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**APT REPORT ON**

**METHODOLOGY TO DETERMINE VALUE OF IMT SPECTRUM AND INFORMATION ON SPECTRUM PRICES IN ASIA PACIFIC COUNTRIES**

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**No. APT/AWG/REP-140**

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# 1. Introduction

Given that spectrum is a finite resource, it is managed by Administrations following the ITU Radio Regulations and their national requirements. As part of national spectrum management, Administrations regulate spectrum assignment and the pricing of spectrum resources.

Some APT Members have carried out IMT spectrum auctions in some of the IMT frequency bands. However, there is no publicly available database documenting the methodologies used to determine IMT spectrum prices for such auctions.

This APT Report is a compilation of responses to the Questionnaire and aims to provide useful information to APT Members on IMT spectrum pricing and the methodologies adopted by those APT countries that have auctioned their IMT spectrum.

# 2. Questionnaire and Responses

## **2.1 Questionnaire**

The Questionnaire sent out to each of the APT Members included the following questions.

**Question 1**: What are existing regulations and the mechanism for licensing the IMT spectrum?

**Question 2**: Does your regulation require any payment for the assignment of IMT spectrum to the mobile operator, other than spectrum usage fee/charge/tax, when licensing the IMT spectrum? If an answer is “Yes”, please provide in detail those regulations and the purpose of this payment.

**Question 3**: In your regulation, what methodology is used for the determination of the value of the IMT spectrum for specific bands? Please provide details.

**Question 4**: Does your Administration willing to share the reserved/starting price and auction price results with the associated requirement to licensees of the IMT spectrum?

## **2.2 APT Members that submitted responses to APT during the development of this Report**

The following APT Members provided their responses to the Questionnaire.

1. Bhutan (as of AWG-31/INP-14)
2. China, People’s Republic of (as of AWG-31/INP-90)
3. India, Republic of (as of AWG-31/INP-74)
4. Indonesia, Republic of (as of AWG-31/INP-58, AWG-33/INP-23)
5. Korea, Republic of (as of AWG-31/INP-103)
6. Nepal (as of AWG-31/INP-19, AWG-32/INP-31)
7. Palau (as of AWG-31/INP-45, AWG-32/INP-25)
8. Thailand (as of AWG-31/INP-25)
9. Viet Nam, Socialist Republic of (as of AWG-32/INP-103)
10. Sri Lanka (as of AWG-32/INP-11)
11. Brunei Darussalam (as of AWG-32/INP-16)
12. Pakistan, Islamic Republic of ((as of AWG-32/INP-20)
13. Philippines, Republic of the (as of AWG-33/INP-103)
14. Japan (as of AWG-33/INP-27)

## **2.3 Responses to Question 1 (What are existing regulations and the mechanism for licensing the IMT spectrum?)**

| **APT Member** | **Regulations and the mechanism for licensing the IMT spectrum** | | | |
| --- | --- | --- | --- | --- |
| **Administrative**  **e.g. first-come first-serve** | **Beauty contest** | **Auction** | **Other** |
| Bhutan | Yes | Yes  (sometimes) | - | Based on availability and band plans (made after thorough research) |
| China[[1]](#footnote-2) | Yes | - | - | - |
| India | - | - | Yes | - |
| Indonesia | Yes  (Evaluation) | Yes | Yes | - |
| Korea | Yes  (Local 5G) | Yes  (Rarely used after the adoption of auction) | Yes  (Most of the IMT spectrum) | - |
| Nepal (Federal Democratic Republic of) | - | - | Yes | - |
| Japan | - | When allocating IMT spectrum, the Minister of Internal Affairs and Communications sets guidelines for the deployment of IMT base stations. Each applicant who wishes to establish an IMT network needs to submit a deployment plan for IMT base stations to the Minister in accordance with these guidelines. Once the plan is approved, the applicant has the exclusive right to apply for a radio station license for the IMT base station on the designated frequency for a specific period. The evaluation of the submitted plans is carried out in two phases: absolute assessment and comparative assessment. Plans that are judged to be the most effective for the efficient use of the IMT spectrum are approved. | -  (The introduction of conditional auctions is being considered) | - |
| Palau (Republic of) | Yes | - | - | - |
| Thailand | - | - | Yes | - |
| Viet Nam | Yes | Yes | Yes | Renewal |
| Sri Lanka | Yes | - | Yes | - |
| Brunei Darussalam | No | No | No | by allocation for a pre-determined fee |
| Pakistan (Islamic Republic of) | - | - | Yes | - |
| Philippines (Republic of the) | Yes | Yes | - | - |

## **2.4 Responses to Question 2 (Does your regulation require any payment for the assignment of IMT spectrum to the mobile operator, other than spectrum usage fee/charge/tax, when licensing the IMT spectrum?)[[2]](#footnote-3)**

| **APT Member** | **Any payment related to the economic value of the spectrum** | | | |
| --- | --- | --- | --- | --- |
| **Administrative** | **Beauty contest** | **Auction** | **Other** |
| Bhutan | Yes | No | No | No |
| China | Yes | - | - | - |
| India | - | - | Yes  (based on final price of spectrum in auction, Bank guarantees (see response to Q4). Winner has to pay the final price discovered in the auction. There are two payment options:  (i) Option 1: Full or part upfront payment of the bid amount  (ii) Option 2: Payment of 20 equal annual instalments of the bid amount, duly protecting the NPV (Net Present Value) of the bid amount at the applicable rate of interest.  Prior to 2022, a percentage of Adjusted Gross Revenue (AGR) of Telecom Service Providers was also levied annually, but the same has been done away with as part of telecom reforms since last auction (July-August 2022)). | - |
| Indonesia | No  (Evaluation) | No | No | - |
| Korea | Yes  (Administrative Pricing) | Yes  (Spectrum Incentive Pricing) | Yes  (Winners bidding price) | - |
| Philippines | No | No | No | No |
| Thailand | - | - | No | - |
| Viet Nam | Yes | Yes | Yes | Yes (Renewal) |
| * In special cases, the IMT bands could be administratively grant to state-owned enterprises who directly serving national defense and security for a period up to 3 years, extendable up to 12 years more, for providing public service in combination with serving national defense and security. * Beauty contest could be applied to the IMT bands in case to facilitate the large-scale coverage of new technologies within a limited time or to encourage new entry to mobile market for promoting competition. * Auction shall be applied to all IMT bands, except those be licensed through beauty contest or administrative which be decided by the Prime Minister. * Payment for the right to use spectrum, excluding spectrum usage fee. | | | |
| Sri Lanka | Yes  (Upfront Fee) | Yes | Yes  (Upfront Fee) | - |
| Brunei Darussalam | No | No | No | by allocation for a pre-determined fee |
| Pakistan (Islamic Republic of) | - | - | Yes | - |
| Palau (Republic of) | Yes[[3]](#footnote-4) | - | - | - |
| Nepal (Federal Democratic Republic of) | - | - | No | No |
| Japan | - | The amendment to the Radio Law in Japan, enacted on 17 May 2019, established regulations concerning frequency allocation procedures based on the economic value of the spectrum. Each approved applicant is required to pay an annual fee to the government, as specified in their deployment plan. The fees collected from the applicants are used for initiatives that support “Society 5.0”, including the promotion of the development of advanced information and communication networks that utilize radio waves. | - | - |

## **2.5 Responses to Question 3 (In your regulation, what methodology is used for the determination of the value of the IMT spectrum for specific bands?)[[4]](#footnote-5)**

**1) Bhutan**

Number of user/coverage (Regional Factor), Frequency, Bandwidth, Site location (Rural/ Urban), Publicity factor. Please refer NRRR 2021 for detailed explanation on spectrum pricing. (Please refer to [Annex 3 to document 1B/80](https://www.itu.int/dms_ties/itu-r/md/19/wp1b/c/R19-WP1B-C-0080!N03!MSW-E.docx))

**2) China, People’s Republic of**

In China, Frequency characteristic and social/indirect benefits are the main influence factors for the determination of the value of the IMT spectrum for specific bands.

1. Frequency characteristic. Different frequency bands have different characteristics, such as different propagation and different path loss. The lower the frequency band, the larger the coverage of the single base station, and the higher the value provided from the single MHz spectrum.
2. Social and indirect benefits. Social and indirect benefits are important factors in evaluating the importance of the radio spectrum authorization. These factors are reflected in the socio-economic development, the feelings of happiness and convenience of the people. To provide universal services to bridge the urban-rural digital divide and bring broadband to rural areas.

**3) India, Republic of**

It is well understood that rational valuation and pricing of the precious spectrum resource to enable the orderly growth of the telecom sector is essential. In India, the Government has set itself the following objectives for the auction of spectrum:

* Obtain a market determined price of spectrum through a transparent process;
* Ensure efficient use of spectrum and avoid hoarding;
* Stimulate competition in the sector;
* Promote rollout of the respective services;
* To arrive at optimal price of spectrum to ensure sustainable and affordable access to Digital Communications.

India has 22 service areas, and each service area has its own GDP which is a factor in deciding the reserve price for that service area. The range of frequencies is also an important factor while deciding the reserve price. There are various economic approaches and models which are considered and evaluated before adopting one (or multiple) of them for establishing the reserve price of different IMT spectrum bands for each of the service area. Some of these economic models[[5]](#footnote-6) are as follows:

1. Multiple Regression Model
2. Producer Surplus Approach
3. Production Function Model
4. Revenue Surplus Approach
5. Trend-line Approach
6. Extrapolated ADP based on a time-series analysis
7. Use of last auction determined prices

In India, the auction model which has been adopted is “Simultaneous Multiple Rounds Ascending (SMRA)” e-auction, conducted over the Internet. Bidders are able to access the Electronic Auction System (EAS) which is used for participation in the auctions using approved web browser.

**4) Indonesia, Republic of**

IMT bands in Indonesia are licensed based on a bandwidth license with a maximum license duration of 10 years and can be extended for a maximum of 10 years. There are 2 methods used in determining the value of the IMT radio frequency spectrum, namely:

1. Auction mechanism;
2. Formula.
3. **Auction**

Based on new government regulation no. 43/2023 about Types and tariffs on types of non-tax revenue applicable to the Ministry Communication and Informatics. Radio frequency band licensing in Indonesia is conducted through 3 mechanisms, namely:

1. Auction mechanism with price bidding (price auction);
2. Auction mechanism without price bidding through beauty contest method;
3. A combination of auction mechanism with price bidding (price auction) and auction mechanism without price bidding through beauty contest method.

An auction is conducted when demand exceeds the supply. To determine the level of interest, MCI will request prospective bidders to express their interest. If the expressed interest is greater than the supply, an auction will be held. Indonesia uses the Simultaneous Multiple Round Auction (SMRA) methods of auction, where the determination of the reserved price is calculated based on the Discounted Cash Flow (DCF) or Cost Reduction (CR) approach.

The winning bidder of the auction will be granted a spectrum license for a maximum period of 10 (ten) years, which can subsequently be renewed for an additional 10 (ten) years subject to evaluation. As part of the obligation, the winner is required to pay an upfront fee and an annual fee based on a technology-neutral approach. According to the ministry regulation no.9/2023 about implementation guidelines for the determination of tariffs on types of non-tax revenues, the spectrum fee is determined by:

1. **Upfront fee** is set at maximum of 2 (two) times the bidding price of auction winner. The determination of upfront fee considers to the condition of telecommunication industry, non-tax revenue comes from frequency spectrum usage. Upfront fee is paid only once during the license period.
2. **Annual fee** is calculated by considering the condition of telecommunication industry, non-tax revenue comes from frequency spectrum usage, consideration from financial supervision institution and national development. Annual fee is paid every year during the license period.
3. **Spectrum Fee Formula for Bandwidth License**

The Spectrum Fee Formula is primarily utilized for the renewal of the spectrum license (from auction after the first 10 years period). Spectrum Fee Formula is also applied in cases where the policy involves the changing of an apparatus license to a bandwidth license for certain radio frequency bands, as described in Annex ITU**-Rep. ITU-R SM.2012-6.**

Spectrum fee based on bandwidth license in Indonesia = N×K×I×C×B, where:

*N*: is a normalization factor to stabilize government revenue from the non-tax sector. The N, For the period year, the value of N will be adjusted every year by multiplying the value of (N-1) by the ratio between the Consumer Price Index in December a year before (N-1) and two years before (N-2).

*K*: is an adjustment factor for the frequency band considering the economic value of the spectrum used depending on the service and benefits;

*I*: is the basic price index that is adjustable with the propagation of the spectrum (IDR/MHz). The index is settled by government regulation;

*C*: is the last total population in a service area according to the spectrum bandwidth license (kilo population);

*B*: is the bandwidth occupied by the spectrum user, including the guard band (MHz). The spectrum fee for the license renewal is directly calculated using the above formula. However, when changing from an apparatus license to a bandwidth license for certain radio frequency bands, the spectrum fee is calculated with a transition period.

To ensure the sustainability of the telecommunication industry following the change from the apparatus license to the bandwidth license, the government of Indonesia has implemented a policy to give the spectrum user a 5-year transition period. During this period, the spectrum users are required to make spectrum fee payments based on the spectrum bandwidth license, utilizing the provided formula. This 5-year transition period is considered fair and appropriate as it helps mitigate potential fluctuations in the spectrum fee resulting from the transition.

According to new government regulation no. 43/2023, adopted from the change of an apparatus license to bandwidth license, the government of Indonesia has implemented a policy to give the spectrum user a maximum 5-year transition period. First year until the end of transition, the determination of the spectrum fee for a bandwidth license is calculated the obligation of an apparatus license for each spectrum licensee in the previous year before the transition period.

Apparatus License

TRANSITIONnN

Bandwidth License

The spectrum fee for an apparatus license for each spectrum licensee in previous year is used initial amount of the spectrum fee for a bandwidth license for each spectrum licensee which gradually to a bandwidth license in accordance with the calculation formula. The transition formula based on new government regulation is defined as follows:

* 1. First Year

|  |  |
| --- | --- |
| First Year | Y1 = X + ((W x (100/T)% x ∆) – Z) |

* 1. Second Year to The End of Transition (Y)

|  |  |
| --- | --- |
| Year W | Yw = X + (W x (100/T)% x ∆ |

With:

* Y = the spectrum fee for the related year
* X = the apparatus license spectrum fee value of the licensee at the time of year 1
* W = consecutive numbers ranging from 1 to T correspond to the bandwidth license year period to which the staging period applies
* T = the time of transition period
* ∆ = the different spectrum values of the apparatus license and bandwidth license

(N x K x I x C x B)

* Z = the reduction factor that compensates for the excess license term of the apparatus license when implementing the bandwidth license

For example: if transition period is 5 years, the spectrum user will pay the spectrum fee using the formula below:

|  |  |
| --- | --- |
| Year 1 | Y1 = X + ((20% × ∆) – Z) |
| Year 2 | Y2 = X + (40% × ∆) |
| Year 3 | Y3 = X + (60% × ∆) |
| Year 4 | Y4 = X + (80% × ∆) |
| Year 5 | Y5 = X + (100% × ∆) |

After the transition period, the spectrum user will pay the spectrum fee using the formula (N x K x I x C x B)

**5) Korea, Republic of**

(Please refer to [Annex 3 to document 1B/80](https://www.itu.int/dms_ties/itu-r/md/19/wp1b/c/R19-WP1B-C-0080!N03!MSW-E.docx))

Spectrum Incentive pricing can be calculated in one of three ways. (“Enforcement Decree of the Radio Waves Act” Article 14, 14-2, Attached Form 3)

* the benchmarking method
* the price based on the forecasted revenue
* unit price per unit bandwidth

Spectrum pricing for Local 5G is calculated based on the frequency band, bandwidth, duration, geographic area and geographic location. There are some incentives under related policy and it is imposed as shown below: Annual payment = Base price per MHz × (5×a1 + a2 +\_1) × duration × Number of blocks

Base price per MHz: KRW100,000 per 10 MHz for 4.7GHz and KRW50,000 per 50 MHz for 28GHz

a1: service area in case of metropolitan areas

a2: service area in case of non-metropolitan areas

Number of blocks: blocks to apply for assignment

**6) Thailand**

The NBTC used three different methods to determine the value of IMT spectrum which are business model, benchmarking approach, and econometric model. The business model approach—essentially determine how much is the firm willing to pay for the spectrum band through examination of its potential future cashflows—was employed to set an upper bound of the value of the IMT spectrum. The benchmarking and econometric models were employed to ensure that values of any specific band are in line with other countries. For benchmarking, we computed the average of value per MHz per population using other countries’ past auction results for the specific band that we were interested in. The other benchmarking method yields relative value by multiplying a band’s past winning bid in Thailand with the average ratio between values of the auctioned band and the specific band that we are evaluating. The ratio is computed using other countries’ past auction results. Econometrics modelling follows standard model that explains winning price through auction-related variables, socioeconomic variables, and some dummies variables to differentiate time and regions.

**7) Palau**

Frequencies below 1 GHz (per 10 MHz)

Frequencies above 1 GHz, but below 6 GHz (per 10 MHz)

Frequencies above 24 GHz (per 100 MHz)

(Please refer to [Annex 3 to document 1B/80](https://www.itu.int/dms_ties/itu-r/md/19/wp1b/c/R19-WP1B-C-0080!N03!MSW-E.docx))

**8) Viet Nam, Socialist Republic of**

(Please refer to [Annex 3 to document 1B/80](https://www.itu.int/dms_ties/itu-r/md/19/wp1b/c/R19-WP1B-C-0080!N03!MSW-E.docx))

1. Comparative approach (Benchmarking method). Using Benchmarking method to determine the basic amount of Payment for the right to use spectrum. In case of licensing the IMT spectrum by auction, the basic amount of Payment for the right to use spectrum equal the reserve price.
2. To determine the basic amount of Payment for the right to use spectrum for specific band, the total winning bid of the equivalent frequency band in other countries (so call samples). The basic amount of Payment is the average of amounts converted from winning bids in auctions of valid samples.
3. The selection of samples from countries or territories for benchmarking:

* Only information on auctions in countries or territories which have been completed before the date of base fee determination shall be collected;
* Information on each auction collected shall be considered as a sample;
* Valid sample means a sample which is not removed under the method for removing outliers prescribed in Appendix VII enclosed Decree 63/2023/ND-CP;
* Required number of samples: At least 04 samples are collected and there are at least 03 valid samples after removing outliers;
* Samples of frequency bands of the same type with the subject frequency band shall be taken within duration of the last 07 years before the date of base fee determination which may be extended up to 10 years if the required number of samples cannot be taken in full. Where the number of samples required cannot be achieved, samples of similar frequency bands of the subject frequency band may be taken within duration of the last 07 years before the date of base fee determination which may be extended up to 10 years in order to achieve the required number of samples.
* If the required number of samples cannot be achieved after samples of both frequency bands of the same type and similar frequency bands have been collected within the last 10 years before the date of base fee determination, the method specified in this Article shall not apply to determination of the base fee.
* Samples shall be also taken from auctions for frequency bands of the same type and/or similar frequency bands of the subject frequency band conducted in Viet Nam within the prescribed sampling duration.
* The duration of use of the licensed frequency band shall be at least 10 years;
* The auction for right to use frequency band is conducted nationwide; information on auctions by geographical areas shall not be collected.

1. Data collected from countries or territories for base fee determination must meet the following requirements:

* Data on the winning bid, bandwidth and duration of use of the frequency band licensed through an auction in a country or territory shall be obtained through consultations with, or from sources announced by, competent authorities of that country or territory. Where there are multiple sources of data, the data obtained through consultations with competent authorities shall be used;
* Consultation requirements:

If the list of countries or territories that have conducted auctions for the frequency band on which information needs to be collected can be obtained from the Global System for Mobile Communications Association (GSMA), request for consultation shall be sent to competent authorities of the listed countries or territories that have not yet published adequate information on the time of publishing auction result, winning bid, frequency band and licensed duration of use of frequency band. If the said list is not available, the request for consultation shall be sent to competent authorities of all countries or territories that have not yet published adequate information on the time of publishing auction result, winning bid, frequency band and licensed duration of use of frequency band.

Within 15 days from the date of the request, if no response is given, it shall mean that requested information is not available. Requests for consultation and responses shall be sent and received via email, by fax or post or in any another appropriate form;

* Data on population and GDP/capita of countries or territories and of Viet Nam shall be obtained from the website of World Bank. If data on population and GDP/capita of a country or territory is not available on World Bank, it can be obtained from competent authority of that country or territory;
* Data on exchange rates between currencies used in auctions of countries or territories shall be obtained from financial market websites in the following order of priority; Bloomberg financial market website, X-rates financial market website or another financial market website specializing in providing exchange rates;

For more detail: <https://vanban.chinhphu.vn/?pageid=27160&docid=208534>

**8) Sri Lanka**

By the Published Rules – Extraordinary Gazette No 1497/23(Radio Frequency ) Land Mobile license fee rules and the Upfront fee.(URL: <https://trc.gov.lk/images/pdf/5_1497_23e.pdf> )

(Please refer to [Annex 3 to document 1B/80](https://www.itu.int/dms_ties/itu-r/md/19/wp1b/c/R19-WP1B-C-0080!N03!MSW-E.docx))

**9) Brunei Darussalam**

Our current reference for regulation in Brunei Darussalam is the Telecommunications (Radio-communication) Regulations, 2013 and the Telecommunications (Radiocommunication) (Amendment) Regulations, 2022.

There are 2 fees: Spectrum Rights Fee and Annual Fees for Use of Radio Frequency





**10) Pakistan**

In Pakistan market analysis and price valuation/assessment for IMT spectrum is usually done by reputed international consultant using various financial/commercial techniques including international benchmarking, NPV etc. Based on consultant recommendations final determination of value of IMT spectrum is done by Government of Pakistan.

**11) Philippines (Republic of the)**

Not available

(Please refer to [Annex 3 to document 1B/80](https://www.itu.int/dms_ties/itu-r/md/19/wp1b/c/R19-WP1B-C-0080!N03!MSW-E.docx))

**12) Nepal (Federal Democratic Republic of)**

• Supply and demand of Spectrum

• International practices, usefulness, management fee, purchasing capacity of user and per capita income

• Signal propagation Characteristics, Radio coverage and spectral efficiency

• Investment on infrastructure development, availability of equipment, ecosystem development

• Historical price analysis and comparison of spectrum fee in other bands.

**13) Japan**

The standard price of IMT spectrum to represent its economic value is presented in the guidelines by the Minister of Internal Affairs and Communications. Taking into account this standard price, each applicant is requested to include information on a fee that will be paid annually to the government in the IMT base stations’ deployment plan.

To calculate the standard price, the following steps are taken: In the first step, a reference price is determined by analyzing the winning bid amounts from 5G frequency auctions in various countries. Adjustments are then made to account for factors such as frequency band and bandwidth, license duration, coexistence with other radiocommunication systems, and the economic scale of those countries. In the second step, additional adjustments are made to the reference price, considering factors specific to the Japanese situation. These factors include the frequency band and bandwidth, specified period, issues related to spectrum sharing with other incumbent systems, including the costs required to facilitate the early transition of incumbent radio stations to other frequency bands, and interference issues in adjacent frequency bands.

## **2.6 Responses to Question 4 (Does your Administration willing to share the reserved/starting price and auction price results with the associated requirement to licensees of the IMT spectrum?)[[6]](#footnote-7)**

| **APT Member** | **Auctioned bands** | **Reserved price** | **Payment term** | **License &duration** | **License type** | **Roll-out obligations** |
| --- | --- | --- | --- | --- | --- | --- |
| Bhutan | No. We have not done auction | | | | | |
| China | No. | | | | | |
| India | Yes. The details of IMT spectrum bands put up for auction along with reserve price details and other terms and conditions (including payment term, license duration, roll out obligations, etc.) of the last auction held in July-August 2022 can be found in the ‘Notice Inviting Applications’ for auctions. Auction results provide key information including final value of spectrum for each service area and different IMT frequency bands. Details of auctions held in India for IMT spectrum bands since 2010 can be found at <https://dot.gov.in/spectrum>. | | | | | |
| Indonesia | Year 2017, FDD 1970-1975 MHz pair with 2160-2165 MHz | • Auction Price IDR 42.31 billion MHz/year (around USD 2.8 million MHz/year) | • The payment amount for the first year is 2x each winner’s bidding price as an upfront fee and 1x the lowest winner’s bidding price as an annual fee  • The payment amount for the second year until the tenth year is 1x the lowest winner’s price as an annual fee. | 10 years | Nationwide | - |
| Year 2017, FDD 1975-1980 MHz pair with 2165-2170 MHz | • Auction Price IDR 42.31 billion /MHz/year  (around USD 2.8 million MHz/year) | • The payment amount for the first year is 2x each winner’s bidding price as an upfront fee and 1x the lowest winner’s bidding price as an annual fee  • The payment amount for the second year until the tenth year is 1x the lowest winner’s price as an annual fee. | 10 years | Nationwide | - |
| Year 2017, TDD 2300-2330 MHz | • Auction Price IDR  33.58 billion /MHz/year (around 2.2 million MHz/year) | • The payment amount for the first year is 2x each winner’s bidding price as an upfront fee and 1x the lowest winner’s bidding price as an annual fee  • The payment amount for the second year until the tenth year is 1x the lowest winner’s price as an annual fee. | 10 years | Nationwide | - |
| Year 2021, TDD 2360-2390 MHz | • Auction Price IDR  17.69 billion /MHz/year  (around USD 1.17 million /MHz/year) | • The payment amount for the first year is 2x each winner’s bidding price as an upfront fee and 1x the lowest winner’s bidding price as an annual fee  • The payment amount for the second year until the tenth year is 1x the lowest winner’s price as an annual fee. | 10 years | Regional | To deploy a minimum of 3 transmitters using 2.3 GHz in each city where Fiber Optic connection is available, utilizing either 4G (LTE) or 5G (IMT-2020) technology. |
| Year 2022, FDD 1975-1980 MHz pair with 2165-2170 MHz | • Auction Price IDR  60.5 billion /MHz/year  (around USD 4.03 million MHz/year) | • The payment amount for the first year is 2x each winner’s bidding price as an upfront fee and 1x the lowest winner’s bidding price as an annual fee  • The payment amount for the second year until the tenth year is 1x the lowest winner’s price as an annual fee. | 10 years | Nationwide | - |
| Korea[[7]](#footnote-8) | 3400-3700 MHz | Reserved/starting price: USD 2,428.8  (KRW 2,654)  Auction Price:  USD 2,741.3  (KRW 2,996)  0.98USD/MHz/year | • 25% upfront payment  • The rest is annually paid | 10 years | Nationwide | 22,500 base stations in 3 years, 45,000 base stations in 5 years |
| Nepal[[8]](#footnote-9) | 700 MHz (band 28) | Reserve Price: 13.5 mil NPR/MHz/year  Not auctioned yet. | Annually (in advance) | Until the validity of Service License. The Service License is issued for a maximum of 25 years duration (after 3 renewals) and may be reissued thereafter. | Nationwide | - |
| 800 MHz (band 20) | Reserve Price: 13.5 mil NPR/MHz/year  Not auctioned yet. | - |
| 900 MHz (band 8) | Reserve Price: 24 mil NPR/MHz/year  Auction Price: 38.88 mil NPR/MHz/year | - National 4G coverage (in all 7 provinces and 77 district headquarters) within a specified time;  - 4G coverage in urban area shall be 95% (by population) within specified period;  - 4G coverage in rural areas of municipalities and rural municipalities shall be 90% (by population) within a specified period;  - 4G coverage in Tourist Areas/Specified National Parks/High Way shall be 95% within a specified period;  - All installed 4G sites shall be of LTE-advanced standard;  - User Experience (Download Speed) shall be of minimum of 20 Mbps in Urban and 10 Mbps in rural areas;  - In order to ensure that the coverage & capacity requirements in urban and rural areas are met as prescribed above, the Operator shall deploy additional 3,000 new 4G sites within a specified time period;  - Operator shall report to NTA about the progress of new 4G sites deployment quarterly (including site quantity, population coverage and speed). |
| 1800 MHz (band 3) | Reserve Price: 18 mil NPR/MHz/year  Auction Price: 29 mil NPR/MHz/year |
| 2100 MHz (band 1) | Reserve Price: 12 mil NPR/MHz/year  Auction Price: 15 mil NPR/MHz/year |
| 2300 MHz (band 40) | Reserve Price: 9 mil NPR/MHz/year  Not auctioned yet. | - |
| 2600 MHz (band 7, 38) | Reserve Price: 5.5 mil NPR/MHz/year  Not auctioned yet. | - |
| Philippines | 3400 – 3600 MHz | 1 Mil/1MHz/1 year | 3 terms:   * 10% at the day license granted. * 40% in the next three months. * 50% in the next six months. | 10 years | Nationwide/Regional | 50% of population coverage in 2 years from licensed. |
| Thailand | 2100 MHz | 2012  Reserved price: 13,500 million Baht (2x15 MHz)  Auction price:  DTN – 13,500 million Baht  (2x15 MHz)  TUC – 13,500 million Baht  (2x15 MHz)  AWN – 14,625 million Baht  (2x15 MHz) | 3 terms  - 50% at 90 days from the date of receipt notice of the winning bidder  - 25% per year until the end of the period | 15 years | Nationwide | Not less than 50% of population coverage in two years  Not less than 80% of population coverage in four years |
| 1800 MHz | 2015  Reserved price: 15,912 million Baht (2x15 MHz)  Auction price:  TUC – 39,792 million Baht  (2x15 MHz)  AWN – 40,986 million Baht  (2x15 MHz)  2018  Reserved price: 12,486 million Baht (2x5 MHz)  Auction price:  DTN – 12,511 million Baht  (2x5 MHz)  AWN – 12,511 million Baht  (2x5 MHz) | 3 terms  - 50% at 90 days from the date of receipt notice of the winning bidder  - 25% per year until the end of the period | 18 years | Nationwide | Not less than 40% of population coverage in four years  Not less than 50% of population coverage in eight years |
| 900 MHz | 2015  Reserved price: 12,864 million Baht (2x10 MHz)  Auction price:  TUC – 76,298 million Baht  (2x10 MHz)  2016  Reserved price: 75,654 million Baht (2x10 MHz)  Auction price:  AWN – 76,298 million Baht  (2x10 MHz)  2018  Reserved price: 37,988 million Baht (2x5 MHz)  Auction price:  DTN – 38,064 million Baht (2x5 MHz) | 4 terms  - 4,020 million baht at 90 days from the date of receipt notice of the winning bidder  - 2,010 million baht in the next for two the period  - Rest of the auction fee in the end of the period | 15 years | Nationwide | Not less than 40% of population coverage in four years  Not less than 50% of population coverage in eight years |
| 700 MHz | 2020  Reserved price: 8,792 million Baht (2x5 MHz)  Auction price:  NT – 34,306 million Baht  (2x10 MHz)  AWN – 17,154 million Baht  (2x5 MHz) | 10 terms  - 10% at 15 days before permission.  - 10% per year until the end of the period. | 15 years | Nationwide | - |
| 2600 MHz | Reserved price: 1,862 million Baht (10 MHz)  Auction price:  AWN – 19,561 million Baht  (100 MHz)  TUC – 17,872.89 million Baht  (90 MHz) | 7 terms  - 10% 15 days before permission.  - 15% per year until the end of the period. | 15 years | Nationwide | Not less than 50% of area coverage in ECC within one year from licensed  Not less than 50% of population coverage in center city within four years |
| 26 GHz | Reserved price: 423 million Baht  (100 MHz)  Auction price:  AWN – 5,345 million Baht  (1200 MHz)  TUC – 3,576.89 million Baht  (800 MHz)  NT – 1,795 million Baht  (400 MHz)  DTN – 910.4 million Baht  (200 MHz) | 1 term within one year from the date of receipt notice of the winning bidder | 15 years | Nationwide | - |
| Viet Nam | 2300 – 2400 MHz | 550 thousand USD/MHz/year | Within the 4-months period from the date of notification, winner must pay final bidding in one installment. | 15 years | Nationwide | ***1. For 4G network deployment:***  - After 2 years from the date of a license granted: at least 2000 BTSs be deployed.  - Average download data speed: at least 50 Mbps.  ***2. For 5G network deployment:***  - After 2 years from the date of a license granted:  + 5G coverage to at least 200 administrative units at district level and 1000 administrative units at commune level (at least 01 station/unit).  + at least 2000 BTSs be deployed.  - By the end of the license period: at least 15 000 BTSs be deployed.  - Average download speed: at least 100 Mbps; Average upload speed: at least 30 Mbps. |
| 2500 – 2600 MHz | Reserved price: 3.983.257.500.000 VND  Auction price:  Viettel: 7.533.257.500.000 VND  (100 MHz) | a) Within 03 months from the date the Ministry of Information and Communications approves the auction results, the winning bidder must pay at least 50% of the amount of money for the right to use radio frequencies at one time  b) Within 30 months from the date the Ministry of Information and Communications approves the auction results, the winning bidder must pay at least 50% of the remaining amount of money for the right to use radio frequencies at one time, plus the interest calculated as prescribed in Clause 4, Article 53 of Decree 63/2023/ND-CP  c) Within 60 months from the date the Ministry of Information and Communications approves the auction results, the auction winning organization must pay the remaining amount of radio frequency usage rights at one time, plus interest calculated according to the provisions of Clause 4, Article 53 of Decree 63/2023/ND-CP | 15 years | Nationwide | 1. After 02 years from the date of being licensed to use this frequency band, commit to deploying at least 3,000 5G BTSs. 2. Commit to officially provide terrestrial mobile telecommunications services using this frequency band no later than 12 months from the date of being licensed to use the 3800-3900 MHz frequency band.   At the time of officially providing terrestrial mobile telecommunications services using this frequency band, the enterprise must deploy at least 30% of the number of radio transmission stations committed to deploy within the first 02 years from the date of being licensed to use this frequency band. |
| 3700 – 3800 MHz | Reserved price: 1.956.892.500 VND  Auction price:  VNPT: 2.581.892.500 VND  (100 MHz) | a) Within 03 months from the date the Ministry of Information and Communications approves the auction results, the winning bidder must pay at least 50% of the amount of money for the right to use radio frequencies at one time  b) Within 30 months from the date the Ministry of Information and Communications approves the auction results, the winning bidder must pay at least 50% of the remaining amount of money for the right to use radio frequencies at one time, plus the interest calculated as prescribed in Clause 4, Article 53 of Decree 63/2023/ND-CP  c) Within 60 months from the date the Ministry of Information and Communications approves the auction results, the auction winning organization must pay the remaining amount of radio frequency usage rights at one time, plus interest calculated according to the provisions of Clause 4, Article 53 of Decree 63/2023/ND-CP | 15 years | Nationwide | 1. After 02 years from the date of being licensed to use this frequency band, commit to deploying at least 3,000 5G BTSs. 2. Commit to officially provide terrestrial mobile telecommunications services using this frequency band no later than 12 months from the date of being licensed to use the 3800-3900 MHz frequency band.   At the time of officially providing terrestrial mobile telecommunications services using this frequency band, the enterprise must deploy at least 30% of the number of radio transmission stations committed to deploy within the first 02 years from the date of being licensed to use this frequency band. |
| 3800 – 3900 MHz | Reserved price: 2.581.892.500.000 VND  Auction price:  Mobifone: 2.581.892.500.000 VND (100MHz) | a) Within 03 months from the date the Ministry of Information and Communications approves the auction results, the winning bidder must pay at least 50% of the amount of money for the right to use radio frequencies at one time  b) Within 30 months from the date the Ministry of Information and Communications approves the auction results, the winning bidder must pay at least 50% of the remaining amount of money for the right to use radio frequencies at one time, plus the interest calculated as prescribed in Clause 4, Article 53 of Decree 63/2023/ND-CP  c) Within 60 months from the date the Ministry of Information and Communications approves the auction results, the auction winning organization must pay the remaining amount of radio frequency usage rights at one time, plus interest calculated according to the provisions of Clause 4, Article 53 of Decree 63/2023/ND-CP | 15 years | Nationwide | 1. After 02 years from the date of being licensed to use this frequency band, commit to deploying at least 3,000 5G BTSs. 2. Commit to officially provide terrestrial mobile telecommunications services using this frequency band no later than 12 months from the date of being licensed to use the 3800-3900 MHz frequency band.   At the time of officially providing terrestrial mobile telecommunications services using this frequency band, the enterprise must deploy at least 30% of the number of radio transmission stations committed to deploy within the first 02 years from the date of being licensed to use this frequency band. |
| Sri Lanka | No. (Depends on Assigning Methodology) | | | | | |
| Brunei Darussalam | 3400-3500 MHz | Spectrum Rights  Fee:  BND16,250,000  Annual Fees For  Use of Radio  Frequency: BND  800,000 | Spectrum Rights  Fee: One-time  payment  Annual Fees For  Use of Radio  Frequency:  Annual payment | 20 years | Nationwide | None |
| Pakistan | 1800 MHz, 2100MHz for Year 2021  (previous years details avail on [Spectrum Auctions PTA](https://www.pta.gov.pk/en/spectrum-auctions)) | 31 Mil USD/MHz/15year,  29 Mil USD/MHz/15year  Both Reserved/starting price and auction price were same | • 100% at the day license granted  or  • 50% at the day license granted and remaining in 5 equal installments  in the next five years | 15 years | Cellular Mobile License, Nationwide | 3% annual increase in population coverage every year |
| Palau | No | | | | | |
| Nepal | 900MHz | 24 (Base Rate) 38.88(Auction Price) | yearly | Until the validity of Service License | | • The operator shall ensure that it shall provide national 4G coverage (in all 7 provinces and 77 districts) within a specified period  • 4G coverage in urban area shall be 95% (by population) by end of 2022.  • 4G coverage in rural areas of municipalities and rural municipalities shall be 90% (by population) within a specified period  • 4G coverage in Tourist Areas/Specified National parks/Highway shall be 95% within a specified period.  • 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. |
| 1800MHz | 18 (Base Rate)  29(Auction Price) | yearly |
| 2100MHz | 12(Base Rate)  15(Auction Price) | yearly | Until the validity of Service License | |

# 3. Summary

This Report has compiled the responses from 14 APT Members to the questions summarized in section 2.1 about the questionnaire.

* Regarding the IMT spectrum licensing method, the auction method has been adopted by 9 APT Members, while the first-come first-serve method still be the choice in 9 APT Members. In addition, the beauty contest and others method are still chosen by some APT Members.
* As for pricing of IMT spectrum, each of these APT Members has its own policies that are appropriate to their current situation when deciding on prices.
* If the reserved price is set too high, valuable spectrum may go unsold or sold at such a high price that consumers may suffer due to limited competition and high prices.

**ANNEX. GSMA’S STUDIES ON BEST PRACTICES FOR**

**LICENSING AND PRICING OF IMT SPECTRUM**

This Annex provides relevant information on best practices for the licensing and pricing of IMT spectrum. The information supplements the responses from APT Member Administrations to the questionnaire compiled which are compiled in the above APT Report on “Methodology to determine value of IMT Spectrum and information on Spectrum Prices in Asia Pacific countries”.

1. **Introduction**

Spectrum is a finite resource essential to the operation of mobile networks. As such, it is a valuable commodity in high demand globally. Licensed spectrum is required for mobile services to ensure quality of service and customer value. This, in turn, facilitates the investments needed to deploy mobile networks with good quality and widespread coverage. The licensing of spectrum bands for mobile services also supports international harmonisation, which delivers lower cost devices and equipment through economies of scale.

The primary objectives of a licensing framework are to:

* ensure operators have access to sufficient spectrum
* provide predictability to support the new network investment needed
* avoid costly restrictions on the use of spectrum beyond those needed to manage interference.[[9]](#footnote-10)

1. **Type of award mechanism**

Auctions are the most common methodology around the world and work best when there is excess demand for the spectrum and help select those operators most likely to put it to the best use in benefitting society. Administrative or direct assignments, on the other hand, may be suitable in certain cases where there is less demand and may allow authorities to compare different aspects of the bids offered by the candidates and how they align with policy objectives. Sometimes, a hybrid approach involving elements of auction and administrative awards may also be used, for example in spectrum renewal processes.

There is no single best assignment approach. The merits of each approach have to be assessed on a case-by-case basis. Figure A1 below compares the advantages and disadvantages of auctions and administrative assignments. Careful consideration of policy objectives and specific market conditions in the award design is necessary. These include factors such as current spectrum use, the competitiveness of the market, and the promotion of investment in mobile networks. It is important for policymakers and regulators to identify issues through public consultation and to weigh up the trade-offs in specific design choices (noting the importance of efficient spectrum use and safeguarding competition). Sufficient time and transparency should be provided to allow potential candidates to make informed decisions.

**Figure A1: Comparison of auctions and administrative assignments**

|  |  |  |
| --- | --- | --- |
| **Mechanism** | **Advantages** | **Disadvantages** |
| **Auctions** | Well-designed auctions result in spectrum being assigned to the operators who value it most and will generally use it to improve connectivity.  Auctions seek to discover the market value of spectrum and obtain a fair return.  Outcome is typically transparent and legally robust. | Poor auction design can lead to spectrum being assigned inefficiently or in way that harms competition in communications markets.  Inflated prices risk restricting the licensee’s ability to invest in their network. |
| **Administrative assignment** | Enables a range of criteria to be taken into account and for authorities to balance the trade-off between objectives.  Authorities can select the level of the licence fee, which may improve operators’ ongoing financial viability and assist in raising capital for network investment.  Ability to set network investment or coverage requirements to focus on delivering high quality services rather than raising state revenues.  Can be quick and affordable to organise. | Licences may be assigned to the candidate that presents an attractive proposal rather than the candidate that can make best use of the spectrum.  When operators fail to meet commitments after the auction, authorities may face difficult choices as to whether to cancel the licence or otherwise penalise the operator.  Administrative assignment is vulnerable to bias or corruption. Even the perception of such issues can lead to protracted legal disputes that delay spectrum being put to good use. |

1. **Spectrum pricing**

In most cases, an up-front price is paid for spectrum licences, normally at auction but occasionally through administrative awards such as beauty contests. Licensees also normally pay an annual fee to cover the costs of managing spectrum. In some cases, the annual fee can be higher where licences have been renewed without an up-front cost, or where lower up-front charges were applied.

Authorities set spectrum licence fees for three main purposes:

* To recover the administrative cost of licensing process and spectrum management
* To encourage efficient spectrum use
* To raise revenue for the government

The primary goal of charging a fee for spectrum is to encourage the most efficient use of spectrum through investment in widespread, high quality networks and in doing so deliver the maximum benefits for society. In this way, a well-designed auction will assign spectrum to those who value it most, thus incentivising them to use it efficiently through investment in widespread, high quality mobile networks.

The balance between raising revenue and setting policies that help maximise the socio-economic benefits of mobile connectivity has to be right. The higher the level of licence fees, the greater risks that no operators will acquire the spectrum, that competition will be reduced, or that final prices will be too high.

It is crucial that licence fees are not set at levels that exceed the opportunity cost of the spectrum. Efficiency in markets is promoted where users consider the opportunity cost of a resource. The opportunity cost of spectrum is the value the spectrum would have if used in the next best alternative. Where there is no excess demand for the spectrum band, then the opportunity cost of the spectrum will be zero.

1. **Spectrum valuation and pricing approaches**

There are a range of spectrum pricing approaches with different terms. Options include whether charges are levied as an upfront sum, annually or a combination of both, and whether the charge is fixed or varies with revenues. The basis for setting prices may also vary from recovery of regulatory costs to promoting efficiency or government revenue objectives.

Auctions can directly determine market value and prices that reflect the market value of spectrum. When designed and implemented correctly, they help promote efficient spectrum use.[[10]](#footnote-11) Where these market mechanisms are not used, different approaches to estimate the market value and set spectrum prices are possible as described in Figure A-2.

One way to estimate market value is considering the costs operators avoid by gaining an additional increment of spectrum. For example, operators with more spectrum need fewer cell sites to supply the same traffic volumes. The incremental value of spectrum can be estimated on the basis of this trade-off, taking into account the network being modelled and traffic forecasts.

An alternative approach is using benchmarks based on recent auctions. The accuracy of benchmarking depends on using comparable spectrum bands, conditions, and countries. For important spectrum bands, where the cost of errors is high, the combined use of both modelling and benchmarking can further improve accuracy. Benchmarks also require normalisations, such as via ARPU or revenue, depending on market conditions.

**Figure A2: Pricing Approaches for Spectrum**

| **Approach** | **Overview** | **Considerations** |
| --- | --- | --- |
| Administrative costs | Appropriate where there is no excess demand for spectrum | May not lead to efficient spectrum use where there is excess demand for the spectrum and where spectrum assignment is not market based |
| Share of revenue | Shares risk between government and operator | Trading off predictability for flexibility would only be beneficial in some circumstances  If not paid retroactively, requires modelling based on assumptions.  Runs significant risk of placing onerous, high fees and limiting investment |
| Avoided cost modelling | Provides a direct estimate of the value (cost savings) of an increment of spectrum | Requires modelling based on assumptions  May overestimate or underestimate value, risking investments |
| Benchmarking | Simple and transparent where close benchmarks exist, and correct normalisations are used | Results dependent on benchmarking sample set available  Will be inaccurate if the analysis does not fully account for differences in factors impacting market value |
| Net Present Value | Provides a direct and fair estimate of the value of an increment of spectrum, based on costs and revenue  Accurate to the specific market and based on historical data  Considers both costs and revenues for the duration of the license | Complex and requires many different variables; requires modelling based on assumptions  May overestimate value if done wrong; may be a risk to the interest for the available spectrum  Hard to be implemented to new technologies when additional services may be unlocked |

Setting an upfront licence fee is often seen by economists as preferable to annual charges. However, upfront fees need careful consideration to be set as affordably as possible, as they carry greater risks to operators and may be harder to justify when future technological and market development is uncertain. Instalment payments can also be made available to operators, adding another possibility to their financial strategy.

1. **Auction reserve prices**

Reserve prices are used in auctions to help discourage uncertain bidders and ensure a floor price for spectrum in case competition for the licences is weak. However, reserve prices should be set conservatively so as not to undermine the price discovery function of the auction, which is central to the market-based approach to spectrum management.

If reserves are set too high, valuable spectrum may go unsold or sold at such a high price that consumers may suffer due to limited competition and high prices. Where competition is expected, reserve prices can be set as a minimum safety net as competition in the auction will ensure fair prices.

1. **Risks of excessive spectrum prices and rising total cost of spectrum**

High spectrum prices also have other serious consequences for consumers. Expensive spectrum can impact the mobile sector by reducing the funds available to undertake investments and generating upward pressure on consumer tariffs. A study by GSMA Intelligence found significant evidence of a causal link between high spectrum prices and slower mobile data speeds, worse coverage and slower rollouts.[[11]](#footnote-12) It found that in the countries studied with the highest spectrum prices, the average mobile operator’s 4G network would cover 7.5% more of the population if they had acquired spectrum at the median spectrum price. Numerous other studies also highlight similar harms to consumers from high spectrum prices.[[12]](#footnote-13)

A particular concern in the 5G era is rising cost of spectrum. As demand for mobile increases, the amount of spectrum required to meet user demand and the total cost of spectrum are rising, while at the same time, operator revenues per MHz of spectrum used is falling. Unless this changes it will become increasingly difficult, and ultimately impossible, to fund sufficient investment in future mobile spectrum and networks.

As the supply of mobile spectrum increases, reduction in unit spectrum prices is vital in order to avoid total spectrum costs spiralling. High spectrum costs also make it difficult to extend services more widely, especially in rural areas where the cost of delivering services is significantly higher than in cities. Regulators can respond by avoiding measures that artificially increase the cost of spectrum, and planning spectrum awards in a manner that enables a fall in spectrum prices in line with the increase in spectrum supply.

1. **Licence obligations**

Regulators sometimes impose obligations on licensees to provide a particular level of service coverage within a specified time frame. These can include requirements to offer certain services, or quality-of-service levels, as well as measures relating to universal access and consumer protection objectives.

In deciding on obligations, it is important to assess the benefits and costs of such obligations, and whether there are less costly means to achieve the objectives such as improving the conditions for the provision of commercial services. Where obligations are imposed, they should be made clear prior to the auction or assignment process so that operators can develop a viable business case. Costs related to licence conditions and obligations should be deducted from spectrum costs. Some regulators and policymakers have implemented innovative spectrum pricing approaches by assigning spectrum in exchange for connectivity, coverage and infrastructure build-out.[[13]](#footnote-14)

1. **Best practices and considerations for spectrum pricing and fees**

* Spectrum prices should promote, and not undermine, the optimal use of spectrum for the benefit of society.
* High spectrum fees reduce the funds available for investment and will negatively impact the quality, speed and reach of mobile broadband services.
* Licensing authorities should set auction reserve prices conservatively to allow the market to determine a fair price and to reduce the risk of leaving spectrum unassigned.
* Authorities should be particularly careful not to set renewal fees that remove returns on earlier investments. Renewal fees should only recoup administrative costs.

Costs related to conditions or obligations attached to the licence should be deducted from spectrum fees.[[14]](#footnote-15)

1. In China, the 3400-3600 MHz band was planned for IMT-2020 in November 2017, and it was licensed for 5G trial in December 2018, and officially for commercial use in June 2019. In China, it was used by Fixed Satellite Service on a primary basis for a long time in this band. There are intra-band and inter-band interferences between 5G station and FSS earth station. In December 2018, MIIT issued the Interference Coordination Regulation between 5G stations and other radiocommunication stations in 3.0-4.2 GHz which took effects from 1st January 2019. There is a description that the costs incurred by various measures taken to prevent 5G base stations from interfering with satellite earth stations in the 3400-4200 MHz band shall be borne by the operators setting up and using 5G base stations in the 3400-3600 MHz band. [↑](#footnote-ref-2)
2. View of industries on spectrum award mechanism is provided in Section 2 of Annex enclosed in this report. [↑](#footnote-ref-3)
3. Palau: (1) Frequencies below 1 GHz (per 10 MHz): **Application Fee (**160 or as determined in the tender documents); **Annual Fee (**8,000**); Renewal Fee (**As determined by the Bureau at the time of renewal).

   (2) Frequencies above 1 GHz, but below 6 GHz (per 10 MHz): **Application Fee (**160 or as determined in the tender documents); **Annual Fee (**4,000**); Renewal Fee (**As determined by the Bureau at the time of renewal);

   (3) Frequencies above 24 GHz (per 100 MHz): **Application Fee (**160 or as determined in the tender documents); **Annual Fee (**As determined by the Bureau in the spectrum license**); Renewal Fee (**As determined by the Bureau in the spectrum license). [↑](#footnote-ref-4)
4. View of industries on methodology to determine value of IMT spectrum is provided in Section 4 of Annex enclosed this report. [↑](#footnote-ref-5)
5. https://www.trai.gov.in/sites/default/files/CP\_30112021.pdf and https://www.trai.gov.in/sites/default/files/Recommendations\_11042022.pdf [↑](#footnote-ref-6)
6. View of industries on reserved price and auction results are provided in Section 5, 6 of Annex enclosed this report. [↑](#footnote-ref-7)
7. The Radio Waves Act stipulates that the regulator should consider and reflect the following five factors in setting the reserve price for the auction (Enforcement Decree of Radio Waves Act, Article 14.2):

   ① Assignment charges for radio frequencies of the same or similar use

   ② Characteristics and bandwidth of the radio frequency to be assigned

   ③ License duration, service types, and technical standards of the radio frequency to be assigned

   ④ Turnover expected from the business for which the radio frequencies are assigned

   ⑤ Demand for the radio frequencies to be assigned [↑](#footnote-ref-8)
8. 1 USD = 130 NPR (approx.) as of April 1, 2023 [↑](#footnote-ref-9)
9. GSMA. Best Practice in Mobile Spectrum Licensing. February 2022. <https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2022/02/Mobile-Spectrum-Licensing-Best-Practice.pdf> [↑](#footnote-ref-10)
10. GSMA. Auction Best Practice. September 2021. <https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2021/09/Auction-Best-Practice.pdf> [↑](#footnote-ref-11)
11. GSMA Intelligence. The impact of spectrum prices on consumers. September 2019. <https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2019/09/Impact-of-spectrum-prices-on-consumers.pdf> [↑](#footnote-ref-12)
12. ‘[The effects of spectrum allocation mechanisms on market outcomes’](https://www.sciencedirect.com/science/article/abs/pii/S030859611630194X) by T. Kuroda and M. Forero (2016) found that ‘auctions, when used to raise public revenues, not only transfer profits to government but also sacrifice consumer surplus’. A [Policy Tracker study for the European Commission](https://op.europa.eu/en/publication-detail/-/publication/2388b227-a978-11e7-837e-01aa75ed71a1/language-en) (2017) concluded that countries with low spectrum auction prices, long licence lengths and less onerous coverage obligations tend to have better network coverage, a wider choice of services, better take-up and healthy competition. [Spectrum 5.0: Improving assignment procedures to meet economic and social policy goals](https://hal.science/hal-01892202/document) by Gerard Pogorel and Erik Bohlin recommended governments prioritise mobile network investment rather than maximising spectrum fees [↑](#footnote-ref-13)
13. Examples include [Brazil’s multiband auction](https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2023/02/Brazil-Spectrum-Licensing-Best-Practice.pdf) in 2021 and [New Zealand’s 3.5 GHz award](https://www.gsma.com/connectivity-for-good/spectrum/wp-content/uploads/2023/09/New-Zealand-Spectrum-Licensing-Best-Practice.pdf) in 2023. In Europe, France and Germany have renewed mobile spectrum directly in exchange for network investments. [↑](#footnote-ref-14)
14. GSMA. Best Practice in Mobile Spectrum Licensing. February 2022. Further GSMA resources on spectrum pricing is available at <https://www.gsma.com/connectivity-for-good/spectrum/gsma_resources/effective-spectrum-pricing/> [↑](#footnote-ref-15)