have been made for 2025-2030. |
| Indonesia | N/A |

* + 1. IMT-2020 industrial use cases

**Q9:** What IMT-2020 sectoral/industrial use cases are you expecting to unfold in your country/territory? Please select all that apply.

🗌 Agriculture

🗌 Drones

🗌 Education

🗌 Energy

🗌 Manufacturing

🗌 Media

🗌 Medical

🗌 Mining

🗌 Smart Cities

🗌 Transportation

🗌 Others, please specify

**Answers**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Bhutan | Nepal | Thailand | Palau | Viet Nam | China | Korea |
| Agriculture |  | X | X | X | X | X | X |
| Drones | X | X |  |  |  | X | X |
| Education | X | X |  | X | X | X | X |
| Energy | X | X |  | X |  | X | X |
| Manufacturing | X |  | X |  |  | X | X |
| Media |  | X |  | X | X | X | X |
| Medical | X | X | X | X | X | X | X |
| Mining |  |  |  |  |  | X | X |
| Smart Cities |  | X | X | X | X | X | X |
| Transportation |  | X | X | X | X | X | X |
| Others, please specify |  |  |  |  |  | Public service |  |

Further information from China: In 2022, achievements in integrated applications in the fields of intelligent manufacturing, intelligent medical care, intelligent education and digital government affairs continue to emerge. More than 4000 “5G + Industrial Internet” projects have been invested and built across the country, creating a number of 5G fully connected factories. Telecom operators use 5G slicing technology to provide more than 14,000 5G virtual private networks, helping industries accelerate digital transformation.

<https://www.miit.gov.cn/zwgk/zcjd/art/2023/art_9f5022af3cdf48789484117d9da03c58.html>

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Sri Lanka | Brunei | Pakistan | Nepal | Indonesia |  |  |
| Agriculture | X | X | X | X | X |  |  |
| Drones | X |  | X |  |  |  |  |
| Education | X | X | X | X | X |  |  |
| Energy | X | X | X | X |  |  |  |
| Manufacturing | X |  | X |  | X |  |  |
| Media | X |  | X | X |  |  |  |
| Medical | X | X | X | X | X |  |  |
| Mining | X |  | X |  | X |  |  |
| Smart Cities | X | X | X |  | X |  |  |
| Transportation | X | X | X | X | X |  |  |
| Others, please specify |  |  |  |  |  |  |  |

* + 1. Traffic demand

**Q10:** Have there been any report indicating significantly increased high mobile (4G and 5G) traffic demand and/or network congestion in your country?

**Answers**

|  |  |
| --- | --- |
| Bhutan | Yes especially during the Covid 19-lockdown period |
| Nepal | Yes, Mobile traffic (4G) has been growing and service providers are reporting congestions in different spectrum bands. The service providers are doing continuous upgrade to avoid the congestion |
| Thailand | - |
| Palau | Yes, 4G |
| Viet Nam | No public report in this regard. |
| China | - |
| Korea | TBD |
| Sri Lanka | Yes |
| Brunei | There is a significant increase in traffic since the introduction of 5G network in June 2023 based on our internal report. |
| Pakistan | Trend in mobile data usage is provided in the above graph. PTA also publishes mobile data usage stats on its website at the following link:  <https://www.pta.gov.pk/en/telecom-indicators/13>  Further, PTA also publishes its annual reports with analysis of its telecom sector development, the same may also be referred for reporting on increased data demand and usage e.g. Chapter 2 (Telecom and ICT development) of PTA Annual Report 2022, available at following link:  <https://www.pta.gov.pk/en/data-&-research/publications/annual-reports> |
| Nepal | Not reported yet |
| Indonesia | Yes, there has been some reports indicating an increase in traffic demand for mobile broadband. |

* + 1. Technology switch-off and refarming plans

**Q11:** Has any timeline been set for the switch-off of any particular technology (e.g., 2G or 3G)? By taking the experience from past re-farming of spectrum, what are the plans to re-farm existing spectrum for IMT in your country/territory before 2030? Is there a roadmap or any plan to build one? Where possible, please state frequency band, total bandwidth available and anticipated timeline for re-farming.

**Answers**

|  |  |
| --- | --- |
| Bhutan | No timeline has been set for switch-off. There are plans to re-farm spectrum but no specifications and timeline has been set. The switch-off will depend on the operators. |
| Nepal | In Nepal, majority of the voice traffic is still using 2G/3G technology. The voice traffic is not increasing, it is steady. The operators are also providing VoLTE services which is expected to offload CS traffic gradually to be more focused on data lead network. Based on the market dynamics of handset, user behaviour and push on usage of VoLTE, CS network will be gradually downsized. However, explicit timeline for the complete switch-off of 2G or 3G has not been set. It is anticipated that 3G network will be phased out before 2G. As the spectrum assigned to the operators are mainly technology neutral, the operators are free to refarm spectrum to spectrally efficient technology for better customer experience. The Authority provides required assistance and coordination for such refarming. |
| Thailand | - |
| Palau | Planning stage |
| Viet Nam | Ministry of Information and Communication are working with mobile operators to specify the timeline for the switch-off of 2G and 3G in the timeframe of 2025-2030. Since 2017, Viet Nam has allowed operators to deploy IMT-2020, IMT-Advanced and next versions on the incumbent bands, 850/900/1800/2100 MHz. All mobile operators are operating multiple technologies in their licensed bands. |
| China | At the national level, there is no unified re-farming roadmap, and the telecom operators are allowed and encouraged to re-farm existing spectrum for new generation of IMT when there are permissions from the administration. |
| Korea | 2G service was shut down by operators around 2021 taking into account the license duration and the spectrum re-farming plan. 3G service is also approaching shut down in the aspect of 3G mobile traffic data, but the exact timeline is hard to predict considering existing users. |
| Sri Lanka | The discontinuation of 3G services is taking place at a slow pace. |
| Brunei | No current plan to switch off / re- farming of any particular active/existing bands in the country. |
| Pakistan | Cellular mobile operators are voluntarily switching off 3G technology in consultation with PTA and switching to 4G technology. Similarly, Federal Government has set the deadline of 2024 for switching of WLL based services. 700 MHz band is also being approved by the Government for refarming. Refarming of 2600 MHz band is also under consideration. |
| Nepal | CDMA shut down has been completed in 2023. Currently, majority of the voice traffic is still using 2G/3G technology. The voice traffic is not increasing, it is steady. The operators are also providing VoLTE services which is expected to offload CS traffic gradually to be more focused on data lead network. Based on the market dynamics of handset, user behaviour and push on usage of VoLTE, CS network will be gradually downsized. However, explicit timeline for the complete switch-off of 2G or 3G has not been set. It is anticipated that 3G network will be phased out before 2G. As the spectrum assigned to the operators are mainly technology neutral, the operators are free to refarm spectrum to spectrally efficient technology for better customer experience. The Authority provides required assistance and coordination for such refarming. |
| Indonesia | No timeline has been made for 2G shutdown, meanwhile 3G has been switched-off since 2023. In regards to the re-farming of IMT spectrum, Indonesia has implemented neutral technology policy in all IMT frequency bands. |

1. Industry Research Reports and Information
   1. Socio-economic impact in APAC of mid-band spectrum[[3]](#footnote-3)

The study report assesses mid-band spectrum on a global basis with analysis at the Asia Pacific level. The socio-economic impact study examined the contribution of 5G spectrum to gross domestic product (GDP) by 2030, providing insight into the role 5G will play in helping deliver global economic growth. At a global level, mid-bands are expected to account for 63% of the overall socio-economic value generated by 5G. In the APAC region, mid-band 5G spectrum is expected to drive an increase of around $285 billion in APAC GDP in 2030.

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Figure 2. Annual impact of 5G on GDP in APAC, by band, 2020-2030[[4]](#footnote-4)

In Asia Pacific, the East Asia and Pacific regions are expected to drive most of the benefits associated with 5G mid-band spectrum, with the biggest economies (China, Japan and South Korea) delivering most of the regional benefits, supported by extensive 5G network deployment.

Graphical user interface, application

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Figure 3. Asia Pacific: GDP contribution generated by mid-band 5G, 2030[[5]](#footnote-5)

At the country level, the largest economies of each Asia Pacific sub-region are expected to drive most of the region’s overall contribution to GDP from mid-band 5G. In terms of overall Asia Pacific contribution, China, Japan and South Korea are the major contributors, due to the high level of 5G penetration that will be reached by 2030 in these countries.

A picture containing graphical user interface

Description automatically generatedA picture containing application

Description automatically generatedA picture containing application

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Figure 4. Share of sub-regional GDP contribution generated by mid-band 5G, 2030

For the period 2020–2030, eMBB and FWA use cases (and their associated applications) are expected to drive most of the 5G benefits. This is particularly the case for mid-band spectrum as indicated below.

Table

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Figure 5. 5G use cases and spectrum band relevance

However, for FWA, pilot projects on the use of mmWave bands to deploy FWA in suburban and rural areas suggest mmWave may play a greater role in the future.

* 1. Mid-band spectrum needs[[6]](#footnote-6) in some densely populated areas

Delivering reliable high-speed mobile broadband services is a particular challenge in densely populated areas such as major cities. The large number of people in relatively small areas can easily over-burden the capacity of mobile networks. As a result, mobile networks’ spectrum requirements are typically higher in these urban settings.

This GSMA report analysed how much spectrum is expected to be needed to meet key ITU targets for IMT- 2020 (5G) in 36 cities around the world in the 2025-2030 timeframe. At this time, 5G take-up is expected to be significantly higher than today. The analysis calculates how much spectrum is needed to reliably deliver 100 Mbps download speeds and 50 Mbps upload speeds to end users.

The report’s analysis found that the amount of spectrum needed depended on a number of factors. These included:

* Population density (excluding temporary population);
* Predicted amount of available spectrum by 2025;
* Geographical separation of base stations (inter- site distance);
* 5G technology used in every band, with MIMO upgrades and both outdoors small and macro cells;
* Percentage of high-band, indoor small cells and Wi-Fi offload; and
* Cellular network activity factor[[7]](#footnote-7).

This study takes into account the effect of Wi-Fi offload, but not other alternative technologies such as satellite, that can also can also support use cases requirements, in particular for Fixed Wireless Access and IoT. Therefore, spectrum requirements presented in this study would be adjusted accordingly.

It is to be underlined that this study focuses on densely populated urban areas, and conclusions should not be extrapolated to the whole territory of the concerned countries. For sub-urban and rural areas, current spectrum identification for IMT may be sufficient on the long-term. For dense urban areas, other bands such as mmWave are also relevant (see below figure) and would cover some traffic requirement instead of increasing mid-band spectrum needs. This study takes into account the effect of mmWave offload.



Figure 6: Mix of spectrum for 5G

The study also highlights that alternative solution such as network densification can be considered to cover traffic requirements, even if the increase in network cost is to be anticipated.

By the end of 2021, mid-band spectrum – primarily in the 3.5 GHz range, but also in the 2.3 GHz, 2.6 GHz and 4.8 GHz bands – had been the most commonly used around the globe to launch 5G networks. By 2030, and without potential factors of improvement listed above, an average of 2 GHz of additional spectrum is expected to be needed in some densely populated areas to deliver 5G services at a performance consistent with the ITU’s IMT-2020 (5G) requirements.

Figure 7 below shows expected spectrum requirement in cities within scope of the report.

A graph of numbers and a number

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Figure 7. Total mid-band spectrum needed for 5G in the 2025-2030 timeframe

As of end-2023, live 5G commercial networks are available in 20 Asia Pacific markets, with at least 7 more planning to launch services in 2024, based on GSMA Intelligence.[[8]](#footnote-8)

By 2030, the number of 5G connections in APAC is forecast to exceed 3.1 billion, up from some 1 billion as of end-2023. 5G technology is expected to make up 61% of total connections in the APAC region by 2030 as shown in Figure 8.

A close-up of a graph

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Figure 8. Adoption Rate of IMT Technology in APAC region by percentage of connections[[9]](#footnote-9)

In addition, LS Telecom in 2019 have indicated that countries in Asia Pacific region in average have only licensed 44% of the available harmonized IMT spectrum for low and mid band IMT spectrum. It meant that there are still average of 56% of the harmonized IMT spectrum for low and mid band in Asia Pacific region that have not yet licensed which could be used for 5G deployment. However, it is noted that administrations may not be able to use the entire portion of globally identified IMT spectrum for mobile services, and so must ensure they have sufficient spectrum in appropriate ranges to meet their needs. It is noted that this report is released in 2019. If latest data is available, the conclusion may be adjusted.

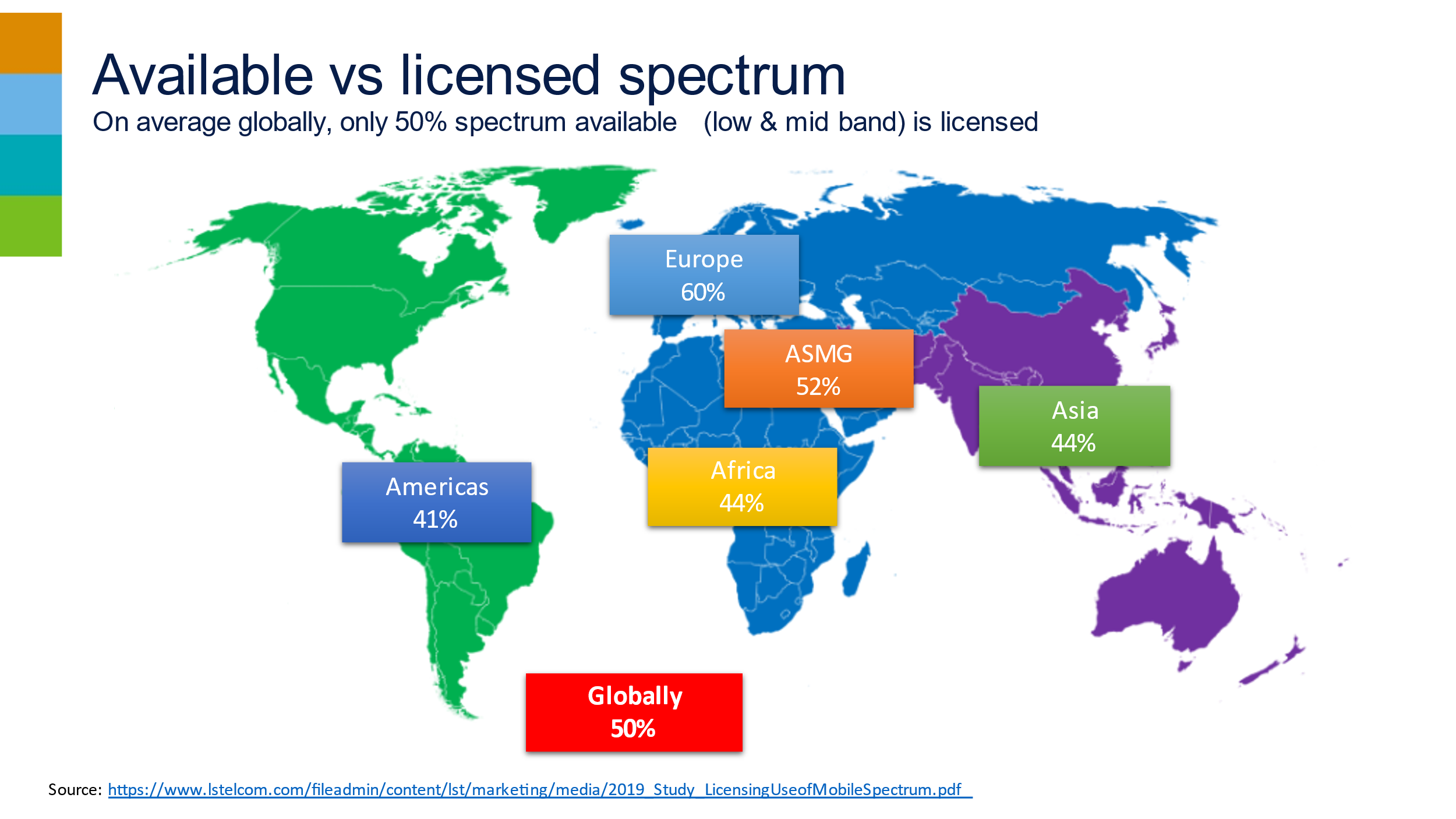


Figure 9. Available IMT Spectrum for low and mid band spectrum worldwide in 2019[[10]](#footnote-10)

5G delivers broadband FWA with fibre-like speeds, but at a fraction of the deployment cost. This can have a profound impact in areas with limited access to high-speed fibre. Mid-band spectrum is well-equipped to provide 5G FWA in population clusters such as towns and smaller urban areas, especially where other options are expensive or unavailable.

* 1. 5G traffic growth towards 2030

According to Ericsson[[11]](#footnote-11), global mobile data traffic is expected to reach 130 EB per month at the end of 2023. This is projected to grow by a factor of around 3 and to reach 403 EB per month in 2029. When fixed wireless access (FWA) is included, total mobile network traffic is anticipated to reach around 160 EB per month at the end of 2023, rising to an expected 563 EB per month by the end of 2029 as shown in Figure 10.

Of total mobile data traffic, 5G’s share is estimated to be 25 percent at the end of 2023, an increase from 15 percent at the end of 2022. This share is forecast to grow to 76 percent in 2029.

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Figure 10: Global mobile network data traffic (EB per month)[[12]](#footnote-12)

Global average monthly mobile data usage per smartphone is expected to reach 56 GB in 2029, rising from 21 GB at the end of 2023. Mobile data traffic per smartphone is even higher among countries in the Asia Pacific region as shown in Figure 11. The growth in mobile data traffic per smartphone can be attributed to three main drivers: improved device capabilities; an increase in data-intensive content; and growth in data consumption, due to continued improvements in the performance of deployed networks.

A graph of different colored lines

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Figure 11: Mobile data traffic per smartphone (GB per month)[[13]](#footnote-13)

FWA connections are forecast to increase rapidly across the rest of this decade from 130 million in 2023 to 330 million by 2029. Of the total projected connections, close to 85 percent are expected to be over 5G. The Asia Pacific region is expected to account for over 45 percent of global FWA connections as shown in Figure 11.

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Figure 12: Regional split in FWA connections 2023-2029[[14]](#footnote-14)

Similar projections from Nokia[[15]](#footnote-15) confirm the growth trends in mobile and FWA traffic as summarised in Figure 13. 5G connectivity and technology will be a crucial enabler of enterprise services, business office applications and industry 4.0 uses such as metaverse, IoT and digital twins. As a result, enterprise traffic is another category which is projected to expand significantly over this decade.

|  |  |  |
| --- | --- | --- |
| Traffic category | Projected traffic for 2030 | Growth |
| Consumer mobile | 415 to 644 EB/mo. | 4.3x to 6.6x |
| Consumer FWA | 172 to 423 EB/mo. | 5.9x to 14.6x |
| Enterprise | 270 to 1647 EB/mo. | 5x to 25x |

Figure 13: Network traffic by category[[16]](#footnote-16)

* 1. IMT developments in some bands
     1. IMT trials in upper 6 GHz (6.425-7.125 GHz)

In the “6 GHz IMT Ecosystem Report”[[17]](#footnote-17) it is indicated that there are no difficulties to supply IMT equipment in the upper 6 GHz band (6.425-7.125 GHz) from the ecosystem perspective. Several recent field trials involving the upper 6 GHz band confirm this and the results provide further evidence on the ability of the upper 6 GHz band to provide an effective coverage and capacity layer for IMT. Further details on these trials are provided below.

* + - 1. Chulalongkorn University (February 2023) [[18]](#footnote-18)

Chulalongkorn University, Thailand, conducted a field test of upper 6 GHz to study the data transmission quality for 5G Outdoor to Outdoor (O2O) and Outdoor to Indoor (O2I) deployment scenarios using the upper 6 GHz band. Using a channel bandwidth of 80 MHz, the test achieved average throughputs of 1100 Mbps (O2O) and 550 Mbps (O2I). This trial demonstrates that upper 6 GHz is able to offer good macro base station coverage performance, making it a suitable band for nation-wide IMT deployment.

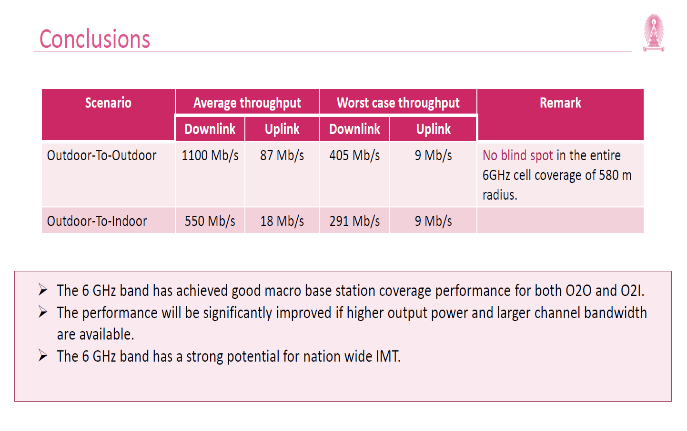
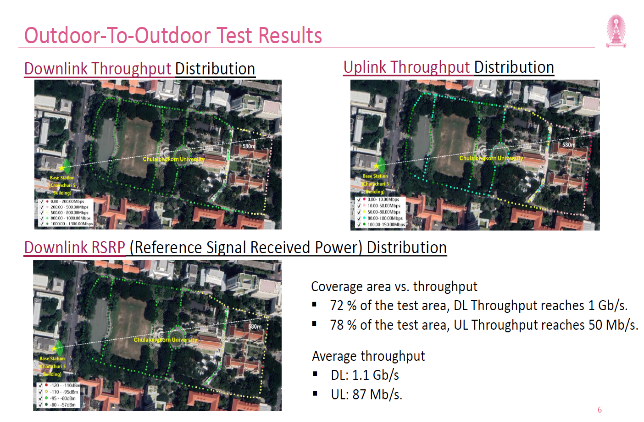


Figure 14: Overview of test results[[19]](#footnote-19)

* + - 1. Du, e& (August 2023)[[20]](#footnote-20)

UAE operators du and e& completed a successful 5G-Advanced trial project involving the upper 6 GHz band. Using 400 MHz bandwidth, the trial achieved a throughput of 10 Gbps. The TDRA which confirmed the results, noted that the increase in data speed will support many future projects at the UAE level, especially those that require highly sophisticated technologies (e.g. nanotech) and high internet speeds, such as remote diagnostics in healthcare, or autonomous (self-driving) vehicle projects in transportation, as well as help in the management of some industrial installations.[[21]](#footnote-21)

* + - 1. Deutsche Telekom (August 2023)[[22]](#footnote-22)

German operator Deutsche Telekom completed a trial which achieved a data rate of ~12 Gbps. To achieve this speed, two 5G data streams – from upper 6 GHz and 3.7 GHz spectrum – were combined. The results highlight the capacity expansion benefits of 5G deployment using carrier aggregation of 3.5 GHz and upper 6 GHz mid-band spectrum and the ability of such a deployment to achieve reasonable indoor coverage.

* + - 1. Maxis, Universiti Malaya (September 2023)[[23]](#footnote-23)

This upper 6 GHz trial conducted by Malaysian operator Maxis and Universiti Malaya achieved a peak throughout of 1.28 Gbps with 80 MHz bandwidth using a prototype Active Antenna Unit and a prototype mobile device. The test results showed good indoor penetration and the ability to achieve speeds of over 300 Mbps at locations more than 400m away from the mobile site, as well as potential for improvements in mobile signal propagation with more advanced antenna technology.

* + - 1. Vodafone (October 2023)[[24]](#footnote-24)

Vodafone announced a successful test of the upper 6 GHz band in Spain which achieved download speeds of up to 5 Gbps and on average 2 Gbps across various indoor locations. It was noted that 75% of all mobile traffic originates from users at home, in the office, or in enclosed public places such as cafes, bars, shops, and gyms, and the ability of upper 6 GHz to serve indoor users will ensure consumers and businesses receive even faster access and more reliable 5G services over the next 5-10 years.

* + - 1. Ericsson, MediaTek (November 2023)[[25]](#footnote-25)

Ericsson and MediaTek successfully carried out an interoperability test involving 5G NR data calls over upper 6 GHz band. This was performed with a MediaTek prototype test device and an Ericsson base station. The test was the first 5G NR data call on the 3GPP-defined n104 band (6.425-7.125 GHz) and highlights the efforts by telecom vendors, service providers, and device/chipset makers to build a global ecosystem for IMT in the upper 6 GHz band.

1. ITU-R Report on Future technology trends of terrestrial IMT systems towards 2030 and beyond. [↑](#footnote-ref-1)
2. *Wireless access* application in which the location of the *end-user termination* and the network access point to be connected to the end-user are fixed. <https://www.itu.int/dms_pubrec/itu-r/rec/f/R-REC-F.1399-0-199905-S!!PDF-E.pdf> [↑](#footnote-ref-2)
3. <https://www.gsma.com/spectrum/wp-content/uploads/2022/02/mid-band-5G-spectrum-benefits.pdf> [↑](#footnote-ref-3)
4. Source: GSMA [↑](#footnote-ref-4)
5. Source: GSMA [↑](#footnote-ref-5)
6. <https://www.gsma.com/spectrum/wp-content/uploads/2022/07/5G-Mid-Band-Spectrum-Needs.pdf> [↑](#footnote-ref-6)
7. An assumption surrounding what percentage of human and machine connections require the 100 Mbps download and 50 Mbps upload connection at any one time during the busiest hours. [↑](#footnote-ref-7)
8. GSMA Intelligence. 5G in Context, Q4 2023. <https://data.gsmaintelligence.com/research/research/research-2024/5g-in-context-q4-2023> [↑](#footnote-ref-8)
9. Notes: \*Asia Pacific excluding Greater China. Source: GSMA Mobile Economy Report 2024. <https://www.gsma.com/solutions-and-impact/connectivity-for-good/mobile-economy/wp-content/uploads/2024/02/260224-The-Mobile-Economy-2024.pdf> [↑](#footnote-ref-9)
10. Source: LS Telcom [↑](#footnote-ref-10)
11. Ericsson. Mobility Report, November 2023. <https://www.ericsson.com/4ae12c/assets/local/reports-papers/mobility-report/documents/2023/ericsson-mobility-report-november-2023.pdf> [↑](#footnote-ref-11)
12. Source: Ericsson Mobility Report [↑](#footnote-ref-12)
13. Source: Ericsson Mobility Report [↑](#footnote-ref-13)
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15. Nokia Global Network Traffic 2030 report. <https://onestore.nokia.com/asset/213660> [↑](#footnote-ref-15)
16. Source: Nokia Global Network Traffic 2030 report [↑](#footnote-ref-16)
17. GSMA. The 6 GHz IMT Ecosystem. <https://www.gsma.com/spectrum/wp-content/uploads/2022/08/6-GHz-IMT-Ecosystem.pdf> [↑](#footnote-ref-17)
18. More information at <https://www.chula.ac.th/en/news/118185/> [↑](#footnote-ref-18)
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20. More information at <https://www.eand.com/en/news/29-aug-etisalat-by-eand-5G-advanced-network-speed-trials.html> and <https://www.du.ae/about/media-centre/newsdetail/du-breaks-new-ground-in-5g-advanced-trial> [↑](#footnote-ref-20)
21. More information at <https://www.chula.ac.th/en/news/118185/><https://tdra.gov.ae/en/media/press-release/2023/tdra-announces-successful-completion-of-phase-ii-of-advanced-5g-trials> [↑](#footnote-ref-21)
22. More information at <https://www.telekom.com/en/media/media-information/archive/world-record-12-gigabits-per-second-in-mobile-communications-1048610> and <https://api.cept.org/documents/ecc-pt1/81398/ecc-pt1-24-032_%C2%ADdt_6-ghz-trial> [↑](#footnote-ref-22)
23. More information at <https://www.maxis.com.my/en/about-maxis/newsroom/2023/september/setting-the-right-path-to-meet-growing-data-consumption/> [↑](#footnote-ref-23)
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25. More information at <https://www.ericsson.com/en/news/2023/11/ericsson-and-mediatek-demo-on-6-ghz-licensed-5g-band> [↑](#footnote-ref-25)