ATU-R RECOMMENDATION

RELATING TO

SPECTRUM LICENSING FOR MOBILE/BROADBAND SYSTEMS

NUMBERED

ATU-R Recommendation 002-0

DATED

March 2021

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Contents

PART A: EXECUTIVE SUMMARY

Spectrum licensing is a strong statutory instrument that aligns the use of radio frequency spectrum with the national information and communications technology (ICT) policy objectives to the benefit of all citizens.

Spectrum licensing frameworks are a critical component of maximizing the use of spectrum resources to ensure that they enhance and expand the capacity and coverage of mobile and broadband networks for the benefit of end-users and bridging the Digital Divide. Besides ensuring that spectrum is made available in low, mid, and high frequency bands, the manner in which we make this spectrum available is equally important.

High quality mobile services are vital for consumers and businesses and deliver major socioeconomic benefits. They rely on increasing amounts of spectrum to support faster broadband speeds and rapidly growing data demand. Given there is a limited supply of mobile spectrum, it is vital that governments and regulators primary goal is to ensure it is awarded to operators who will use it most efficiently, as technology improvements alone cannot deliver the required capacity.

To this end, the development of guidelines that address, at a minimum, maximizing spectrum availability, implementing long-term spectrum licenses to maximize regulatory certainty, taking a technology-neutral approach to licensing, and making innovative licensing options available while ensuring the protection of existing services is recommended.

PART B: BRIEF DESCRIPTION

In order to ensure sustainable telecommunication business, effective use of radio spectrum, mobile broadband services to a wider population in the country, facilitation of social economic benefits, and nation's economic development, the Spectrum licensing process should consider:

1. Rules for use of the spectrum: license parameters; coverage and QoS obligations, equipment type approval, bilateral and multilateral agreements; obligations relating to the mutual interference caused to/by other services in the band or in adjacent bands;
2. Class of license whether it is a technology neutral license or dedicated license;
3. International commitment to protect services of other countries; interference that may be caused to the notified licensed network in border areas, while protecting the services of other countries and those taken by other governments to protect the licensed network.
4. Obligations to protect the public against potential health risks from electromagnetic waves;
5. License terms and conditions (e.g., fees, term limits, renewal period, modification as well as termination criteria);
6. Potential applicants' qualifications in terms of financing, operational experience in other countries, and management capabilities;
7. Making available a good mix of frequency bands for licensed and licence-exempt usage to meet demand and to support innovation;
8. The competing demands for spectrum: regulators should endeavour to make spectrum available across different services;
9. The impact of license duration on ICT sector investment. In particular, longer spectrum license terms increase regulatory certainty, encouraging investment in network deployment and upgrades. Shorter-term licenses can serve as a complement, ensuring efficient use of spectrum and meeting specific unique circumstance and needs;
10. Utilization of already identified spectrum for mobile communication, member states may consider not to or delay the licensing of additional new frequency bands for IMT until spectrum already identified for IMT has been fully licensed in the country;
11. Mobile services continue to demand additional spectrum even though much of the spectrum identified for mobile remains unused. Consideration should be given to re-farming opportunities in frequency bands already identified for IMT.

PART C: COLLATION OF PRACTICES

CASE STUDIES

1. The Republic of Sudan

Regarding the licensing of mobile/broadband, in the Republic of Sudan the main operators regularly award the license with agreement signed between the TPRA and the licensee. The license for all operators had been issued in a different time depending on the market requirement. The spectrum awarded case by case taking into consideration the economic status on that time, and the upfront fees was a portion of the total license fees.

Moreover, an annual usage fees is applicable for all the operators for the use of access and transmission frequencies.

The main mobile and broadband operators in Sudan are four and they are:

1- 1 Licensee had a unified licensing: Sudatel.

2- 2 mobile operators: Zain and MTN.

3- 1 fixed broadband operator: Canar.

The first operator was the incumbent and national operator. The sector then had been privatized in 1994 to have a competitive environment and to allow the entrance of other operators to improve the sector. The operator granted the unified license for providing both mobile and fixed broadband services. The spectrum for mobile was firstly granted in the 850 MHZ for CDMA technology. Later, granted the 3G and 4G GSM services and have spectrum in 900/1800/2100/800 and 700 MHz bands. This was done by spectrum reframing to increase the efficiency of the digital dividend spectrum of 800 and 700 MHz band.

The second operator had awarded the license for providing mobile services in Sudan and the spectrum in 900 and 1800 MHz band had been awarded to provide 2G service. The license for this operator had been developed to provide 3G service and a slot in 2100 MHz later. For providing, the 4 G services over the country TPRA finally signed with the licensee an addendum to his agreement to provide 4G service in the band 1800 MHz.

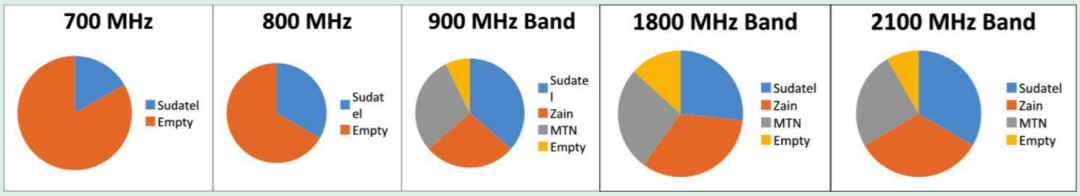
The second mobile operator was granted the license in 2003 and the operator was granted to provide GSM and UMTS services in all the territory of the country using 900, 1800 and 2100 MHz slots of spectrum. An addendum for the agreements was signed with TPRA to provide the 4 G services and additional spectrum in the 1800 MHz was release for 4G service, and the pricing was done by considering the economic value of spectrum and service benefits for the community.

The last operator for fixed services had been licensed to cover all the entire country with fixed CDMA and EVDO services using 450MHz band. The first license was granted in 2005 for a period of 15 years. This had been developed and a migration for 4G and LTE technology was started and is moving forward in most area using the 2.3 GHz band to provide broadband LTE. The license duration has ended recently and the renewal for this license has completed last month with newly agreed terms and conditions for the license.

In Licensing for telecom operators, the term of agreements should always include that the reframing of spectrum to enable the regulator to make it when needed. This was very useful for Sudan when the reframing was done to evacuate the 850MHz in order to be able to use the 700 and 800 MHz spectrum and have the ability to use the valuable 800 and 700MHz bands. This was done by giving the operator a replacement in those bands instead of his 850 MHz assignment.

Most of the time, the spectrum licensing and pricing is done by using bench market method taking into consideration economic situation of the country.

The figures bellow shows the assignment for mobile bands for the operators:



Regarding the fixed broadband, 4 internet service providers had been licensed to provide the services in dedicated areas. All the service providers are using WiMAX technology. This had been granted to increase the penetration of fixed broadband services in the country using the available spectrum bands 3.5GHz, 28GHz and 5.8 GHz bands.

Regarding the connectivity of rural areas, all the agreements of the main operators include universal service obligation which provide a specific amount to be funded to the universal services treaty to cover the cost of connecting the uncovered areas. Moreover, the license and annual fees take into consideration (and encourage) the coverage of rural areas.

2. The Republic of Kenya

Kenya Communication Authority published their National Broadband Strategy 2018-2023, which provides the vision to transform Kenya into a globally competitive knowledge-based society enabled by affordable, secure and fast broadband connectivity. It covers draft policies on broadband ecosystem as a whole including spectrum.

3. The Republic of Tunisia

Historically, Tunisia spectrum was assigned on technology specific basis, however as a measure to improve mobile broadband connectivity during pandemic of COVID-19, Tunisia granted technology neutrality, on a temporary basis initially, so operators can use their spectrum holding for LTE. Soon after, the decision was made permanent by the ICT Minister, as it concluded it is more appropriate to go towards technological neutrality for these licenses and leave the field for operators to choose the appropriate technology and the most appropriate timing for the adoption of future generation of technology.

4. The Federal Republic of Nigeria

a. Spectrum Trading

Nigerian Communications Commission (NCC) commenced in 2017 the process of developing a framework that was intended to guide the sharing and trading of spectrum in Nigeria. The NCC conducted a comprehensive public consultation process, receiving written submissions from stakeholders and hosting a public forum to discuss the framework. As the output from the consultation process, the Spectrum Trading Guidelines were finalised and published in 2018. The

Guidelines allow for licensees of the NCC to share and trade spectrum, whilst putting in place measures to guard against exploitation of the principles of the guidelines. For instance, the guidelines allowed spectrum to be traded by eligible licensees that had held spectrum for up to two years and achieved at least 25% of rollout obligations specified in the license.

b. Spectrum Auctioning Experience

An examination of previous spectrum auctions/assignments in a number of countries suggests that many could be viewed as problematic. In many cases, auctions have failed because reserve prices were set too high and because the amount of spectrum on offer was limited.

However, Nigeria was able to find a middle ground while applying the auction licensing method in ensuring spectrum to users that are most likely to put it into better use. The Nigerian Communications Commission (NCC) in line with its mandate to manage and administer the Frequency Spectrum for telecommunication in Nigeria has organized and executed several spectrum auctions which include the Digital Mobile Auction of the 900MHz and 800MHz band in 2001, the 2GHz 3G Auction in 2006, the 2.3GHz wholesale wireless access in 2014 and the 2.6GHz spectrum auction in the year 2016. It also auctioned 2 slots of 27MHz in Lagos state alone in the year 2016 just before the 2.6GHz auction.

A. The 900mhz and 1800mhz Auction

The Nigerian communications Commission (NCC) adopted an auction format that encompasses the properties of both ascending bid and sealed bid auctions in awarding the Digital Mobile license (DML) license in the 900MHz and 1800MHz in the year 2001. The ascending bid auctions format required participants to indicate interest on the "Clock" price set in each round of the bidding process. The sealed bid auctions format is usually applied in circumstances where the number of participants and items are relatively small.

i. Packaging

In packaging the spectrum, the 900 MHz band (862 – 960 MHz) as allocated by the International Telecommunications Union (ITU) for mobile service at the World Administrative Radio Conference in 1979 (WARC-79) in Region 1 (Europe and Africa) was divided into Five (5) slots of 2 x 5 MHz to accommodate five operators. Another slot of 2 x 10 MHz was reserved as Extended Global System for Mobile (EGSM) band. Similarly, in accordance with ITU recommendation the 1800 MHz (1710 – 1880 MHz) was equally divided into Five (5) slots of 2 x 10 MHz for the same purpose. The band plans for the 900MHz and 1800MHz can be seen in tables 1 and 2 below:

ii. Invitation Stage

During this invitation stage, the Information Memorandum (IM) which contains all information pertaining to the auction was published and also applications, corporate details of participants as well as bidder's certificate of compliance were submitted to the Commission. Participants also made deposit payment of 20Million US Dollars at this stage. Before the IM was developed, an extensive consultation was conducted to elicit input from industry stakeholders.

After the consultation, the 900MHz and 1800 MHz bands were unanimously adopted for the deployment of GSM services as the best option for the provision of qualitative services on these spectrum bands. The reserve price was also discussed amongst so many other important issues.

iii. Pre – qualification Stage

To pre – qualify for participation in the auction, intending operators had to meet certain application requirement which most conform to the provision of information as contained in the Information Memorandum (IM). An additional requirement was instated to the effect that applicants satisfied include ownership restriction and general power of exclusion which ensured that bidders do not have any relationship with each other and clearly expressed the powers of the Commission to exclude any noncompliant bidder respectively. Basically, The Information Memorandum

(IM) defines the procedure that the Commission has decided to use in the licensing 2 x 10MHz spectrum in the 1800 MHz band. It presents the overview of the Nigerian telecommunications market, provides the details of the Spectrum being made available, the pre-qualification process, the auction process, the auction rules as well as the timetable for the auction process. On the successful completion of pre-qualification checks, the commission formally announced the qualified bidders and the auction date. The following companies qualified to participate in the auction:

- MTN Nigeria Communications Limited
- Econet Wireless Nigeria Limited
- United Networks Mobile Limited
- Communication Investments Limited
- MSI-Celtel Nigeria Limited

iv. Auction Stage

The Digital Mobile license auction closed on the third day of bidding in the fifth round. The bidding closed at a "Clock" price of Three Hundred Million ($300,000,000) US dollars. However, the final price paid by each participant was two Hundred and Eighty-Five Million ($285,000,000) US dollars. The Commission settled for the price of 285 Million US dollars because the two unsuccessful operators were unable to pay the winning price of 300 Million USD. The Auction did not reach the sealed bid auction stage rather it ended in the ascending clock auction stage.

The following companies emerged as winners of the DML license

- Communication Investments Limited.
- Econet Wireless Nigeria Limited.
- MTN Nigeria Communications Limited

v. Final Stage

Successful bidders were formally notified of the award of the DML license, and a provisional award notice was issued to the operators subject to the payment of license Fee within 14 days. One (1) slot out the five (5) slated for auction was reserved for NITEL and M-TEL two financially independent limited liability Company owned by government.

B. The 2Ghz and 3G Spectrum Auction

Sequel to the year 2001 award of DML licenses in the 1800 MHz and 900 MHz frequency bands, the Nigerian telecoms market witnessed a tremendous growth and increase in competition inspired by the liberalization policies adopted by the Commission. The Increase in competition resulted in further liberalization of the market consequently leading to increased number of connections and the provision of better services to subscriber. Sequel to this development and in accordance with International Telecommunication Union (ITU) recommendation, the Nigerian Communications Commission (NCC) in the year 2006 announced its plan to auction spectrum in the 2 GHz bands which it earlier reserved for the deployment of 3G services to foster additional development in the Nigerian telecommunications industry. Like the DML auction, the 3G auction followed the same process from invitation stage through the final stage. After an industry wide consultation with all relevant stakeholders and expert bodies, an Information Memorandum was developed and published. The IM contained all the necessary information regarding the auction.

i. Invitation Stage/ Pre – qualification Stage

Sequel to the Commission's advert in February 2007 for applicants to submit expressions of Interest for the 2G auction, 17 companies indicated interest to participate in the auction. Consequently, the Commission published an Information Memorandum, which amongst other things provided information about the availability of four (4) spectrum slots for bidding. In response to the publication of the Information Memorandum, four (4) applications were submitted to the Commission by the deadline on the 16th March 2007.

The applications received were from the following companies:

- Alheri Engineering Co. Ltd
- Celtel Nigeria Ltd.
- Globacom Ltd.
- MTN Nigeria Communications Ltd

Subsequently, the four (4) applications were evaluated with respect to compliance to the requirement detailed in the Information Memorandum. Each of the applicants was found to have fully complied with requirements.

PACKAGING

The spectrum was packaged as seen in table 3 below:

SPECTRUM BLOCK	BLOCK A	BLOCK B	BLOCK C	BLOCK D
RX FREQUENCY	1920 - 1930	1930 - 1940	1940 - 1950	1950 -1960
TX FREQUENCY	2110 - 2120	2120-2130	2130-2140	2140 - 2150

Table 3:

ii. Auction Stage/Final Stage

Considering that the total number of applicants who successfully met the requirement to participate in the auction equals the number of Spectrum slots available, the NCC decided to award a provisional license of 2 x10MHz to each of the applicants at a reserve price of $150 million less $15 million being the deposit fee previously paid by each of the successful operators. The offer made to these successful bidders was subject to the payment of the spectrum fee within 14 business days of the offer. These companies later paid the spectrum fee and were all given a substantial award letter.

C. The 2.3GHz Auction

As earlier mentioned in this document, since the year 2000, the Nigerian communications industry has witnessed significant growth and tremendous increase in competition, which is driven by the decision Government took to liberalize the industry. Subsequently, the growth of the industry and the corresponding increase in competition led to a general growth in the number of connections and improvement of services. To further deepen the success recorded, the NCC decided to license a portion of the of 2.3 GHz spectrum to support wholesale wireless access retail service (ISPs and other users) by providing the requisite bandwidth necessary for service provisioning to end users.

i. Invitation Stage/Pre-qualification

In the year 2013 the NCC announcement its intention to auction one unpaired block of 30MHz in the 2.3 GHz band for a period of 10 years. Subsequently, 27 companies expressed interest to participate in the auction. The interested parties include existing markets such as MTN Nigeria, Etisalat Limited, Globacom Limited, Airtel limited, Mobitel limited, Main One and the Zinox Group among many others.

Like with other auctions, after an extensive stakeholder's consultative forum, an information memorandum was published and in response, two (2) companies namely: Globacom Limited and Bitflux Limited applied to participate and successfully met the pre-qualification requirement as stipulated in the information memorandum (IM). Companies like Airtel Limited declined to participate because of their plan to participate in the auction of other spectrum bands such as 700MHz likely to come up in the near future. Among the condition in the IM that these companies had to meet is the payment of 10% of the reserve price as deposit which was fixed at $23million.

ii. Packaging

The Spectrum offered is a 30MHz block of unpaired Spectrum in the 2.3GHz band. The Spectrum is adjoining a 10 MHz guard band, which lies between the upper edge of the 30MHz block and the 2.4 GHz Industries Scientific and Medical Bands(ISM). The 30MHz unpaired block in the 2.3GHz band and the adjoining guard band are as shown in table 4 below:

60MHz(Licensed Earlier)	Spectrum Offered	Guard Band
2300-2600MHz	2600 – 2900MHz	2900-2400MHz

iii. The Auction Stage

The Nigerian Communications Commission (NCC) adopted the Ascending Clock Auction (ACA) format with Exit Bids in the auctioning of the 2.3GHz band. On the 19th of February, 2019 the auction took place at the Transcop Hilton Hotel in Abuja the capital city of Nigeria. As earlier mentioned, two (2) companies pre-qualified to participate in the auction. In the second round of auction, at "Clock" price of $23.251million Bitflux Limited a consortium of three companies emerged winner. Subsequently, the winner was granted a provisional offer subject to payment of the auction fee.

D. The 2.6GHz Auction

Following stakeholders' consultations with all relevant industry participants and in accordance with the Nigerian National Broadband Plan of 2013, the International Telecommunication Union recommendation as well as developments in international trends as regards the licensing of the 2.6GHz Spectrum, the Nigerian Communications Commission decided to put forward a Spectrum lot of 2 X 70 MHz in the 2.6GHz spectrum band for auction.

The Commission offered the Spectrum on a technology neutral basis. However, with an intention to rollout services in consonance with the International Telecommunication Union (ITU) recommendation which has set aside Spectrum in the 2.6GHz band for the deployment of advanced wireless broadband services. Succeed bidders in 2.6GHz auction will be awarded a 10-year spectrum license. The reserve price for each spectrum lots of 2 x5MHz was fixed at $16million.

i. Invitation Stage/Expression of Interest

On March 11, 2016 the Nigerian Communications Commission (NCC) published an Information Memorandum (IM) conveying its intention to auction 2 x 70 MHz in the 2.6GHz Frequency Band for a period of 10 years. It offered to auction the spectrum at a reserve price of $16M for each slot of 2 x 5 MHz band. At the deadline for submission of applications and the subsequent evaluation of applications that was conducted, only MTN Nigeria Limited qualified and satisfied the conditions in the Information Memorandum (IM). It expressed interest to bid for a lot of 2 x 30 MHz of spectrum in the 2.6GHz band.

PACKAGING

The Spectrum was packaged as shown in the table 6 below.

Slots	Primary Spectrum Band	Paired Spectrum Band
1	2500 - 2505	2620 - 2625
2	2505 -2510	2625 - 2630
3	2510 - 2515	2630 - 2635
4	2515 - 2520	2635 - 2640
5	2520 - 2525	2640 - 2645
6	2525- 2530	2645 - 2650
7	25 30 - 2535	2650 - 2655
8	2535 - 2540	2655 - 2660
9	2540 - 2545	2660 - 2665
10	2545 - 2550	2665 - 2670
11	2550 - 2555	2670 - 2675
12	2555 - 2560	2675 - 2680
13	2560 - 2565	2680 - 2685
14	2565 - 2570	2685 - 2690

Table 5

ii. Auction Stages

Since MTN Nigeria is the only company that emerged as the sole bidder, the commission in line with the rules contained in the information memorandum, awarded a provisional license to MTN consistent with the interest it expressed to bid for 2 x 30MHz in the 2.6GHz band. The company was given 21 days from the date of the provisional offer to pay the reserve price less the deposit it had already paid as the Intentions- Bid Deposit (IBD). Going by this MTN paid $96Million for six (6) slots less the deposit. Eventually MTN paid the full amount and was awarded spectrum license for 2 x30MHz in 2.6GHz band for 10 years.

Lots	Band (MHz) Available	Licensing Area	Duplex Mode
1	5510 - 5540	Regional in each of the geographic Regions	TDD
2	5540 - 5570	Regional in each of the geographic Regions	TDD
3	5570 - 5600	State by State Basis	TDD
4	5600 - 5630	State by State Basis	TDD
5	5630 - 5660	State by State Basis	TDD
6	5660 - 5685	State by State Basis	TDD
7	5685 - 5710	State by State Basis	TDD

Table 6

iii. 5.4Ghz Auction for Lagos State

In the year 2016 NCC advertised the following bands in the 5.4GHz band for licensing on regional and state by state basis within the Nigerian market;

- Responding to this advert, many companies applied and secured licenses administratively in most of the regions and states apart from Lagos state where the demand for the two (2) spectrum lots available exceeded supply
- Considering that demand outstrips supply in Lagos state, the Nigerian Communications Commission decided to auction the two (2) spectrum lots

iv. Invitation/Pre-qualification

Following the advert for two (2) lots of 27 MHz in Lagos, several companies applied to participate in the auction. However, only six (6) companies namely Swift networks Ltd, Cobranet Ltd, Tizeti Network Ltd, E-Kennet Ltd, Steam Broadcasting and Communications Ltd. and Juniper Solutions Ltd qualified and met the criteria specified by the Nigerian communications Commission.

v. Auction Stage

The commission adopted the Ascending clock Auction (ACA) format in auctioning the 5.4GHz band in Lagos. At the eleventh round of auction on the same day two (2) companies, namely Cobranet Ltd and Swiftnetworks Ltd emerged winners. Each company won one of the two slots at a price of N27, 659,347.10. The two successful companies were therefore offered provisional award letters subject to the payment of N25, 784,347.10 being the amount due to the Commission after deducting the 2Million naira earlier paid by these companies as deposit. These companies later paid the said amount and were granted spectrum license in this band for a period of ten years.

vi. Conclusion

Like many administrations, Nigeria has successfully organized several auctions with so much success story to tell but not without shortcomings. The DML auction and the 2GHz 3G auctions and 5.4GHz auction were very largely successful. All auctions conducted were adjudged to be free, fair and transparent. However, there was low participation in the 2.6GHz and 2.3GHz auction, which can be viewed as a challenge.

5. The Republic of Ghana

Spectrum is a natural resource, which must be utilised efficiently to inure to the benefit of the citizens. Ghana's regulator like other world class regulators, ensures that spectrum is licensed to operators who value it most. In Ghana, the following practices are followed to auction/licence spectrum for mobile/broadband services.

a. Public Consultation prior to the opening of spectrum bands for services. In 2012, there was a public consultation for the sale and use of the 2600MHz band. A similar exercise was undertaken by the Authority in 2015 and 2019 for the 800MHz digital dividend. The views and inputs of relevant stakeholders were comprehensively sought on the best way to make the band available for use.

b. Valuation of the spectrum prior to sale/auction. The NCA employs appropriate financial models which takes into consideration the economic factors such as GDP, population size, inflation rate etc., to value the spectrum. The following factors were used in the valuation of the 800MHz spectrum:

i. Industry Average Revenue Per User (Mobile Data)
ii. Year-On-Year (YOY) Growth
iii. Growth in Data subscription
iv. Interest Rate on Loans.

c. Request for Applications. The NCA after the consultation and spectrum valuation usually invites applications for the award of licences in the band(s) under consideration. The number of licences on offer, the selection and award procedure, the eligibility criteria for applicants and the fees expected to be paid by applicants and eventual winners are usually spelt out clearly.

d. Auction/sale of the Spectrum. In situations where, the NCA sells the spectrum outrightly, it informs the buyers of the price based on the valuation. On the contrary, if the NCA decides to follow the path of an auction, it uses the suitable auction methods. In the past, the NCA has used methods such as the 'beauty contest' auction approach to sell the 800MHz band. This method allows prospectus buyers to bid the spectrum based on how much they value it.

e. Payment of spectrum fees. The NCA has in the past employed outright payment of the lump sum of the spectrum before usage as well as payment in instalment for over a period of time. Either of these payments methods has its pros and cons which the NCA has encountered.

f. In addition to the above-mentioned procedures, the NCA gives priority to indigenous Ghanaian companies in the telecom space. For example, the NCA exclusively gave the 2600MHz band to local companies to deploy Long-Term Evolution (LTE) in 2012. The intention was to help them grow.

g. Further, the NCA recognises the need to expand broadband internet access especially to rural settlers. To achieve ubiquitous internet access, the NCA took a singular step in 2017 by allowing the MNOs to deploy Universal Mobile Telephony System (UMTS) technology (3G) using their spectrum holding in the 900MHz (originally licensed for only 2G). This increased broadband internet access in Ghana with at least every district capital having 3G broadband services.

6. The Arab Republic of Egypt

The Egyptian National Telecom regulatory Authority (NTRA) spectrum auction for 3rd Mobile license case study in 2006: In 2006, NTRA intended to open the mobile market for a third operator, the objectives decided at that time:

Provide the 3G mobile services in Egypt for the first time.

- Introducing a new operator in the mobile market to accommodate the increase in the number of customers and improve the quality of the mobile services provided.
- The third mobile license was designed with the assignment of 900, 1800 and 2100 MHz. NTRA sought that in order to achieve the above objectives that an auction in sealed-bid auction was suitable for the new license.

Out of the nine original applicants, one operator was successful and awarded spectrum. The auction raised a total EGP16.7 billion (USD2.9 billion), almost eight times the minimum offer that was expected at that time by the Egyptian government.

7. The Republic of Ivory Cost

National regulations entrust the role of assigning radio frequencies to the Authority Ivory Coast Telecommunications Regulatory Authority (ARTCI) after the frequency bands have been made available to the Authority by the Ivorian Frequency Management Agency radio (AIGF).

The regulations in force established three systems and services regimes.

a. Network and service regimes at:

i. The Individual Licensing Regime

They are required for:

- The establishment and operation of an electronic communications network open to the public, including those requiring the use of scarce resources;
- The provision of telephony services to the public;
- The establishment and / or operation of a network for the provision of transmission capacities national or international;
- The provision of services under special conditions, in particular public order, public safety and public health.

ii. The general authorizations regime

General authorization is required for:

- The establishment and operation of independent networks using the public domain;
- The provision of Telecommunications / ICT services to the public, with the exception of those subject to individual license or declaration.

iii. Regime of declarations and free activities

The following services are subject to declaration:

- The provision of internet services;
- The provision of value-added services;
- Resale of Telecommunications / ICT services, with the exception of those subject to license individual or with general authorization.

iv. The Specifications appended to the Individual Licenses and General Authorizations

The specifications set out the obligations relating to the use of Individual Licenses and

General authorizations by the various actors. Under the operation of frequencies radio electric, the specifications recall the obligations relating thereto, in particular:

- Payment of royalties related to the use of radio frequencies;
- Interference management and technical specifications for the coordination of frequencies at borders;
- Technological neutrality with regard to the frequency spectrum.

b. The categories of Telecommunications / ICT activities and fees

The different categories of telecommunications activities and services are listed in the table below

CATEGORIES	TYPES OF AUTHORIZATIONS	USE
C1A	Individual license	Establishment and operation of an electronic communications network open to the public, including those requiring scarce resources for the provision of telecommunications / ICT services, as per specifications appended to the individual license. (mobile network operators)
C1B	Individual license	Establishment and operation of an electronic communications network open to the public, including those requiring the use of scarce resources for the provision of phone services or national or international transmission capacity services (microwave links, fiber optics, landing centers, etc.).
C1C	Individual license	Establishment and operation of an electronic communications network open to the public, including those requiring scarce resources for the provision of telecommunications / ICT services concerning the declaration regime and free activities (Internet access providers, etc.)
C2	Individual license	Telecommunications / ICT activities dealing with the provision of telecommunications services for the needs of the State, in particular security, public order, public health.
C3	General authorizations	Establishment of independent networks using the public domain (RRI networks[1], IoT).
C4	Declaration	Provision of Internet services or resale of telecommunications services that are not subject to individual license or general authorization.
C5	Free activity, provided that it is not prejudicial to the state security or public order.	Independent radio networks consisting of low-power, short-range devices whose characteristics are defined by the ARTCI (home WiFi networks, etc.).

(Footnotes)

1 RRI : Independent radio networks often known by the acronym PMR (Private Mobile Radiocommunications)

The assignment of radio frequencies is subject to a fee for the use of Frequencies for categories C1, C2 and C3. This frequency usage fee includes:

- Application fees for radio frequencies;
- The right to assign radio frequency bands;
- The annual fees for the use and control of the assigned bands;
- The annual installation and control authorization fees for radio stations.

c. Licensing and authorization procedures

i. Call for applications or auctions (commercial use)

The assignment of radio frequency bands for the activities of Telecommunications / ICT subject to the regime of individual licenses, is subject to call for applications or auctions. Due to their scarcity and the number of requests being greater than the supply, radio frequencies dedicated to the following services are subject to said procedure:

- Internet access;
- Mobile telephony.

ARTCI identifies spectral resources that could be the subject of a call for applications or auctions and draws up the technical and financial conditions, as well as the provisional schedule for the process, subject to approval by the Ministry in charge of Telecommunications / ICT.

The technical and financial conditions relate in particular to:

- Obligations of coverage, network availability and quality of service;
- The services to be provided and the implementation deadlines;
- The principles to be observed with regard to assignment, in particular for interconnection, roaming and infrastructure sharing;
- The reference amount or the starting price.

The call for candidates' process is led by the Telecommunications Regulatory Authority Ivory Coast, who immediately communicate the results to the Ministry in charge of Telecommunications / ICT.

Finally, the Authority may, upon a reasoned decision, declare the call for applications unsuccessful in the event that the applications appear insufficient with regard to the qualification or selection criteria.

ii. Available on request (private use)

The assignment of radio frequency bands for the exercise of Telecommunications / ICT for private use (general authorization regime) is done on demand by depending on the availability of requested resources.

The process of examining requests for frequencies for private use is entirely led by ARTCI, unlike requests for commercial use.

The granting of a frequency band for the establishment and operation of a network for private use is subject to the applicant obtaining a general authorization for the service to exploit.

In the event that the applicant does not have general authorization or if his authorization has expired, the ARTCI first issues or renews its general authorization before assigning frequencies.

iii. Case of free bands

Free use bands are not subject to frequency assignment. However, it is necessary that the applicant has an authorization (license, general authorization, etc.) related to the service to operate.

iv. Case of tests (temporary authorization)

The allocation of frequencies for experimental purposes is done on the basis of an analysis of the request of the applicant. The request must necessarily include the following information:

- The period of the tests;
- The geographical location of the tests;
- The frequencies requested;
- The objective of the tests;
- The test conditions;
- Technical information (power, etc.) on the technology and equipment to be to exploit.

v. Technological neutrality

In accordance with the regulations in force, in particular ordinance 2012-293 and the various specifications, the principle of technological neutrality is applied to all compatible bands.

Although planning is associated with technologies for compatibility issues between applications of radiocommunications services, technology change is free. However, the user has an obligation to notify ARTCI in order to avoid harmful interference.

This change may be prohibited when it affects the proper functioning of the market and / or networks; or interferes with the interoperability of networks, the continuity of service or the protection of physical persons.

8. The Republic of Guinea

In the Republic of Guinea, three mobile telephony operators have broadband licenses with 3G technology, one of which has a 4G license. In the Republic of Guinea, licenses are granted by negotiation with the public service in accordance with the Law on Telecommunications. Since 2019, there has been the development of specifications for 3G and 4G technologies, the renewal of a 3G license and the granting of a 4G license to an operator. In addition, it should be noted that negotiations for the renewal of two other licenses are underway.

9. The Republic of Chile

Chile has used the 'beauty contest' model for licensing spectrum, including for the award of the 850 MHz band for 2G services and in recent 700 MHz and 2.6 GHz awards. Licences are assigned after submissions of technical proposals, and only if there is a stalemate between the operators' proposals, is there then auction between those operators. Chile leads the region in mobile market development, with a network readiness score of 4.6 points, first in Latin America.

10. The Republic of India

900 MHz licences were initially assigned in India in 1994 and 1995. With several of these original 900 MHz licences due to expire, India's authorities re-auctioned the licences in February 2014 and March 2015.

Existing operators faced a serious risk of losing spectrum critical for them to meet service demand with reasonable quality of service. With a significant overall shortage of spectrum being made available, operators were forced to bid aggressively against each other to seek to protect the viability of their existing operations. Final prices were much higher than reserve prices. Prices for the 900 MHz spectrum ended up being on average 1.7 times those of the 800 MHz spectrum sold in the same auction – indicating a high risk of distortion. A later review found that the auction "resulted in unreasonable prices, high debt levels for companies, and expensive charges for consumers".

11. The State of Qatar and the People's Republic of China

Governments around the world are increasingly aware of the challenges faced by mobile operators and the potential role of 5G in transforming industries and enabling the delivery of national policy objectives. For example, in Qatar there were no upfront fees and the annual fees for the 3500 and 3700 MHz bands awarded to Vodafone and Ooredoo are QAR 624,000 (US$ 171k) for 100 MHz of spectrum. Japan allocated the 5G spectrum licences at no cost to MNOs (including mid-range spectrum in 3.7 GHz) via a competitive tender. Additionally, in China, where there is no upfront spectrum charge, 5G spectrum usage fees for the first three years are waived, followed by a staged reduction of 25%, 50% and 75% for years four, five and six respectively. Full fees apply from year seven onwards.

12. The French Republic

In 2018, France regulator ARCEP and mobile operators announced the "New Deal Mobile", whereby mobile operators took on new and additional licence obligations to address coverage in exchange for the renewals of spectrum in the 900 MHz, 1800 MHz and 2.1 GHz frequency bands, which were about to expire. ARCEP stated that *"This New Deal for Mobile marks an unprecedented escalation in nationwide mobile coverage targets, and the Government chose to make territorial cohesion a priority in the allocation procedures. As a result, rather than focus on financial criteria, the Government elected to steer operators' efforts towards investment by writing in unprecedented coverage obligations."*

13. The Commonwealth of Australia

In 2015, the ACMA and the Department of Communications published their Spectrum Review Report, setting out plans to reform Australia's spectrum policy and management framework. The review highlighted the benefits of extending licence duration and recommended increasing the maximum duration from 15 to 20 years. The ACMA and the Department consider that this extension balanced the benefits of "providing users of spectrum with greater certainty to innovate and invest whilst supporting the development of secondary markets" with the risks of "reducing government flexibility as circumstances change".

14. The Italian Republic and the Republic of Finland

In 2018, Italy designed its auction of 5G spectrum in the 3.5 GHz band in a way that meant only two of the national operators could secure the wider channels that 5G most benefits from. Not surprisingly, the prices paid were astonishingly high, and consumers would suffer. In the same year, the Finnish regulator and the national mobile operators managed to agree a mutually beneficial split of 5G spectrum (also in the 3.5 GHz band) for a fair price thus removing the need for an auction. Such agreements will not always be possible but are an option when consensus can be reached.

15. The United Kingdom

Smith-NERA is one of the first methods for setting AIP values and it was published in a study by the Radiocommunications Agency (later folded into OFCOM) in the UK in 1996. The method aims at calculating the opportunity cost of using the next best alternative or the least-cost alternative to the current usage. The method should be applied based on four main conditions. Firstly, there is not likely to be excess demand for the spectrum now or in the foreseeable future. Secondly, there are political or policy factors which impede the application of spectrum pricing. Thirdly, it is not practically feasible to collect license fees. Fourthly, there is no opportunity for users to change their behaviour except by abandoning their service and in this event, the spectrum would be left idle.

The Method Determines Three Main Steps in Order to Estimate the New Prices:

- Determining the next best use/user.
- Considering the options that the next best user would do if he was denied access to the spectrum.
- Calculating the minimum cost of the alternatives.

Calculation Method for the Mobile Radio Service:

- The method considers four options to be used to relive the congestion on the service: use of narrowband technology, use of trunked systems, use more efficient sharing and re-use arrangements, and move to a different band.
- The method chooses the PAMR service which is trunking-based service to be the next best alternative for the user.
- In order to calculate the opportunity cost of using other alternatives, the method divides the all the areas into three categories based on the congestion in each category 1. Then it assumes that the typical user uses a 2x12.5 KHz channel and has a single transmitter of 25-Watt transmitted power and of 60 Km radius area.

- For simplicity, the study does not consider the congestion in the frequency band and only considers the congestion in the coverage area.
- The study assumes that an exclusive channel across the country would be the sum of 10 regional channels as the same frequency can be reused in 10 different regions, and that on site user occupy only 0.1% of the standard area.
- Comparing the current PMR fees and the current PAMR fees for the same user, the study considers the differential value between the two services to be the incremental value to be added on the current PMR fees.
- The study suggests that the fees in the most congested category should have the whole incremental value, and that the fees in the second category should have 10% of the incremental value and also that the fees in the less congested category should not have any additional fees.

UK LTE (4G) Spectrum Auction Case Study in 2013

The stated objectives of Ofcom, the UK regulator who organised the auction, were to:

- ensure efficient use of spectrum;
- maintain competition in the industry;
- promote widespread availability of services.

Ofcom sought to achieve these aims through the auction design. It used the combinatorial clock auction (CCA) model with modifications such as caps on the amount of spectrum held by any one operator; coverage obligations attached to certain frequency lots; and the adoption of the "second price" rule where effectively the winner of the lot pays the amount bid by the second placed runner-up.

Out of the seven original applicants, five were successful and awarded spectrum. Ofcom reported that all of its key objectives had been achieved by the auction:

- Spectrum was licensed to credible bidders at prices that were at or above the reserve prices;
- A re-entrant won a licence and a fourth wholesaler was secured potentially introducing more competition to the market;
- A licence was issued with a 98% coverage obligation and was won by Telefonica.

The auction of 4G spectrum in the UK was concluded in early 2013. Six different lots of spectrum frequency were auctioned. Overall, the auction raised just over £2.3 billion, much lower than the £3.5 billion anticipated by the government.

16. The Dominion of Canada

In Canada, they put five general guiding principles for the consultation of the new spectrum fees model:

- The fee structure should be simple and equitable.
- The more of the spectrum resource used, the higher the license fee should be
- Where the spectrum resource is relatively scarce, the license fee should be higher
- The fee structure should be flexible and independent of the licensing process
- Any significant change to the user fees should be announced promptly and should be implemented over a reasonable period of time.

The above five principles are really simple and can be valid for any pricing model. They can be a basic for the new Egyptian license model.

The license fees model points out four steps to apply the model (Industry Canada, 1996:4):

- Measure the amount of spectrum consumed by each licensee.
- Measure the amount of spectrum that is being used by all users in a band and geographic area, and the amount available for allocation. This gives a measure of spectrum saturation.
- Based on spectrum saturation, assign a value in $/kHz to each cell in a geographic spectrum grid for each band.
- Calculate the license fees for a radio system.
- Again, the above four steps are very useful and can be used for any new model with some modifications.

The Canadian pricing model is called Spectrum Efficiency Incentive pricing. The name of the model is near to the name of the Smith – NERA pricing method, which is Administrative Incentive Pricing.

The proposed model is based on two factors:

- Consumption of the Radio Frequency Spectrum.
- The relative scarcity of frequencies in a given area.

Spectrum Consumption: is defined as the amount of radio spectrum a licensee consumes or denies to other users. It can be measured in 3 dimensions:

i. **Bandwidth.** The bandwidth factor can be measured as the number of assigned frequencies. The model treats transmitter and receiver frequency as two separate frequencies:

ii. **Exclusivity.** Exclusivity is defined as the extent to which an authorized system excludes, denies or diminishes access by other potential systems to the same spectrum. Exclusivity is a function of four factors:

- **Operational Requirements**: The nature of the radio spectrum usage, an example is the emergency operation, it needs full exclusivity.
- **Traffic Requirements**: the amount of the traffic that the user needs, heavy traffic or law traffic.
- **Allocation Status**: There are two types of allocation; primary and secondary. Primary allocation means that user has protection from interference in the allocated band, Secondary allocation means that the user is operating in no-protection basis. The secondary allocation users cannot cause interference to primary users but in the same time can suffer interference or deny to the radio spectrum.
- **Performance Objectives**: This factor means the degree of reliability the technology of the system needs. High reliability systems may require high protection and, therefore, high exclusivity.

iii. **Denial Area.** The coverage area of the license. The larger the license area, the higher the license fees. As an example, for the Broadband Personal Communications Services Radio Frequencies, If the coverage area is more than 1 Km, the license fees will be 100 times of the license fees when the coverage area is less than 1 Km. The Canadian model uses what is called geographic grid to calculate the coverage area factor. The idea is to divide the whole country into hexagonal cells. The size of the cell is less than the propagation distance of most authorized stations, and it is small enough to avoid significant quantification errors.

Scarcity of frequencies in a given area is defined as the degree of difficulty that exists in a defined geographic area in obtaining access to different frequency bands because of the intensity of their use (Industry Canada, 1996:26). The saturation index is used to measure the degree of the scarcity of the radio spectrum in specific band and in specific area. According to Industry Canada (1996:9) Spectrum saturation is defined as the ratio of spectrum consumed to spectrum available in that geographic area and the total spectrum consumed will be calculated by adding the spectrum used by both transmitters and receivers for all the stations whose coverage includes that cell.

The license fees of high congested zone are nearly the double of the medium congested zone and four times of the law congested zone

17. The Dominion of Canada

TRAFICOM charges a frequency fee for all radio licences and frequency reservations it grants. The amount of the frequency fee is calculated based on:

- Availability
- Usability
- Number of frequencies included in the licence
- Frequency fee is also charged for frequency reservations

Formula and coefficients for calculating the fee:

Fee = C1 x Cinh x C6b x B0 x S x P

C1=Frequency band coefficient

Cinh= is population coefficient

C6b= System coefficient; it is defined according to the scaled number of mobile radio transmitters in the system.

B0= relative band width

S= the basic fee coefficient

P= €1295.50, is the basic fee for calculating the frequency fee of all radio equipment categories

Auctions:

Spectrum auctions have become the dominant mobile spectrum assignment mechanism over the past three decades.

There are many types of spectrum auctions, in this section we will focus on three families of auction types:

- Sealed-bid Auction.
- Combinatorial Clock Auction (CCA)
- Simultaneous Multiple-Round Auction (SMRA);

Sealed-bid Auction: bidders only have one opportunity to submit bids. The auction may either be non-combinatorial, in which case bidders submit bids for individual lots or combinatorial, in which case bidders submit bids for packages. Once the auctioneer has received all bids, it determines the value-maximising allocation. Winning bidders either pay the amount of their bid (pay-as-bid rule), a second price (based on the highest losing bid) or a clearing price (based on the lowest winning bid).

18. The Kingdom of Sweden

The Swedish Post and Telecom Authority (PTS) 700 MHz auction case study in 2018:

The PTS Board of Directors has decided the following objectives for the assignment:

- The overall objective for the assignment is to prepare and implement assignment of block licences through a selection procedure focusing on making 2 × 20 MHz plus 20 MHz in the 694–790 MHz band available for mobile broadband.
- The assignment of licenses in the frequency band shall contribute to maximising the societal benefit over time. Among other things, this means the ability to use assigned spectrum effectively.
- The assignment of the frequencies shall improve coverage that enables the using of different applications in areas where people normally stay or travel through.

The PTS sought to achieve the above objectives that an auction in multiple rounds was suitable for this assignment since it leads to price discovery where the bidders become aware of how other bidders value the objects in the auction.

The (PTS) announced that local operators Telia and Net4Mobility won spectrum in the 700 MHz band for the provision of 5G services. The auction was concluded after 5 days of bidding and 46 bidding rounds. The auction raised a total of $311.9 million.

19. Intel Corporation

Report ITU-R M.2480-0 on "National approaches of some countries on the implementation of terrestrial IMT systems in bands identified for IMT", in its Annexes provide national approaches taken and/or knowledge gained by certain countries wishing to share their approaches, in the use/deployment or planning of terrestrial component of International Mobile Telecommunications (IMT) 5 in certain frequency bands that are allocated to the mobile service and identified for IMT, which includes regulatory, technical and operational aspects.

PART D: PRACTICES AND ASSOCIATED IMPLICATIONS

1. Introduction

When licensing the spectrum to operators, countries that get their approach right can better realise the potential of mobile broadband, bringing substantial benefits to consumers and businesses in terms of innovative, high quality services and lower costs of provision. The best approach will depend on the authority's policy objectives as well as market conditions such as how spectrum is currently used, the competitiveness of the market and the risks to investment and service quality over the forthcoming period.

A range of objectives may be considered by authorities when assigning spectrum licences:

- Promoting the efficient use of spectrum particularly by ensuring that the spectrum will be put to its highest value use;
- Supporting competition in communications markets;
- Ensuring service continuity for end-users;
- Having a well-run, timely and legally robust process;
- Potentially other policy goals such as achieving wide coverage; and
- In some cases, generating revenue to government

2. Technology and Service Neutrality

Service neutrality enables network operators with spectrum licences to offer any type of service to end-users in the spectrum they hold. A common restriction hindering efficient use of spectrum is to restrict spectrum to be used for either fixed or mobile services. This is inefficient because it does not allow usage to evolve in response to market demand. Service neutrality means removing this restriction, while ensuring that other spectrum users receive the same level of protection against interference.

When an administration introduces service neutrality, there should be no financial or administrative barriers imposed on the conversion of service-specific licences to service-neutral licences. However, in cases where a spectrum licence restricted to fixed service provision was acquired at a much lower price compared to what it would have been worth had the licence been a mobile services licence, it may be appropriate for the state to capture some of the value created from removing the service restriction.

Technology neutral license mean that the task of spectrum re-farming process well be handed from the regulator to the licensees, so this gives the ability to operators to re-farm their assigned frequencies so they can use it simultaneously for several mobile technologies or use it for newer technologies, so they can introduce newer technologies to meet the increasing mobile broadband demand while at the same time supporting legacy users. Technology neutrality entails compliance with technical conditions of the licence such as power limits and Out of band emissions.

Issuance of unified service access licence (UASL) regime helps to adopt the principle of technology neutrality in the licensing framework and allows any form of access communications system and infrastructure to be used to provide any type of communications service that is technically feasible. UASL will enable government to generate revenue through:

- Up-front licence fee for spectrum determined by means of an auction or similar market-based mechanism.
- An annual fee based on the net revenue of an operator with a Unified Access Service Licence.
- Further, UASL will enable operators to deploy any technology using their spectrum holdings, which will help in extending broadband connectivity to underserved areas.

3. Spectrum Licensing

Overview

There is no single best practice to spectrum licensing. However, best practice will largely depend on NRA's policy objectives, market competitiveness, current use of spectrum and investment over a given period of time. The following are some spectrum licensing best practices recommended for the adoption of NRAs:

a. Auctions: auctions are considered the best licensing methods that ensure spectrum is assigned to the users who are most likely to put it to use. Auction should be designed to support efficiency in the utilization of the spectrum and to encourage competition in the market. Other spectrum licensing methods such as Administrative Procedure based on first Come, first served, and 'Beauty Contest' can also ensure spectrum is assigned to the users who are most likely to put it to use if properly designed.

b. **Setting moderate spectrum prices**: there should be a balance between revenue generation for the country from spectrum sales and cost of socioeconomic benefit of spectrum. NRAs should set Spectrum prices at minimum as much as possible to encourage competition and effective delivery of mobile and broadband services. It is equally important to set subsequent renewal fees for the Spectrum license such that it will encourage technological innovations.

c. **Enough license duration and renewal period:** NRAs should consider having license duration and renewal period for mobile/broadband system license which is long enough to give licensee regulatory certainty and encourage long term network investment. Renewal decisions should also be made early enough in advance of licence expiry so as to facilitate ongoing network investment and ensure continuity of service delivery to end users without disruptions.

d. **Technology and service neutrality for spectrum licence:** This is important to ensure that spectrum is utilized efficiently and optimally in line with evolutionary trends of technologies and services.

e. **Timely plan for mobile/broadband system spectrum licensing:** Licensing frameworks such as National Broadband Plan (NBP), National Policy on 5G Technology can present viable information about spectrum roadmap providing a schedule for forthcoming spectrum releases to meet the government's broadband plan as well as other demands on spectrum.

f. **Effective licence conditions:** Conditions such as roll out obligations, coverage requirements, use-it-or-lose-it should be such that it will facilitate availability, accessibility and affordability of service to end user without imposing constraints that will lead to the failure of the licensee or loosing rights to the spectrum.

g. **Spectrum trading:** There should be framework for spectrum trading in place to promote efficient spectrum use. The framework should support efficient spectrum utilization by enabling unused or underutilized spectrum to be transferred to licensees who will make better use of it.

Policy makers need to ensure that technologies delivering innovative applications and services should have access to sufficient spectrum through appropriate regulatory regimes, licensed as well as licence exempt.

Certain spectrum licensing approaches are more suited to specific spectrum licensing regimes e.g., the first come first served approach is suitable for lightly licensed general authorisations such as Amateur, Aeronautical and Maritime services where the spectrum is shared, while auctions are suitable for individual licenses where demand exceeds supply.

Policymakers need to ensure that licensed, lightly licensed and licence-exempt wireless technologies have access to sufficient spectrum.

Details

The following recommendations are generic in nature and may or not directly fit into various national ICT policy objectives in many ATU member states, however they are insightful and may help administrations in shaping own national spectrum licensing policies or objectives.

When licensing the spectrum to operators, countries that get their approach right can better realise the potential of mobile broadband, bringing substantial benefits to consumers and businesses in terms of innovative, high quality services and lower costs of provision. The best approach will depend on the authority's policy objectives as well as market conditions such as how spectrum is currently used, the competitiveness of the market and the risks to investment and service quality over the forthcoming period.

A range of objectives may be considered by authorities when assigning spectrum licences:

- Promoting the efficient use of spectrum particularly by ensuring that the spectrum will be put to its highest value use;
- Supporting competition in communications markets;
- Ensuring service continuity for end-users;
- Having a well-run, timely and legally robust process;
- Potentially other policy goals such as achieving wide coverage; and
- In some cases, generating revenue to government

1. Approaches to license spectrum:

There are two main approaches used for assigning the rights to use a particular spectrum band:

i. **Auctions,** in which the licence is assigned to the highest bidder (with that bidder either paying the amount they bid or, in some cases, the amount of the second highest bid); Auctions are most suitable when there is excess demand for the spectrum and hence the benefit of auctions in awarding spectrum to the operators, which are most likely to put it to the best use, helps maximise benefits to society.

ii. **Administrative approaches,** whether via 'beauty contests' or 'direct assignments', the authority assigns the spectrum to the candidate that is considered to best meet a number of criteria such as financial resources, industry experience, technology and rollout plans and, in some cases, price offers.

Administrative assignment may be suitable in cases where there is less demand, an authority wishes to consider multiple objectives, or where an authority wishes to avoid high licence costs which could impact network investment.

There is no single best assignment approach but rather a need to assess the merits of each on a case-by-case basis. Whether an auction or administrative assignment is adopted, the implementation of the approach is important.

Auctions can deliver strong social benefits as long as they are properly designed. Auctions are a proven means of awarding spectrum to those who are most likely to put it to the best use. However, poor auction design can lead to spectrum being assigned inefficiently or in a way that undermines competition. There are numerous examples of spectrum auctions that have failed to assign all or part of attractive mobile spectrum. Such failures are frequently due to the design of the auction or wider regulatory issues. These include high reserve prices, artificial spectrum scarcity and auction rules which prevent price discovery or flexible bidding amongst others. Some of these points will be developed in more details below.

2. A presumption of licence renewal encourages long term network investment

Uncertainty over future rights to use the spectrum may lead to operators ceasing investment in the development of their networks and competing less strongly to grow their customer base until the uncertainty is resolved. A failure to renew an operator's existing rights to use spectrum also may harm service continuity or quality of service to customers.

A presumption of renewal helps avoid investments being delayed because of uncertainty over future rights. A decision not to automatically renew a licence should only be made where there is a reasonable prospect that the benefits from reassigning spectrum would exceed the costs. Given the large number of licences approaching the end of their current term, timely renewal decisions (ideally 3-5 years in advance of licence expiry) can facilitate ongoing network investment and enable planning so as to provide for service continuity to end-users.

3. High spectrum prices jeopardise the effective delivery of wireless services

Maximising revenues from spectrum awards should no longer be a measure of success as seeking to maximise state revenues from spectrum can have negative socioeconomic costs. Competition in communications markets can be undermined and there is a risk of higher retail prices and lower network investment. Recent studies demonstrated higher spectrum prices played a significant role in slowing the rollout of next-generation mobile networks, had a significant effect in reducing the network quality experienced by consumer, and are associated with higher consumer prices in developing countries.

The primary objective should therefore be to assign spectrum to those users that will be able to extract most value from this scarce and finite resource for the benefit of society as a whole.

Licensing authorities should set reserve prices conservatively to allow the market to determine a fair price and to reduce the risk of leaving spectrum unassigned. Where spectrum is auctioned, ongoing charges should be limited to recovering the cost of spectrum management. Any subsequent fees associated with licence renewal should not prevent reasonable returns being earned on risky investments as this discourages technological innovation.

4. Predictable and timely spectrum licensing encourages long-term network investment

Predictability can be supported when governments publish:

a. National broadband plans setting out how targets for widespread broadband will be achieved and
b. A spectrum roadmap providing a schedule for forthcoming spectrum releases to meet the government's broadband plan as well as other demands on spectrum.

In particular, A spectrum roadmap is an important means of ensuring sufficient spectrum will be available to meet the requirements driven by changing technology and demand. Information on future spectrum release is critical in order for businesses to prepare investment plans, secure financing and develop arrangements for deploying particular technologies.

A sound spectrum roadmap should cover:

- An audit setting out current use of spectrum and identifying any spectrum that could be re-allocated to higher value use;
- The schedule for future spectrum releases;
- How spectrum will be assigned including a framework for determining spectrum prices and other terms and conditions;
- The timing and process for spectrum renewal decisions;
- A plan for the introduction of technology neutral licensing and trading if not already in place.

5. Spectrum licences should be technology and service neutral

In the past technology, specific spectrum assignment was the norm, but most markets have subsequently adopted a technology neutral spectrum licensing approach. This enables spectrum to be used efficiently by mobile operators rather than being tied to declining technologies and services. The most important development is the ability to 'gracefully refarm' bands so they are used simultaneously for several technologies – including 4G and 5G.

This allows for the introduction newer technologies in line with increasing mobile broadband demand while at the same time supporting legacy users. For regulators this means they no longer have to worry that refarming will leave legacy users unserved. Introduction of charges for change of use should be avoided as it is discouraging more efficient use of spectrum and delaying the benefits of new technologies. Also, while a renewal process provides an opportunity to re-issue spectrum licences as neutral, regulators should not delay the introduction while waiting for the expiry dates of existing licences.

6. Licence obligations and conditions should be used with caution

Spectrum licences have traditionally contained a range of non-price terms and conditions, which go beyond those necessary to manage interference between users. Providing for flexible spectrum use by limiting licence conditions enables spectrum to be redeployed at a time of rapid technology and market changes and brings down the cost-of-service provision. The conditions imposed in licences – including coverage and other quality of service obligations – should always be carefully considered. Conditions that are unrelated to avoiding interference should be kept to a minimum or removed entirely.

Imposing onerous and inflexible conditions that may be impractical or impossible to meet can jeopardise investments and provoke consumer price rises. Instead, regulators should engage in a dialogue with licence holders to arrive at solutions that are more practical. There are examples where coverage obligations for rural areas can be an efficient tool when used in conjunction with measures to lower the cost.

7. Licence duration should be at least 20 years to incentivise network investment

The longer the duration of a licence, the greater the certainty provided for operators to undertake long-term investments in rolling out networks and in deploying new services. Investors would be reluctant to undertake investments if the licence runs for a shorter period than the expected payback period and if there is uncertainty over whether the licence will be renewed again in the future. The use of indefinite licence terms beyond the minimum period, and the presumption of renewal, can further enhance predictability.

8. Competition can be supported by licensing as much spectrum as possible and limiting charges and other barriers to services, including set-asides

As access to spectrum is essential for the supply of mobile services, the way that spectrum is assigned and how it is managed on an ongoing basis can impact on the level of competition in mobile markets. Making available additional spectrum in capacity and coverage bands is key to supporting better quality, widespread, affordable mobile broadband services.

Specific measures to increase competition, such as spectrum caps or set-asides, should be introduced only after assessing the benefits and costs of alternative options. Auctions should be open on fair and equal terms to all qualified applicants that are committed to rolling out a network and provide services. However, sometimes regulators help to "pick winners" by setting aside spectrum for certain applicants such as new entrants or industry verticals. This type of market manipulation is only appropriate after a formal market review finds evidence of market dominance, and then demonstrates that setting aside spectrum is an appropriate, proportionate action that will lead to long-lasting and sustainable market benefits. Setting aside spectrum is dangerous as it restricts the amount operators can access which can negatively impact mobile broadband speed and coverage and inflate spectrum price.

Specifically, setting spectrum aside may create artificial spectrum scarcity and limit the reach of the services by limiting a separate industry, while MNOs have the capability and expertise to realise what is needed for new applications.

Sharing and trading also allows for unlocking of those applications powered my mobile services, such as remote surgery, automated cars, industry 4.0 needs etc.In many cases, additional spectrum can bring the greatest benefit to society when it is made available to existing operators as their needs are greatest due to the rapid growth of data traffic on their networks. Auctions should be designed to allow operators to secure the optimum spectrum to meet their needs (e.g., amount, type, location etc) and thus ensure it is used as efficiently as possible. Policy makers can support this by ensuring enough spectrum is made available in the award; it is offered in small generic block sizes to support varying demand from all bidders; and activity rules allow bidders to aggregate complementary licences and/or move to substitutes during the auction.

9. Voluntary spectrum sharing, and trading should be encouraged to promote efficient spectrum use

Allowing spectrum rights in new and renewed licences to be traded between operators is an important way to ensure that spectrum continues to be used efficiently over time. In particular, sharing and trading encourage efficiency by allowing spectrum rights to be shared or transferred to those who will make better or more efficient use of them. A regulatory framework that supports voluntary spectrum trading offers the potential for substantial benefits to society from ensuring the ongoing efficient use of spectrum. Sharing and trading also allow unlocking a larger portfolio of different applications powered my mobile services, such as remote surgery, automated cars, industry 4.0 needs etc.

10. Spectrum license obligations

Licence obligations such as coverage obligations can be an important element in delivering policy objectives. The regulator could oblige the licensees to provide coverage for cities, roads, and rural areas, which may not be interested to be covered, by the licensees. Such obligations should include specific duration and timetable for execution, and each area coverage shall be dimensioned to meet percentage amount of indoor coverage requirements. The regulator and licensee should agree to a minimum arranged level of QOS, timetabled for each stage.

However, the conditions imposed in licences – including coverage and other quality of service obligations – should always be carefully considered. It is recommended that administrations consult and negotiate with local MNOs to design obligations that can realistically be met. Onerous and inflexible conditions that may be impractical or impossible to meet can jeopardise investments and incentivise consumer price rises. Instead, regulators should engage in a dialogue with licence holders to arrive at more practical solutions. There are examples where coverage obligations for rural areas can be an efficient tool when used in conjunction with measures to lower the cost.

It is also recommended that a coverage obligation leaves freedom to the licensee to fulfil the obligation using a different spectrum band. For instance, a licence for a block in the 3400-3600 MHz could carry an obligation to provide coverage to a percentage of the population, but it should be possible for the licensee to meet the obligation with spectrum below 1 GHz. In addition, the licence terms should allow the administration to cancel (or revoke) the licence in the case where the obligations are not met, so that the spectrum can be freed and re-issued to others who can make better use.

11. Network synchronization

Synchronized operation is recommended for mobile TDD networks to ensure efficient use of spectrum.

Simultaneous UL/DL transmissions in networks operating in adjacent frequency channels can lead to interference between nodes of the two networks, notably between base stations which can be in short proximity and line of sight. There are two ways to avoid this:

- Synchronise uplink and downlink transmissions of networks in adjacent channels. This requires use of a common clock reference and a common frame structure.
- Maintain networks unsynchronised; but separate the channels in frequency and introduce additional filtering.

Unsynchronised operation results in spectrum wasted in guard-bands and increased BS cost. It is therefore recommended that, at a national level, TDD mobile networks should be synchronised. In addition, cross border coordination needs to be considered. It is recommended that networks should be synchronised at an international level whenever possible. It is recommended that African administrations agree on a limited number of frame structures – possibly one single frame structure – to be used across the continent, in order to limit the potential for cross border interference.

12. Infrastructure and spectrum sharing

Administrations should encourage infrastructure sharing to enhance the interoperability of telecommunications facilities, infrastructure, networks and services countrywide, thus improved spectrum utilization. Spectrum licences should not include barriers for the operators to share neither infrastructure nor spectrum with each other.

Sharing of these resources between MNOs is already commonplace in many countries without regulatory intervention, when it makes economic and business sense for the operators.

In particular, infrastructure sharing can be a useful tool to provide services to locations – such as remote rural areas – where there is no business case for any operator to deploy on its own. It is recommended that administrations consult with operators on how such sharing of network assets may be put in place to advance specific policy goals – say, of inclusion. In these circumstances, administrations could contribute to the undertaking either financially (making use of the national USF, for instance), via tax relief, or through facilitation of network deployment (providing access to public infrastructure for instance). In other words, no blanket obligation to share resources should be imposed without operator agreement, as this may have negative effects on market competition and, by extension, on coverage.

13. Spectrum trading and leasing

Administrations should explore other means to meet the policy objectives of encouraging efficient spectrum usage and improving coverage – for instance, by permitting trading in, and leasing of, spectrum licenses for specific underserved areas. Allowing spectrum trading and leasing is an important way to ensure that spectrum continues to be used efficiently over time. In particular, trading in and leasing of spectrum would encourage efficiency by allowing spectrum rights to be leased or transferred to those who may make better or more efficient use of them. A regulatory framework that supports voluntary spectrum trading offers the potential for substantial benefits to society by ensuring the continued efficient use of spectrum. Leasing of and trading in spectrum may also invite the deployment of a variety of applications powered by mobile services – from remote diagnostics and surgery and automated cars to applications that address emerging Industry 4.0 needs.

14. Spectrum pricing

Costs associated with Licensing: in general, there are two types of such cost: the first is related to the preparation and issuing of the licence or authorisation, and the second is related to maintenance and enforcement of the license. A single fixed fee applied to the licenses can cover the first type while the second could be covered by the application of a fixed annual fee for each type of licence, and the application of a levy based on the licensee's turnover or profitability. Costs associated with Spectrum Management; this includes costs related to participation in international fora, e.g., those organized by the ITU and ATU, licensing of radiocommunication services, coordination of frequency assignments, both within country's territory and with neighbouring countries, enforcement of licence conditions, and pricing the spectrum.

High spectrum prices have been linked to lower investment in networks, worse quality and coverage, and lower consumer welfare. Effective spectrum pricing policies are vital to ensure that operators have the resources to invest in the network.

The value for spectrum during a period can be influenced by several factors including: geography, competition amongst potential users, advances in technology, the present value of cash flows derived from a service over time, and the general economic climate. Spectrum licence values are therefore reflective of the benefits to be gained by society from its best use of spectrum bands.

There are best practices that can be adopted when setting prices for spectrum and this includes the following:

a. Administrative Pricing

It is used in cases where there is no scarcity by applying lower charges (potentially below cost) to frequency bands and/or locations that are not congested in order to encourage migration from congested bands or locations. In addition, administrative pricing should encourage users who have an alternative to migrate to other technologies or frequencies;

b. Auction

This involves the awarding of licenses to those who bid the greatest amount in monetary terms. There are many varieties of auction and their design is a specialized skill. The awarding authority is usually responsible for: designing the auction; setting up the procedures for running the auction; ensuring that all potential bidders have full knowledge of the rules and procedure; and running the auction to a conclusion. As regards spectrum auctions, the following is usually the case:

- As the mobile spectrum is limited resource, it is vital that governments and regulators must ensure that the spectrum is awarded to operators who will use it most efficiently to support affordable, high quality mobile services.
- Governments and regulators may also try to use auctions to meet other goals such as raising revenues for the state, or altering the structure of the mobile market by facilitating the entrant of a new operator.
- Auctions have proved effective at determining fair and efficient spectrum assignments in a timely manner when the demand for spectrum from qualified applicants exceeds the available supply.
- Provide a transparent, impartial and legally robust means of assigning spectrum to those who will use it most efficiently to support attractive, high quality mobile services.
- Auctions are suitable for expired licences if the licensee does not want to renew the spectrum or if they have breached the terms of the licence.

c. Hybrid Approach

A hybrid approach combines elements of both auctions and administrative pricing, for example by including a financial bid as one element of a 'beauty contest'.

d. Benchmark Approach

When evaluating benchmarks of amounts paid for spectrum licences or authorizations, it is very important to consider the local demand for spectrum and the level of competition amongst operators reflected in the revenue and cost drivers associated with a particular market sector and with individual operators.

Regulators may decide to carry out benchmarking, by drawing inferences from market prices in other jurisdictions for similar spectrum bands by taking into account:

- Prices on a "per MHz per population" basis, adjusted for differences in GDP per capital;
- The price relationships across bands in countries where auctions in higher and lower value bands have occurred;
- Differences in license durations; and
- Differences in timing of payments.

When evaluating the use of benchmarks as a reference to local spectrum values and prices, it is most

important to consider the demand for spectrum and the level of competition amongst operators reflected in the revenue and cost drivers associated with a particular market sector and individual operators. Participation by operators will depend on the market positioning and market share.

The following is therefore to be noted when spectrum is Auctioned

- When regulators set high reserve prices, which may result in spectrum remaining unsold or limiting network investment.
- If bidders successfully coordinate, not only may spectrum be assigned inefficiently but also the government would not receive the market value for the spectrum.

It is important to note that high spectrum prices jeopardize the effective delivery of wireless services (broadcasting, broadband, satellite etc). Fair pricing may also help to safeguard the interests of consumers through regulating tariffs while ensuring improved and efficient services.

Further, It will also be beneficial to Spread payment of spectrum fees over a period of the licence term in order to encourage local participation. In most countries licensees are made to pay outright fees to obtain spectrum licences. Operators use huge sums of their revenue to pay for the spectrum fees leaving small amount to invest in network implementation. This because In most cases, the operators are unable to expand their networks after outright payment of huge sums of monies for spectrum. Spreading the fees over a period of time will enable operators to expand their networks especially to rural areas. Further, this will enable the regulator to make more money over a period of time than the one time payment, since operators will pay a percentage of their license fee in addition to an interest rate every year.

e. Sustainable Business Case

Effective spectrum pricing policies are vital to ensure that operators have the resources to invest in the network. The price of IMT spectrum should be affordable and predictable. Studies shown that so long as the annualised spectrum cost for the operator (including all access bands and backhaul spectrum fees) is within a small fraction of the operator's revenues, it would not represent a significant burden for the operator to build a mobile network[1[1]]. Proportionate spectrum fees allow operators to remain more focused on network investment and will drive down end user prices, bringing long-term socio-economic benefits through 5G digital connectivity.

15. Spectrum Auction

a. Spectrum Auction Types

- **Sealed-bid Auction:** bidders only have one opportunity to submit bids. The auction may either be non-combinatorial, in which case bidders submit bids for individual lots or combinatorial, in which case bidders submit bids for packages. Once the auctioneer has received all bids, it determines the value-maximising allocation. Winning bidders either pay the amount of their bid (pay-as-bid rule), a second price (based on the highest losing bid) or a clearing price (based on the lowest winning bid).
- **Combinatorial Clock Auctions (CCA):** is a combination of a clock auction and a single sealed bid auction. During the initial clock stage bids are placed on desired products, after each round if excess demand exists the price is raised. This round ends when there are no new bids. This stage is followed by a sealed bid auction that allows one last bid to be made on packages they qualify for, dealing with the issue of buyer's remorse.

1 [1] Coleago Consulting, "Sustainable spectrum pricing", June 2019

- **Simultaneous Multi-round Auction (SMRA):** is conducted over a series of rounds. In the first round, bidders submit bids for individual blocks. In some variants of the SMRA, bidders can only submit bids at predetermined prices in each round. In others, they can select a bid amount from a predetermined menu of prices. At the end of each round, the auctioneer determines the standing high bid for each block (the highest bid submitted) and a new price (or menu of prices) for each block. The auction continues until no more new bids are placed. The SMRA is usually run with activity rules which ensure that bidders reveal their demand from the beginning of the auction.

b. The Importance of Spectrum Auction:

- Spectrum auctions is a quicker method of assigning spectrum licence than other assignment methods available;
- As the mobile spectrum is limited resource, it is vital that governments and regulators must ensure that the spectrum is awarded to operators who will use it most efficiently to support affordable, high quality mobile services;
- Pricing set at auctions are comparatively free of political influence and collusion. Governments and regulators may also try to use auctions to meet other goals such as raising revenues for the state, or altering the structure of the mobile market by facilitating the entrant of a new operator.
- Encourage competition in the market.
- Auctions have proved effective at determining fair and efficient spectrum assignments in a timely manner when the demand for spectrum from qualified applicants exceeds the available supply.
- Provide a transparent, impartial and legally robust means of assigning spectrum to those who will use it most efficiently to support attractive, high quality mobile services.
- Promote rapid rollout of services in that licensees want to launch services as soon as possible to generate revenue to offset the price paid at auction;
- Auctions are suitable for expired licences if the licensee does not want to renew the spectrum or if they have breached the terms of the licence.

c. Problems of Poor Spectrum Auction Design

- When regulators set high reserve prices, which may result in spectrum remaining unsold or limiting network investment.
- Licensees with extensive financial resource may inflate prices during bidding process resulting in licensees with limited financial resources not being able to acquire spectrum and;

- If bidders successfully coordinate, not only may spectrum be assigned inefficiently but also the government would not receive the market value for the spectrum.
- In the 2013 Czech auction, bids reached triple the reserve price before the auction was cancelled because of concerns the prices would have led to high service prices for and delayed operators' ability to launch the new services.
- The 2015-16 Thai auctions of also encountered problems with high prices and with one of winners defaulting on its licence payment.

16. Infrastructure Sharing

ATU member states should encourage infrastructure sharing to enhance the interoperability of telecommunications facilities, infrastructure, networks, services countrywide, thus improved spectrum, and infrastructure utilization.

African ICT regulator have been actively ensuring policies of Increase spectrum availability as well as ensuring competitive access to spectrum. But more action is needed on liberalisation of the market for spectrum resale and encouraging co-location. Sharing of essential facilities will considerable bring down the CAPEX and OPEX, which can consequence in engendering low Internet tariff.

17. Exclusive Access to Spectrum

Exclusive licensed spectrum allows for better interference protection guarantees and enables higher power output, both of which help improve coverage and incentivise network investment. The amount of spectrum that has been licensed to mobile operators – including the type of bands that are licensed – can have a major impact on the cost, quality and coverage of mobile broadband services. See Recommendation ITU-R M.1036 for Frequency arrangements for implementation of the terrestrial component of International Mobile Telecommunications in the bands identified for IMT in the Radio Regulations.

18. Non-Exclusive Access to Spectrum

License-exemption of spectrum bands is now an important spectrum management tool. Administrations have found that license-exemption can generate benefit for citizens and consumers. License-exemption is generally used where the equipment has a low capacity to cause harmful interference. A wide range of economic equipment is often available in license-exempt bands and it can be rapidly deployed without the need of a license from the administration with associated costs.

For example, the license-exemption of the 2.4 GHz ISM and 5 GHz bands has delivered significant benefits with a wide range of equipment being available including Wi-Fi, as an extension of the fixed network 9 and mobile broadband network.

19. Type Approval

The equipment used by the licensee shall subject to approval of the regulator in order to ensure operation of transmitters will conform to national and international regulations and licence conditions.

All equipment to be used for communications purposes must be type approved to ensure that they comply with the relevant performance, electrical safety and electromagnetic compatibility (EMC) standards. The equipment type approval should be valid indefinitely, provided that there is no change to any of its performance, electrical or EMC characteristics.

Equipment type approval should be based on test reports from accredited labs. We recognise that some countries may not have accredited test labs for all relevant standards. This challenge can be mitigated by accepting test reports from accredited labs in other countries or recognising the type approval certificate from another country with which it has an agreement.

20. Temporary Licenses

ATU member states should consider adopting a special (temporary) license to enable timely access to LTE access spectrum to deliver service to end users in response to disasters, as well as to demonstrate the capacity of the technology to extend coverage in existing commercial settings. This allows for the correct development of the network prior to a commercial launch. Such a license should:

- Be valid for up to 12 months, extendable for the same period of time, to limit administrative burden and ensure licenses are in place well before a disaster;
- Be granted expeditiously for disaster purposes;
- Be in line with the national frequency allocation table, to the extent possible;
- Give priority to disaster radio communications over other services being provided by users of the needed frequencies.

21. Mobile/Broadband Network Backhaul Spectrum

a. Use Spectrum Audit Databases as an Input into Light-Licensing Frameworks

b. ATU member states should leverage spectrum usage databases prepared during spectrum audits to create light-licensing databases. For example, a national regulatory authority could use a database of point-to-point backhaul links with technical information prepared in a national spectrum audit to establish a forward-looking online link-registration database. By adopting a link registration approach to light-licensing for backhaul spectrum, NRAs will be able to conduct significantly more efficient spectrum audits and more dynamic spectrum management in the future

c. Spectrum Licensing

d. A flexible licensing framework is a critical first step in catalysing rural connectivity deployment in Africa. In this regard, ATU member states should adopt a harmonized, flexible and streamlined approach to mobile network backhaul spectrum licensing that permits coexistence of all backhaul networks on a technology neutral basis.

e. Self-coordination of Backhaul Spectrum

f. ATU member states should consider adopting a self-coordinated spectrum licensing framework for mobile network backhaul links to maximize flexibility and efficiency. This can be implemented by having online databases and automated coordination mechanisms for interference management that licensees use to upload license applications, obtain information on available link locations, and details of existing spectrum uses that must be protected from interference. Importantly, these databases may be expanded to incorporate new and emerging services to maximize efficiency and promote coexistence in the bands. The high-gain, directional nature of "pencil beam" point-to-point systems can support dynamic spectrum sharing between co-primary users, including through the use of third-party database managers.

g. Flat, per-link spectrum fee schedule

h. ATU member states consider applying a flat fee per-link for mobile network backhaul spectrum.

PART E: RECOMMENDATIONS

ATU recommends Member States to:

1. **Create** regulatory certainty for how spectrum is used by way of:
   a. Having a clear roadmap;
   b. Protecting incumbent services;
   c. Publishing information on spectrum fees and procedures utilized (e.g. administrative, cost-recovery) by regulators;
   d. Providing clarification on spectrum usage rights from service or network authorizations by regulators so as to provide transparency to the potential licensees

2. **Set up a framework** for making the frequency resource available where technically feasible;
3. **Choose** the least cost and least restrictive approach to achieve spectrum management objectives;
4. **Maintain** a balance between cost of interference and the benefits that may be achieved from greater spectrum utilisation;
5. **Balance** administrative simplicity against requirements to encourage efficient use of spectrum taking into account requirements in respect of coverage and bandwidth to achieve an acceptable level of quality of service;
6. **Put mechanisms** in place to encourage and enable spectrum licensees to move to those services that will provide the highest value of use in a specific spectrum band;
7. **Promote** the harmonization of frequency bands exempted from licensing and the respective technical conditions for use at national and global level. This is so as to avoid harmful interference and ensure the greatest possible flexibility, while promoting a reliable and efficient use of frequency bands by radio equipment as well as the development of economies of scale;
8. **Ensure** fair balance between direct spectrum revenue considerations and the need for affordable high quality mobile services by consumers;
9. **Release** spectrum assets to meet both coverage and capacity demands, where technically feasible.
10. **Provide** sufficient amount of spectrum to address evolving consumer demands;

11. **Promote** technology and service neutrality to foster innovation and rapid nationwide coverage;
12. **Provide** for market players to share for supporting affordable roll out and meeting market demands; enable spectrum and Infrastructure sharing by giving licensees the right to share their spectrum voluntarily through sharing, trading or national roaming agreements;
13. **Design** spectrum licensing obligations that support the coverage of areas that are challenged in terms of viability as well as the ability to support continuous investments.
14. **Clarify** spectrum licensing conditions early enough as well as provide information on the renewal process and its requirements at the time of licensing;
15. **Encourage** a range of innovative business and engineering approaches to meet the growing demand for broadband services;
16. **Continually** bring new feasible bands into use while achieving greater efficiency in the use of existing government, commercial, and shared bands.
17. **Pursue** a balanced spectrum policy that brings more licensed and licence- exempt spectrum into use in order to serve businesses and consumers better;
18. **Adopt** band plans (i.e. frequency channel arrangements) and technical rules in current and future spectrum proceedings that encourage investment and innovation rather than requiring particular channelization approaches and/or channel bandwidths geared to one standard, or otherwise favouring a subset of today's technologies over innovations to come.
19. **Offer** complementary shorter-term licenses to enable efficient use of unassigned spectrum and/or to meet emergency spectrum needs;
20. **Create** incentives for trading or sharing of unused or underutilized spectrum;
21. **Develop** more flexible licensing and regulatory frameworks to support rural connectivity. Also, when licensing spectrum, positive price differentiation should be considered so as to encourage service provision in underserved areas.
22. **Carry** out market studies before defining the price of spectrum.
23. **Adopt** the technology and service neutral regime, which are progressively being established internationally and are replacing earlier service and technology-specific approaches to licensing. The regime provides consistent regulatory conditions for communications providers irrespective of service offered or technology used. These regulatory changes are being driven by advances in technology and new services offered by service providers.

24. **Leverage** spectrum usage databases prepared during spectrum audits to create light-licensing databases where appropriate;
25. **Adopt** a harmonized, flexible and streamlined approach to spectrum licensing for mobile network backhaul that accommodates all backhaul technologies on a technology neutral basis;
26. **Adop**t a special (temporary) license to enable timely access to mobile service spectrum that would facilitate delivery of service to end users in response to emergencies or for trials by commercial networks;
27. **Prevent** spectrum hoarding by designing auctions with spectrum caps. This would prevent some operators from acquiring larger amounts of spectrum than would be used;
28. **Provide** spectrum for use by government/public services such as emergency services subject to a small administrative fee that is based on cost recovery principles;
29. **Licence** by way of auction, exclusive individual licenses where demand exceeds supply, such as International Mobile Telecommunications (IMT) spectrum for mobile services;
30. **Ensure** that all equipment to be used for communications purposes are type approved to ensure their compliance with the relevant performance, electrical safety and electromagnetic compatibility (EMC) standards;
31. **Provide** an option for a sub-regional or Africa-wide type approval in order to facilitate ease of access to a sub-regional or Africa wide market; Ensure that only type approved equipment is used by way of undertaking market surveillance of equipment;
32. **Support,** under the auspices of the ATU, the:
    a. Development of a comprehensive master spectrum plan containing the assignments in all the bands for all its Member States. This master plan will act as a database for potential investors, equipment manufacturers etc. to help them make decisions as well as design equipment tailored for African countries.
    b. Establishment a harmonized framework at the African level for spectrum use authorization including the granting of licenses and authorizations;

PART F: ABOUT THIS RECOMMENDATION

Development: This recommendation was developed by an ATU Task Group on Spectrum Recommendations from July 2020 to February 2021. This group was led by the following:

Name (Country)	Role
Dr Mohamed EL-MOGHAZI (Egypt representing North)	Chair – Task Group
Wilson BOKATOLA (Congo representing ECCAS)	Rapporteur – Recommendation 001- 0
Alfred Joseph BOGERE (Uganda representing EACO)	Rapporteur - Recommendation 002- 0
Gabriel KOFFI (Cote d'Ivoire representing ECOWAS)	Rapporteur - Recommendation 003- 0
Dick SONO (South Africa representing SADC)	Rapporteur - Recommendation 004- 0

Validation: This recommendation was validated in a validation forum that was held from 4th to 5th March 2021. The forum was led by the following bureau:

Chair: Valéry Hilaire OTTOU (Cameroun representing ECCAS)

Vice-Chair: Ahmed BORAUD (Niger representing ECOWAS)

Rapporteurs: Stella BANYENZA (Tanzania representing EACO/SADC)

Mohamed ABDELHASEEB (EGYPT representing North)

Official Launch: This recommendation was officially launched on 22 April 2021 by the Minister of Posts and Telecommunications of Cameroun, **Mrs LIBOM LI LIKENG née MENDOMO AWOUMVELE Minette**

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