

Self introduction and Expectations



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- 6 years National Regulatory Body in charge of International Affairs and Digital transformation , Network interconnexion, Spectrum issues
- 3 years Consultant for Saudi Telecom Company in Middle East
- Developing training materials for high-level decision-makers, Government, Operators
- Affiliation with the International Telecommunications Union, an internationally recognize.
- Strategy and leadership organization – Change and Risk Management

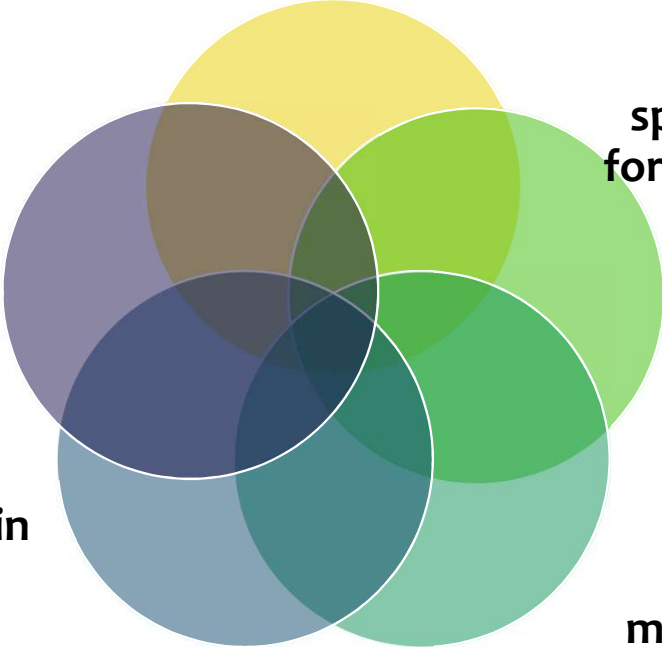
General aspects of Spectrum Management



1-

Introduction to Spectrum Management

5 Questions



2- The importance of spectrum management for national, regional, and international communications



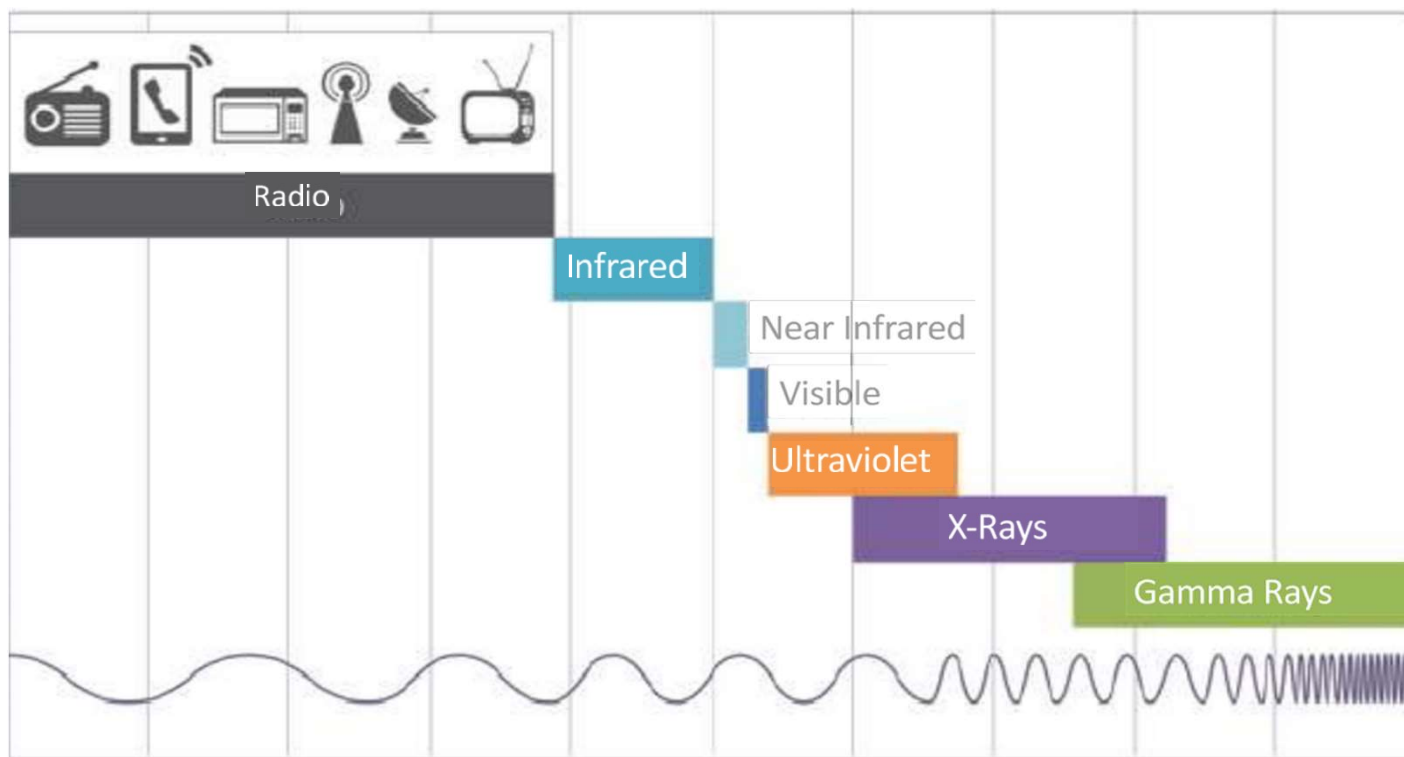
4 –Best practices in spectrum management according to ITU guidelines

3 –Overview of spectrum management layers: National, Regional, International



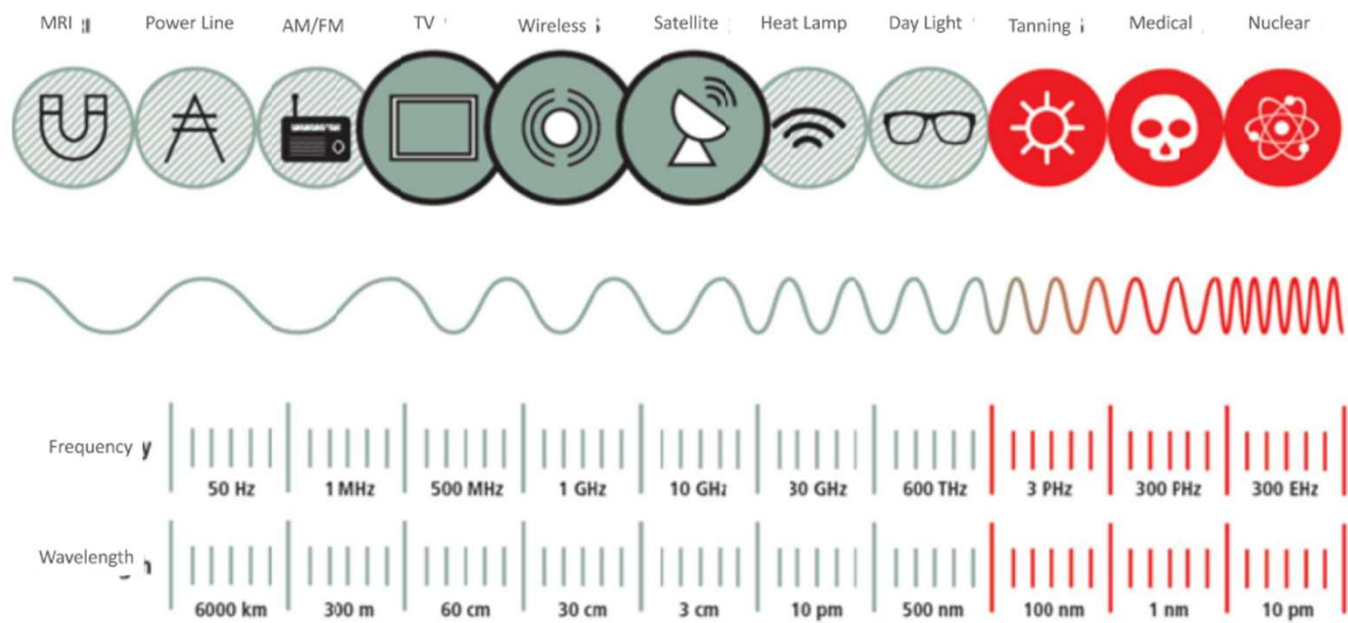
Introduction to Spectrum Management

What is Spectrum?

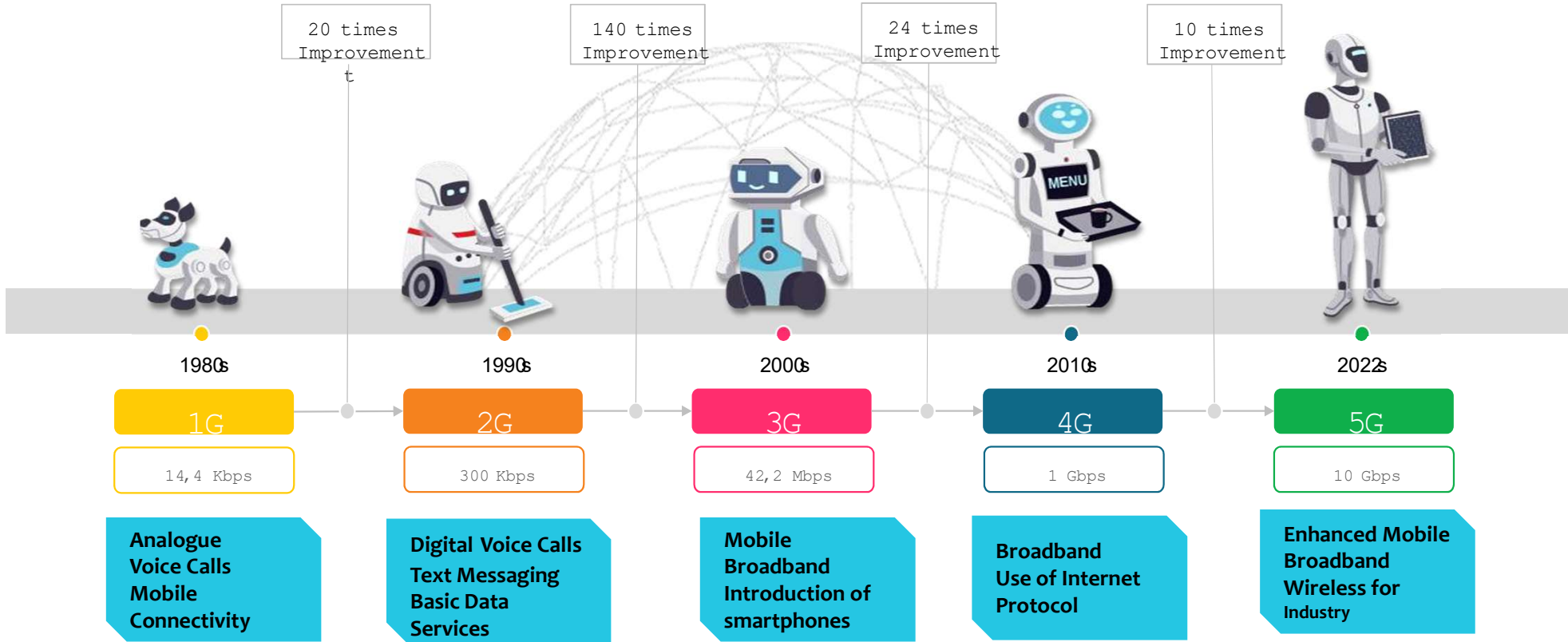


Introduction to Spectrum Management

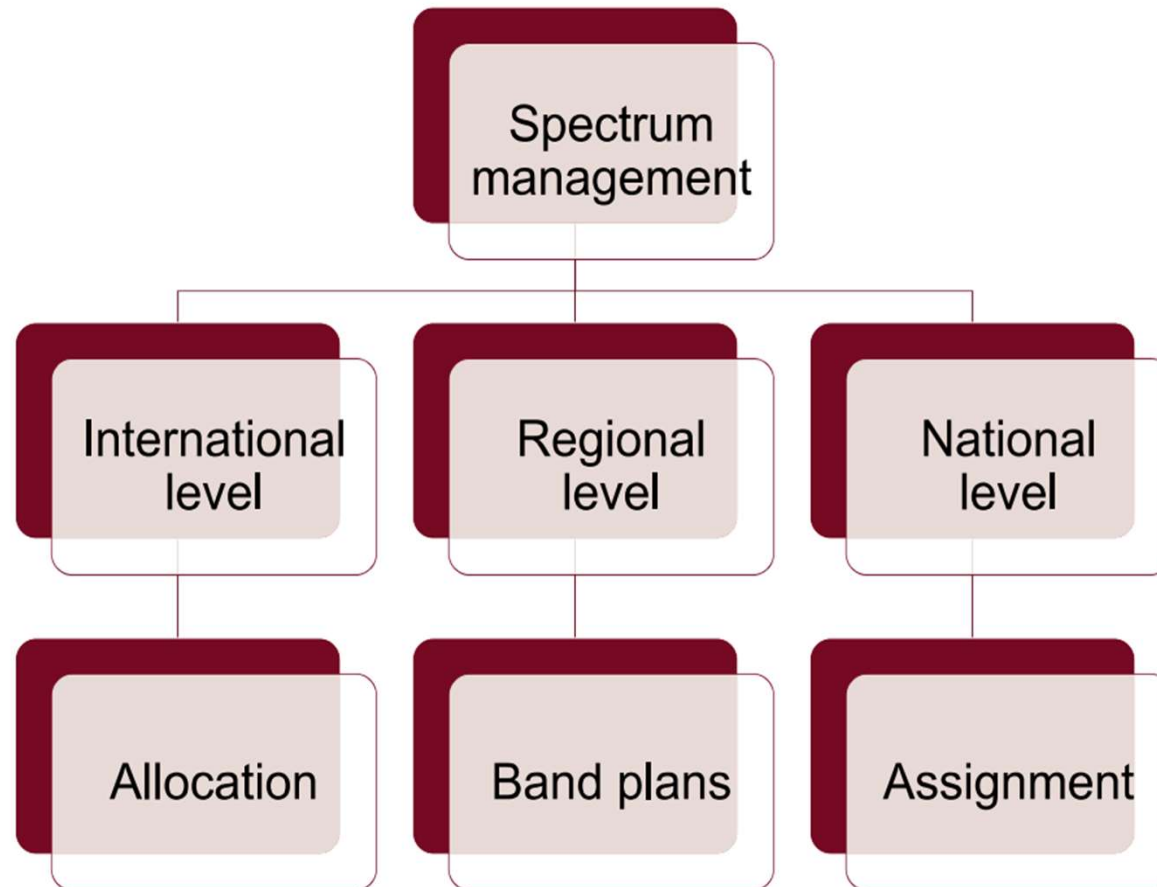
Different type of services



The evolution of Connectivity



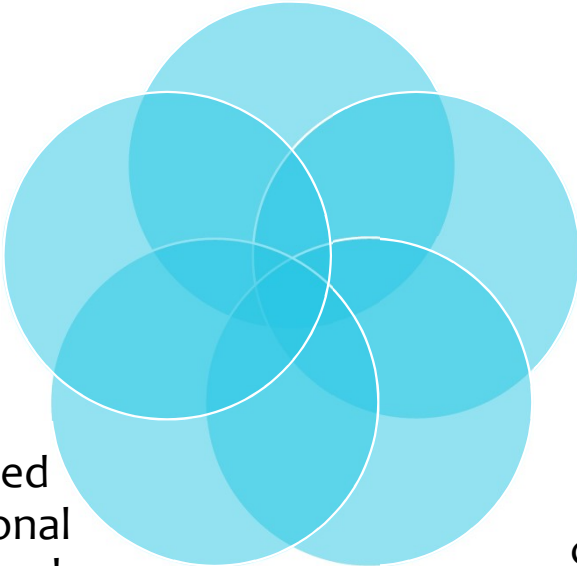
Layers Spectrum Management



Introduction to Spectrum Management

Radio frequencies - 10 kHz to 3000 GHz •

Vital to economic, social & cultural life



A scarce but renewable public resource

Used and managed through international treaties and national policies

Cannot be confined within national borders



Introduction to Spectrum Management

General description of Spectrum Management (SM)

Spectrum management is the combination of administrative, scientific and technical procedures necessary to ensure the efficient operation of radiocommunication equipment and services without causing interference. Spectrum management is the overall process of regulating and administering use of the radio frequency spectrum.

The main goals of Spectrum Management

- Making the radio spectrum available for government and nongovernment uses to stimulate social and economic progress;
- Making efficient and effective use of the spectrum.



Introduction to Spectrum Management

To make available efficient nationwide and worldwide telecommunications services for personal and business use;

To foster innovation in the development of infrastructures and provision of radiocommunication services;

Objectives of Spectrum Management

To serve national interests, including security and defence;

To support crime prevention and law enforcement;



Introduction to Spectrum Management

To safeguard life and property;
to support national and
international systems for
transportation;

To foster conservation of
natural resources

Objectives of Spectrum Management

To provide for dissemination of
educational, general, and
public interest information and
entertainment

To promote scientific research,
resource development, and
exploration



The importance of spectrum management for national, regional, and international communications

National legal Framework Level

The function of primary legislation is to bring a regulator into existence and to set out the scope and remit of their powers

It will typically cover finances such as the budget and the ability to raise revenue through spectrum fees and auctions

Primary legislation

There are a few tasks an NRA typically must do such as publish a National Table of Frequency Allocations (NTFA) which are typically included in the primary legislation

Primary legislation normally outlines the key objectives such as efficient use of spectrum and promotion of innovation



The importance of spectrum management for national, regional, and international communications



Secondary legislation

It will typically cover finances such as the budget and the ability to raise revenue through spectrum fees and auctions

It means nature of a right grant to the assignee of a particular spectrum to claim in case of any harmful interference caused by other entity.

Secondary legislation

There are a few tasks an NRA typically must do such as publish a National Table of Frequency Allocations (NTFA) which are typically included in the primary legislation

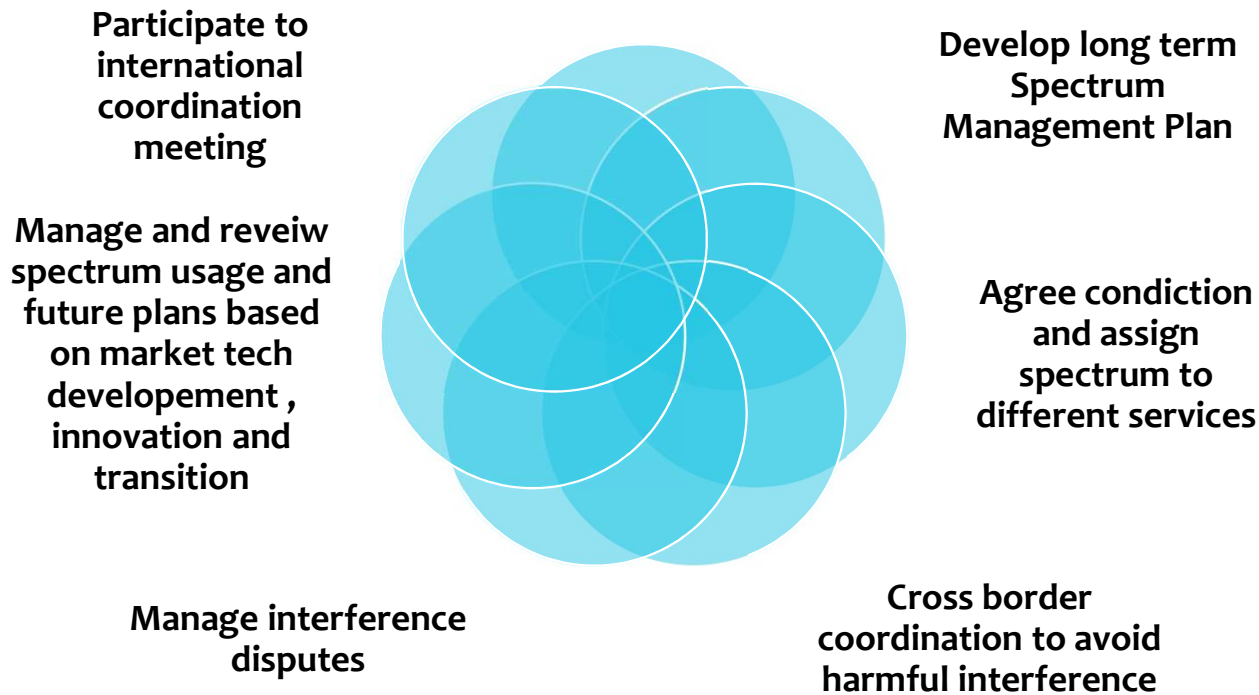
Primary legislation normally outlines the key objectives such as efficient use of spectrum and promotion of innovation means the nature of a right granted to the assignee of a particular spectrum



Overview of spectrum management layers: National, Regional, International



NRA Mission :



National spectrum management

Definitions

Allocation (of a frequency band): Entry in the Table of Frequency Allocations of a given frequency band for the purpose of its use by one or more terrestrial or space radiocommunication services or the radio astronomy service under specified conditions. This term shall also be applied to the frequency band concerned.

Allotment (of a radio frequency or radio frequency channel): Entry of a designated frequency channel in an agreed plan, adopted by a competent conference, for use by one or more administrations for a terrestrial or space radiocommunication service in one or more identified countries or geographical areas and under specified conditions

Assignment (of a radiofrequency or radio frequency channel): Authorization given by an administration for a radio station to use a radio frequency or radio frequency channel under specified conditions.



Day 1

National spectrum Management Actions

Planning:

- Defining the use of different bands (Allocations)

Licensing

- Authorizing of emissions, and technical conditions (Assignments)

Enforcement

- Verifying the use of spectrum in conformity with licensing

Identification

A band may be also identified for a limited range of technology as the WRC meeting did for IMT (4G? 5G)



National spectrum management

it is a government responsibility to develop spectrum management policies that conform to the international treaty obligations of the Radio Regulations while meeting national spectrum needs

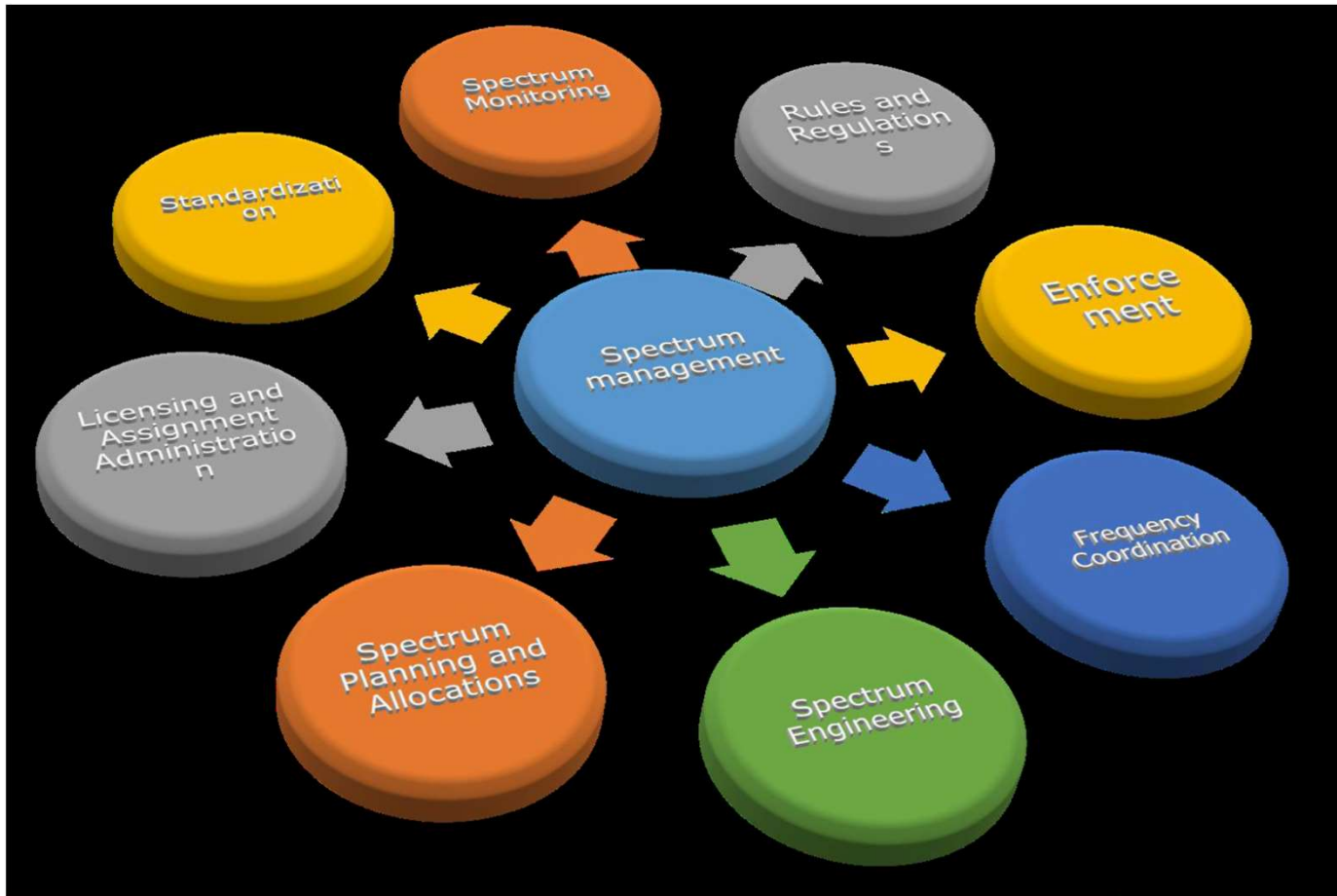
Within the national legal framework for telecommunications a spectrum management organisation has the delegated authority to prepare spectrum plans that meet government policies

National spectrum plans should be reviewed regularly and, when necessary, be updated to keep pace with technology and changing demands

One of the most important tools for effective spectrum management is the National Table for Frequency Allocation Table (NTFA). This shows how the spectrum can be used in the country



National spectrum management



National spectrum Management

➤ **Telecommunication Act of the country**

- Defines National goals, long term and short term policies of telecommunication sector
- Responsibilities of organization dealing with Spectrum Issues

➤ **Spectrum Policy**

- Spectrum Planning
- Spectrum Economics
- Spectrum Licensing
- Interference Mitigation –counter harmful to and from inter or intra country users
- Other issues related to spectrum Management



National spectrum Management Planning



➤ Adherence to

- National Telecom ACT and Spectrum policy
- International Radio Regulations
- Regional frequency allotments and allocations

➤ Covers

- Current and Future demands of different category of users
- Telecommunication technology growth and trends

➤ Major National Document

- National Table of Frequency Allocation

➤ Requires

- Regular Update Especially after World (or Regional) Radiocommunication Conference (WRC/RRC)



- Spectrum scare resources

National Table of Frequency Allocations (NTFA)

A national Level Document that:

- ❖ Divides portion of all allocable spectrum into number of frequency bands for use and/or reservation for future use.
- ❖ Defines Primary, Secondary, Co-Primary usages of band and the bands reserved for specific services
- ❖ Details the national policy on preparation of band plans that are consistent with corresponding spectrum allocations and with existing national and international allotment plan.
- ❖ Other parameters for frequency assignment;



National Table of Frequency Allocations (NTFA)

❖ Primary Basis:

means that in accordance with the nature of a right granted to the assignee of a particular spectrum (band or spot frequency), the assignee is the only entity to use the identified spectrum and is entitled to protection from:

- harmful interference caused by any other spectrum user who may be authorized to use same spectrum on secondary basis; and
- claims of harmful interference by any such spectrum user

❖ Secondary basis:

means the nature of a right granted to the assignee of a particular spectrum (band or spot frequency), is subject to the condition that the entity does not cause any harmful interference to, or claim protection from any harmful interference caused by, other licensees who have been granted the right to use same frequency bands on primary or co primary basis.



National Table of Frequency Allocations (NTFA)



➤ Co-primary Basis:

means that nature of the right granted to the assignee of a particular spectrum (band or spot frequency), to use the specified frequency bands is subject to the condition that

- the entity must coordinate with other co-primary licensees in order to limit harmful interference to existing links and services operating in the relevant frequency bands, and to facilitate the introduction of additional links and services in the relevant frequency bands.
- Co-primary user must refrain from causing harmful interference to, and may not require protection from operations of other co-primary user in relevant band.
- Co-primary usage of band is subject to protection from:
 - *harmful interference caused by any other spectrum user that may be authorized to use the same spectrum on secondary basis,*
 - *claims of harmful interference by holders of licenses granting secondary status with respect to frequency bands covered*



• Spectrum scare resources

TREY
Research

Aspects of Frequency Assignment

❖ Regulatory aspects

- Radio Regulations, Frequency allocation table and agreements
- Spectrum Management department shall provide *provisions* and *decisions*

❖ Technical aspects

- Taking into account regulatory actions required for concerned service
- Seeking frequencies assignable to convince needs of applicant while protecting existing licensees from harmful interference

❖ Regulatory / Technical aspects

- Frequency coordination procedure between existing users and prospective users
- Achieving bilateral/multilateral agreements to divide frequency bands equitably/proportionally in borders



Income from Spectrum Management

❖ Fees collected :

- License application (not refundable);
- License issuing, renewing and amendment;
- Periodically (on monthly/annual basis) from spectrum users proportional with the occupied bandwidth, service type, used frequency, covered location, service area, time duration and etc.;
- Penalties imposed in effect of breaching of regulation;
- Type approval fee;
- Special technical assistance;
- Auction;

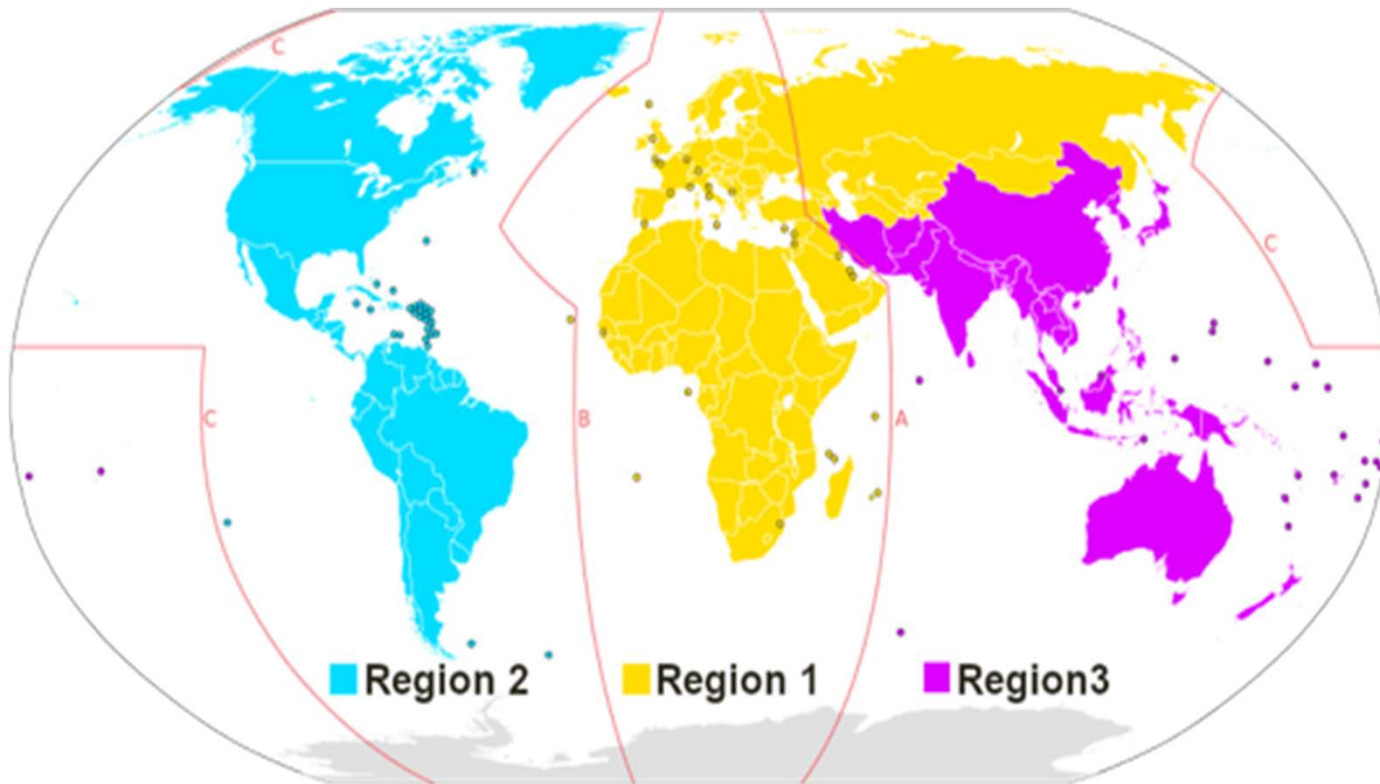
❖ Spectrum management authority could earn much more money than its administrative needs if a suitable spectrum pricing regulation developed

❖ Roughly, spectrum fee should not be more than **3~5%** of net revenue of licensee



- Spectrum scare resources

International Spectrum Management / ITU



International Spectrum Management / ITU

Supporting harmonized global frequency allocations,

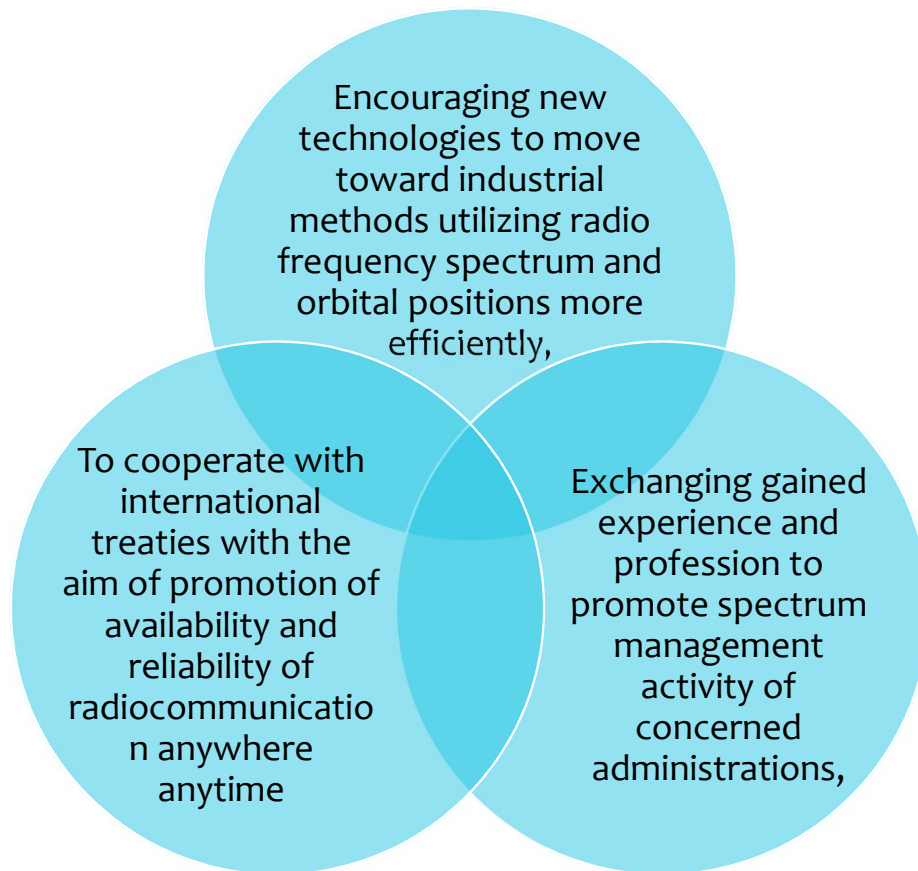
Providing and supporting common standards to achieve the highest level of interoperability and to enable successful interconnection between various systems,

Contribution and supporting regional agreements on utilization of specific frequency bands,

Protection of governed national frequency assignments while recognizing frequency assignments of other governments,



International Spectrum Management / ITU



Best practices in spectrum management according to ITU guidelines

Best practices for national spectrum management

With due regard to the ITU Constitution and Convention, this section addresses best practices for national spectrum management activities.

International practices are not included.

However, some of the best practices outlined below are intended to interface with, or transition to, international practices, e.g. those relating either to collaboration with colleagues in other countries, or to coordination, such as that which would occur at a bilateral or multilateral consultation preceding a WRC, or at an international satellite coordination meeting. These practices are further intended to harmonize global spectrum management policies, to the extent practicable, by harmonizing practices among national administrations.



Best practices in spectrum management according to ITU guidelines

Best practices:

- Establishing and maintaining a national spectrum management organization, either independent or part of the telecommunication regulatory authority responsible for managing the radio spectrum in the public interest.
- Promoting transparent, fair, economically efficient, and effective spectrum management policies, i.e. regulating the efficient and adequate use of the spectrum, taking into account the need to avoid harmful interference and the possibility of imposing technical restrictions in order to safeguard the public interest.



Best practices in spectrum management according to ITU guidelines

- ❖ Making public, wherever practicable, national frequency allocation plans and frequency assignment data to encourage openness, and to facilitate development of new radio systems, i.e. carrying out public consultations on proposed changes to national frequency allocation plans and on spectrum management decisions likely to affect service providers, to allow interested parties to participate in the decision-making process,
- ❖ Maintaining a stable decision-making process that permits consideration of the public interest in managing the radio frequency spectrum, i.e. providing legal certainty by having fair and transparent processes for granting licences for the use of spectrum, using competitive mechanisms, when necessary.



Best practices in spectrum management according to ITU guidelines

- ❖ Providing in the national process, in special cases where adequately justified, for exceptions or waivers to spectrum management decisions.
- ❖ Having a process for reconsideration of spectrum management decisions.
- ❖ Minimizing unnecessary regulations and Encouraging radiocommunication policies that lead to flexible spectrum use, to the extent practicable, so as to allow for the evolution of services and technologies using clearly-defined methods, i.e.
 - ✓ eliminating regulatory barriers and allocating frequencies in a manner to facilitate entry into the market of new competitors;
 - ✓ encouraging efficiency in the use of spectrum by reducing or removing unnecessary restrictions on spectrum use.



Best practices in spectrum management according to ITU guidelines

- ❖ Assuring open and fair competition in the marketplaces for equipment and services, and removing any barriers that arise to open and fair competition.
- ❖ Harmonizing, as far as practicable, effective domestic and international spectrum policies, including of radio-frequency use and, for space services, for any associated orbital position in the geostationary-satellite orbit or of any associated characteristics of satellites in other orbits.
- ❖ Working in collaboration with regional and other international colleagues to develop coordinated regulatory practices, i.e. working in collaboration with regulatory authorities of other regions and countries to avoid harmful interference.



Best practices in spectrum management according to ITU guidelines

- ❖ Removing any regulatory barriers to free circulation and global roaming of mobile terminals and similar radiocommunication equipment.
- ❖ Using “milestone” management steps and phases to monitor and control lengthy radiocommunication system implementation.
- ❖ Adopting decisions that are technologically neutral and which allow for evolution to new radio applications.
- ❖ Facilitating timely introduction of appropriate new applications and technology while protecting existing services from harmful interference including, when appropriate, the provision of a mechanism to allow compensation for systems that must redeploy for new spectrum needs.





Questions???



Best practices in spectrum management according to ITU guidelines

- ❖ Considering effective policies to mitigate harm to users of existing services when reallocating spectrum.
- ❖ Where spectrum is scarce, promoting spectrum sharing using available techniques (i.e. frequency, temporal, spatial, modulation coding, processing, and so on), including using interference mitigation techniques and economic incentives, to the extent practicable.
- ❖ Using enforcement mechanisms, as appropriate, i.e. applying sanctions for non-compliance with obligations and for inefficient use of radio-frequency spectrum under relevant appeal processes.
- ❖ Utilizing regional and international standards whenever possible, and where appropriate, reflecting them in national standards.
- ❖ Relying to the extent possible on industry standards including those that are included in ITU Recommendations, in lieu of national regulations.



Spectrum Licencing

1-

Keys regulatory considerations for spectrum assignment

5 The significance of coverage obligations in spectrum licencing



2.Licencing policy frameworks

3 - Administrative assignment and its role in spectrum management

2- Auction mechanisms and their implications



Spectrum Assignment

Spectrum
Assignment

1-
Keys regulatory
considerations for
spectrum assignment



Keys regulatory considerations for spectrum assignment



In the telecommunication and information and communication technologies (ICT) sectors, having a stable regulatory framework and governance is key for effective regulation. Spectrum management is one of the many functions regulators perform, which may be challenging as new digital technologies and services emerge.

To properly face these challenges, it is important for administrations to consider how spectrum issues are addressed in the national government structure. Considering the technical nature of the spectrum management functions, pressure often exists to design regulatory structures and internal procedures to optimize the use of resources available and increase efficiency. It is important to establish a management or administrative body providing leadership and supervision for the implementation of spectrum planning.

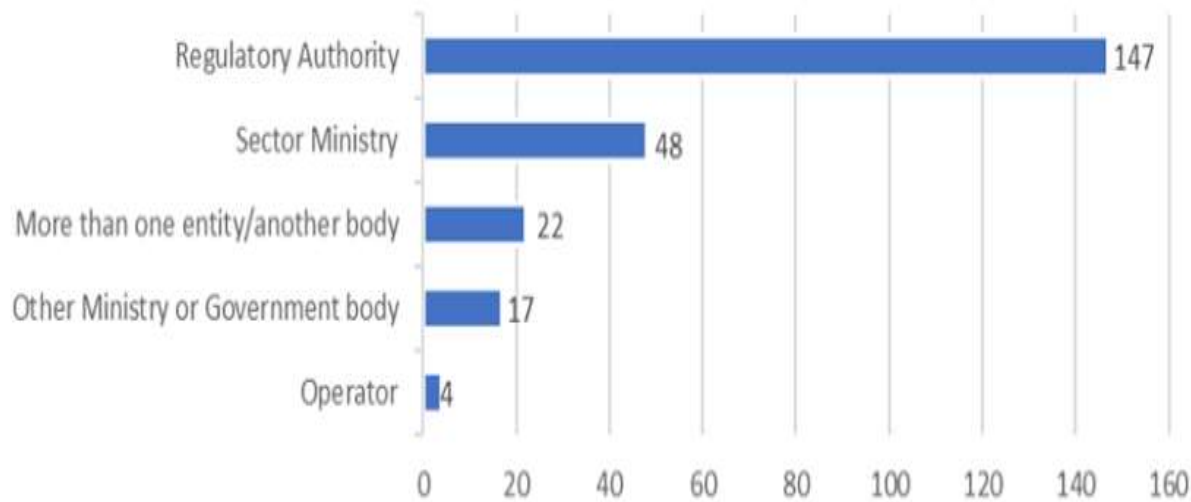


Keys regulatory considerations for spectrum assignment



Keys regulatory considerations for spectrum assignment

Governmental bodies with spectrum management responsibilities around the world



Source: ITU



Keys regulatory considerations for spectrum assignment

Assigning frequencies represents the central part of daily operations of the spectrum management organization.

The frequency assignment unit performs the analysis required to select the most appropriate frequencies for radiocommunication systems and coordinates proposed assignments with existing assignments.

A frequency assignment function, combined with the licensing function, naturally applies national legislation, regulations and related procedures. It exercises control over the operation of stations by:

- ❖ examination of license applications and related documents to determine the licensing eligibility of the applicant from a legal and regulatory point of view and the technical acceptability of the radio equipment proposed;
- ❖ assigning radio calls signs to individual stations;



Keys regulatory considerations for spectrum assignment

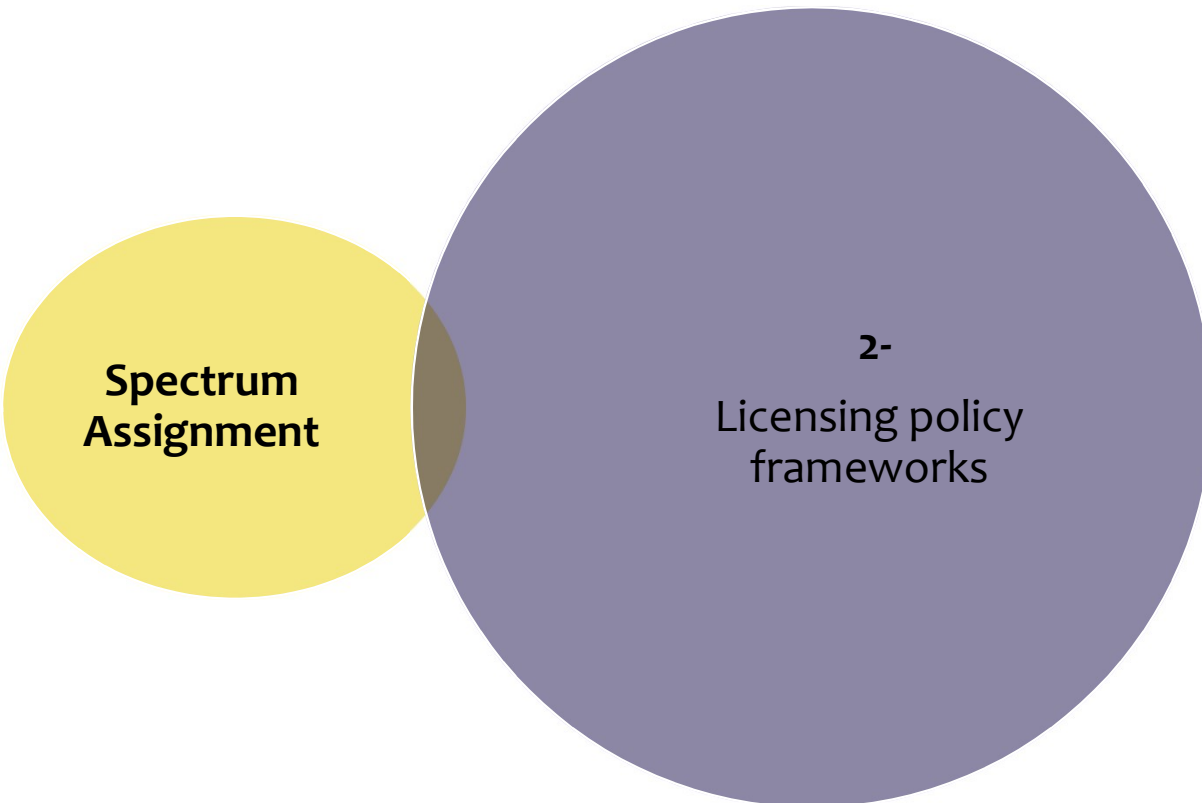
- ❖ issuing licenses and collecting fees, if appropriate;
- ❖ establishing methods for administering system or network licenses, as appropriate;
- ❖ renewing, suspending, and cancelling licenses, as appropriate;
- ❖ conducting examinations of operator competence and issuing operator certificates, as may be required.

The procedures should specify what information must be supplied in with frequency applications. Depending on the national objectives, this information may pertain to the intent of the spectrum use or merely technical characteristics that will enable the spectrum manager to better coordinate the activities of its constituents.

Unnecessary or arduous procedures may discourage radiocommunication development.



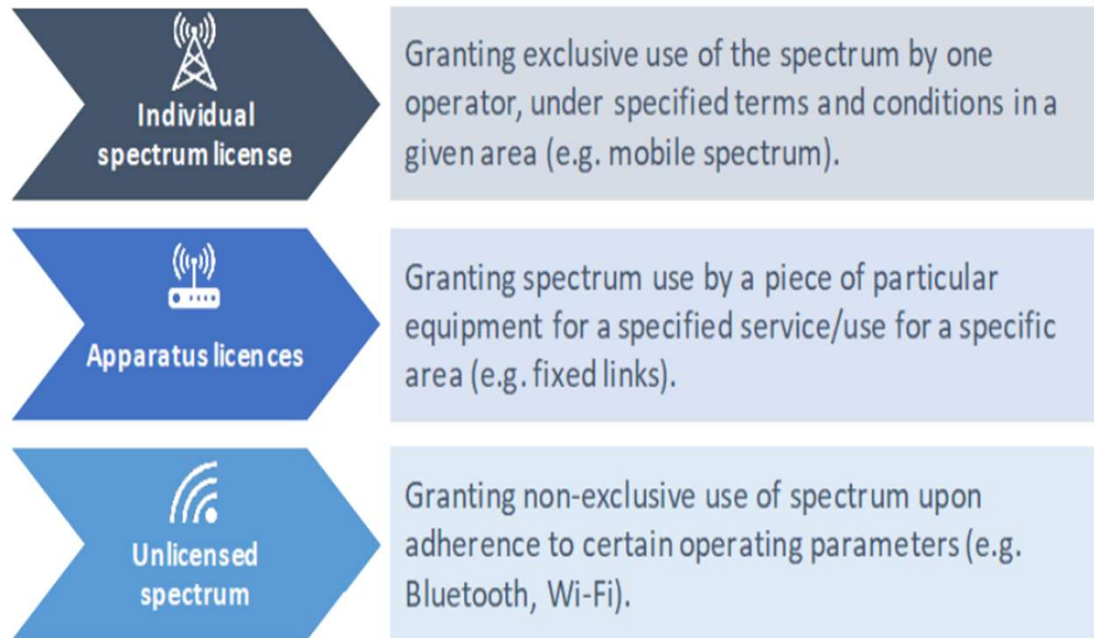
Spectrum Assignment



Licensing policy frameworks

Types of Spectrum Licensing

Regulators decide on the licensing mechanism to apply to spectrum by considering a band's availability, proposed usage, and risk of harmful interference. Generally, spectrum is authorized through one of the following mechanisms:



Licensing policy frameworks

Individual spectrum licences are usually assigned through an administrative assignment or “beauty contest” approach, an auction approach, or a hybrid approach which contains elements of both a direct assignment and an auction. Mobile spectrum is usually issued under an individual spectrum license via either direct assignment, auction, or a hybrid approach.

Apparatus licences are commonly issued by direct assignment, on a first-come, first-served basis. The apparatus license authorizes the operation of an individual device or type of device to deliver an approved service at a defined location. They are frequently used for fixed point-to-point links, and for bands with adequate spectrum supply for the demand of the different users. For example, Australia authorizes fixed links under an apparatus license framework.

Unlicensed spectrum are frequency bands that are exempt from licensing, normally used for the operation of low-power, short-range devices. Devices in unlicensed bands should operate under defined technical conditions to ensure that they do not cause harmful interference to other radiocommunication users. Unlicensed bands enable widespread use of various technologies, including Bluetooth, Wi-Fi, and the IoT.



Spectrum licencing

Individual spectrum licences are usually assigned through an administrative assignment or beauty contest approach, an auction approach, or a hybrid approach.

Administrative assignment: Regulators assign spectrum to the candidates that best meet specified criteria.

Auction: Whichever operator places the highest bid for a spectrum block wins the spectrum, although the auction design may include other criteria. Different auction designs include simultaneous multiple round ascending, clock, combinatorial clock, or sealed bid auctions.

Hybrid approach: A hybrid approach blends auction and administrative assignments. For example, a regulator may select a shortlist of bidders based on administrative criteria and then hold an auction to assign spectrum among the shortlisted candidates.



Spectrum licencing

Spectrum for mobile services are more commonly awarded through auctions, although there are examples of both direct assignment and hybrid approaches. Both administrative and auction approaches to spectrum licensing have advantages and disadvantages.

The best assignment approach will depend on the regulator's policy objectives and the market conditions, including demand for the spectrum, level of competition, and the potential risks to investment and quality of service. Some regulators include aspects of both approaches to balance the risks with the benefits of each



Spectrum licencing

Apparatus licenses and unlicensed spectrum

Apparatus licences are usually issued by direct assignment, on a first-come, first-served basis. Unlike individual spectrum licences, apparatus licences generally use spectrum in less-demanded bands.

While some coordination may be required, these licences usually do not carry the same risk of harmful interference with other services. For example, fixed point-to-point links are highly directional and focused in a concentrated geographic area.

The risk of interference from the fixed point-to-point service can be mitigated by maintaining a certain distance from other transmitters or receivers and putting in place certain power limits for services operating in the same band.

Unlicensed spectrum does not require an official license, nevertheless, equipment must comply with specific technical conditions to ensure sharing and compatibility with other services. Registration may be required before use is authorized, which can be submitted at any time.



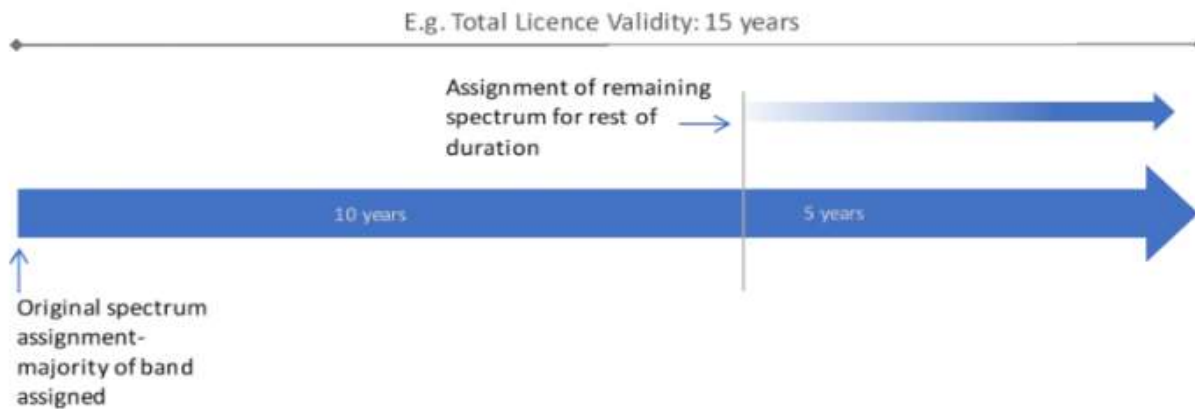
Spectrum licencing

Other examples in spectrum licensing

Short-term assignments of unused spectrum

Given the political impetus to promote mobile networks generally, and 5G in recent years, some countries have made unused spectrum in IMT bands available on a shorter-term basis.

In New Zealand and the Slovak Republic, regulators decided to assign the unused spectrum, left unassigned in prior procedures, on a shorter-term basis to align with the existing license terms of the prior assignment, as illustrated below



Others Licenses-exempt Spectrum

Wi-Fi

The leading success story of license-exempt spectrum is the 2.4 GHz and 5 GHz bands, particularly Wi-Fi communication. From its humble beginning connecting laptops in cafes, hotels, university campuses and airports, Wi-Fi access is now to be found in almost any commercial or public building, not to mention its default use in the home and office as the endpoint of a broadband connection. It is estimated that by en of 2021 be more than **540 million Wi-Fi hotspots worldwide**. We now see Wi-Fi in smartphones, tablets, cameras, printers, even refrigerators and weigh scales. It has become the default “last inch” technology.



Others Licenses-exempt Spectrum

Economy value of Wi-Fi

	LOW VALUE (\$M PER YEAR)	HIGH VALUE (\$M PER YEAR)	CONNECTIONS GENERATED BY WI-FI (MILLION)
Africa	69	901	0.5 - 1
Asia	10,820	41,516	21.2 - 48.2
Europe	21,657	30,164	15.4 - 35
North America	17,769	19,952	10.2 - 23.2
Oceania	1,049	1,217	0.6 - 1.4
South America	782	4,772	2.4 - 5.5

Source : Isoc



Expanding the license-exempt bands

The success of Wi-Fi begs the question as to why more spectrum is not made available on a license-exempt basis. As shown in Annex 1, the United States is one the frontrunners in this space, having made 50 MHz available between 5600 and 5650 MHz for Wi-Fi, not available elsewhere. In addition, in February 2013 the FCC issued a Notice of Inquiry (NOI) to harmonize rules on the 5 GHz license-exempt band which could make the aggregation of channels in 5 GHz easier .



Others Licenses-exempt Spectrum

License-exempt MMWave bands

In addition to the traditional Wi-Fi license-exempt bands, there are other bands that currently can be used without a spectrum license in many countries (USA- CAN- Mexique) provided that, as in the case of Wi-Fi, devices receive type approval and do not transmit over certain maximum power output levels.

Of particular interest are the 24 GHz band, the 60 GHz band (V band) and the E band (from 71 GHz onwards), also known as mmWave as their wavelength in these higher frequencies is on the range of millimetres (mm)



Spectrum licencing

Longer license terms : Many regulators are adopting longer license terms for mobile spectrum, which gives greater regulatory certainty to operators and encourages network investment.



The preferred approach in the **United Kingdom** is to issue a licence for an indefinite validity, with an initial period, after which time Ofcom will be able to revoke the spectrum under specific spectrum management reasons with notice to the licensee (Ofcom 2005).



The EU's Electronic Communications Code directs member states to offer spectrum rights for at least 20 years (*Directive (EU) 2018/1972*). Some have interpreted the Code by assigning licences with a 15-year term with the possibility of a five-year renewal.



With the passage of its new ICT Modernization Act, **Colombia** extended licence terms from 10 to 20 years, with the possibility of a renewal of up to 20 years (*Law No. 1978 of 25 July 2019, Art. 12*).



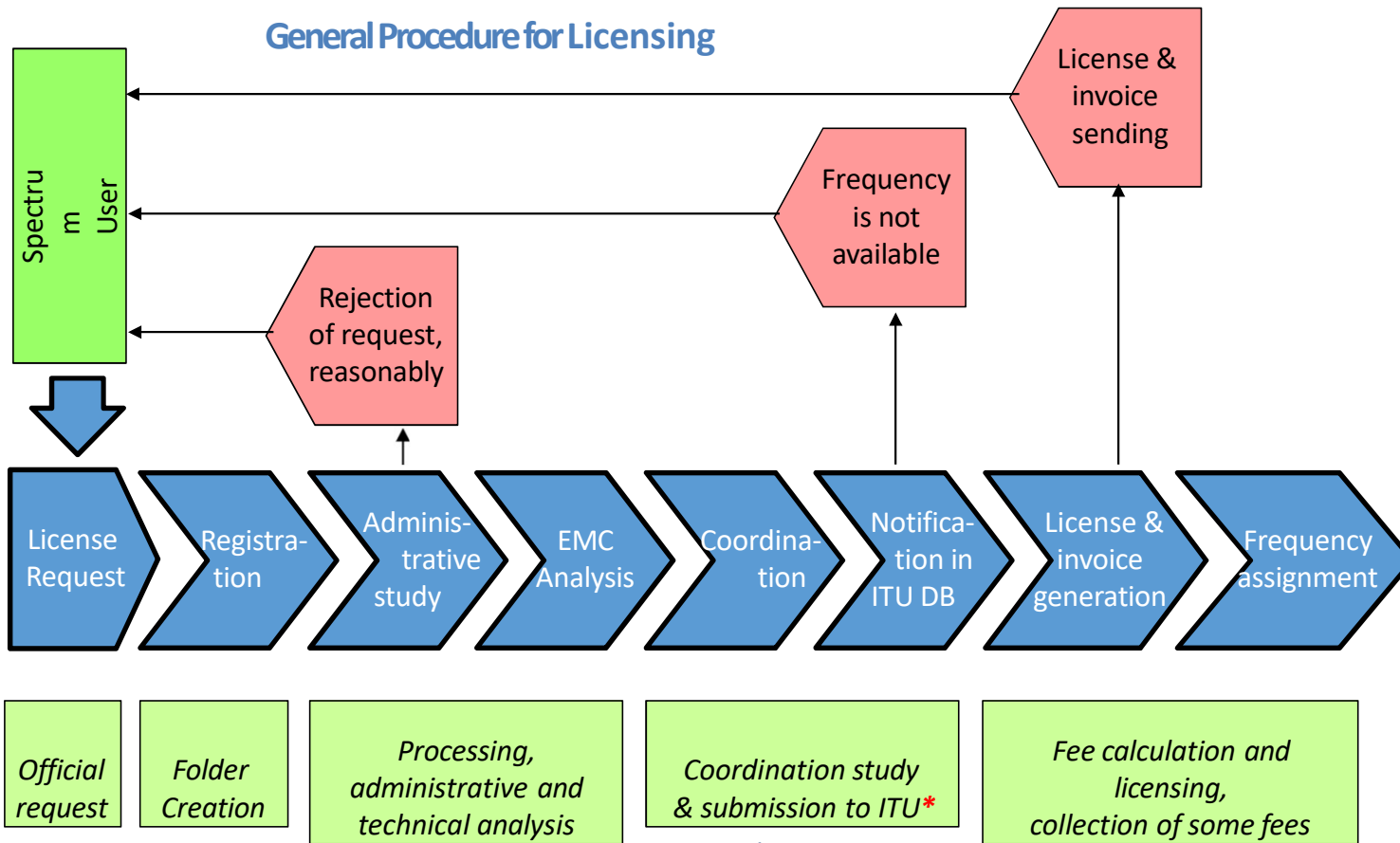
New amendments to **Brazil's** telecommunications law allow spectrum licences to be renewed for up to 20 years and indefinitely, subject to rules to be defined by ANATEL (*Law No. 13.879 of 3 October 2019, Art. 167*).



Licensing policy frameworks



General Procedure for Licensing



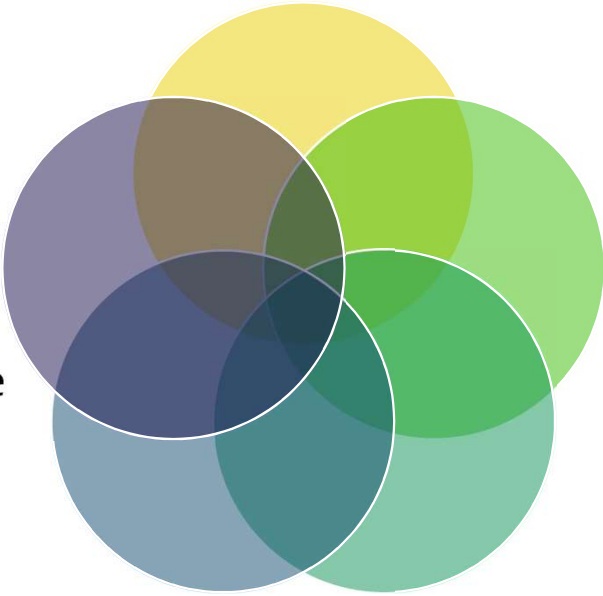
* ITU notification is not required for each cases, and that a bi/multilateral agreement is stronger than the RR (see Article 6 of the RR)

Spectrum Assignment

1- Auction Design



5 Questions

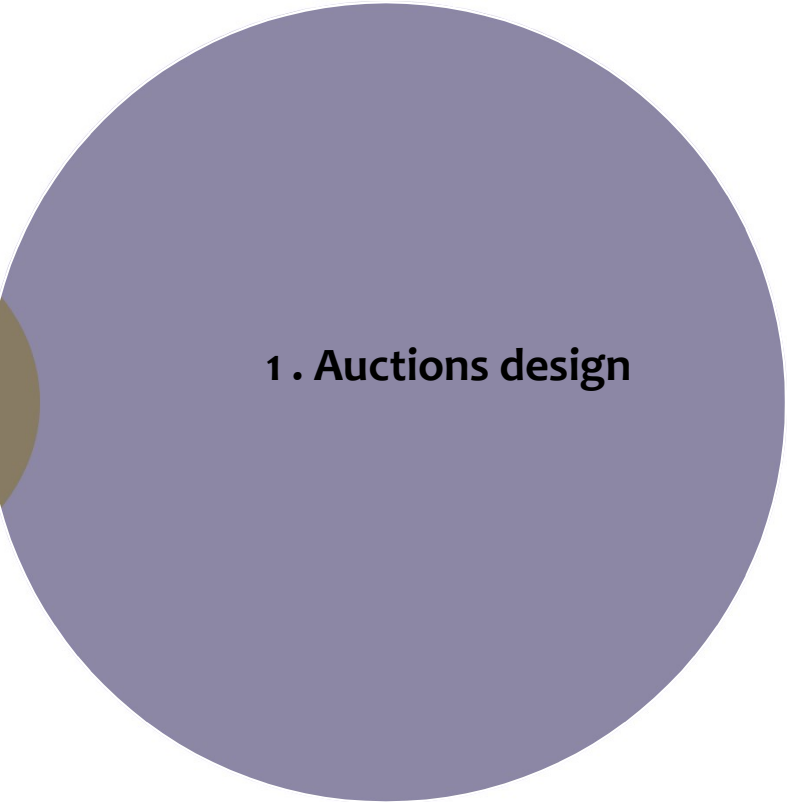
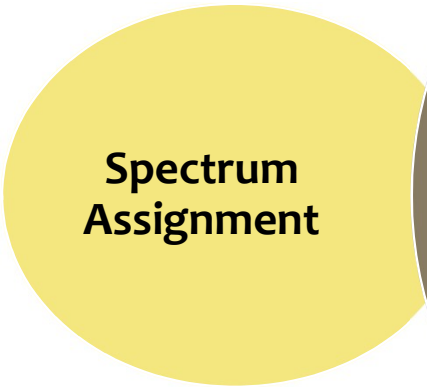


4 The significance of coverage obligations in spectrum licensing

2 Auction mechanisms and their implications

2 –Administrative assignment and its role in spectrum management

Spectrum Assignment



Auction Design

Auctions are the main approach used for assigning the rights to use a particular spectrum band, while sometimes administrative assignments (e.g., beauty contests) are also used where demand is expected to be lower than the supply of spectrum. Sometimes, a hybrid approach may also be used where the licensing authority initially selects a shortlist of bidders based on administrative criteria and then holds an auction to assign the license amongst the shortlisted candidates.

There is no single best assignment approach. Instead, there is a need to assess the merits of each on a case-by-case basis



Auction Design

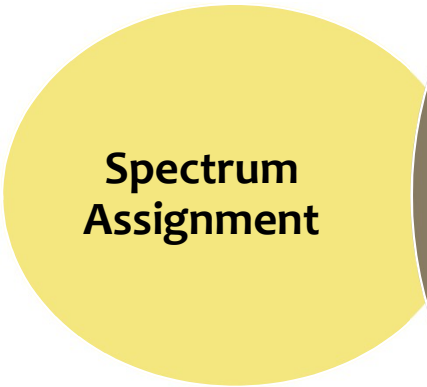
Auctions remain the most common methodology around the globe and work best when there is excess demand for the spectrum and help select those operators most likely to put it to the best use in benefitting society.

There is no single best assignment approach. Instead, there is a need to assess the merits of each on a case-by-case basis. Auctions remain the most common methodology around the globe and work best when there is excess demand for the spectrum and help select those operators most likely to put it to the best use in benefitting society .

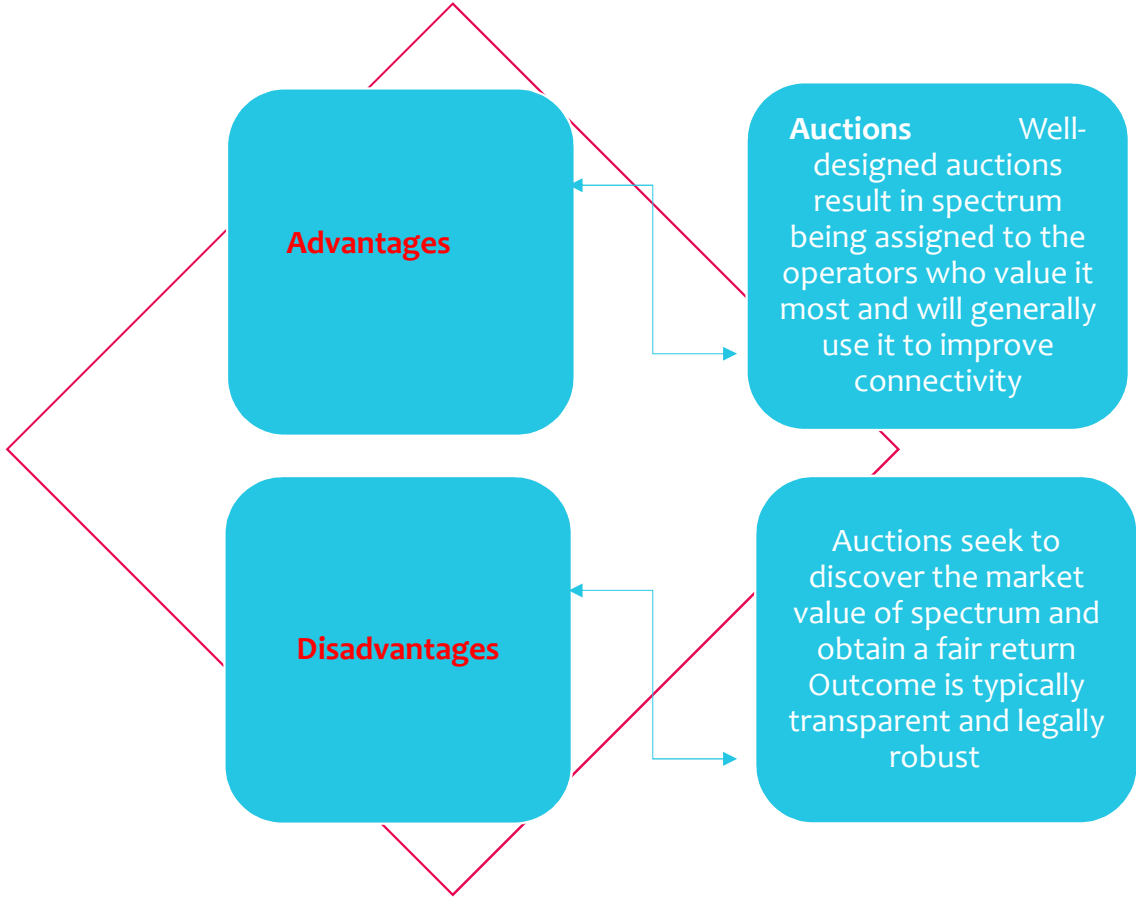
Each type of auctions have advantages and disadvantages



Spectrum Assignment

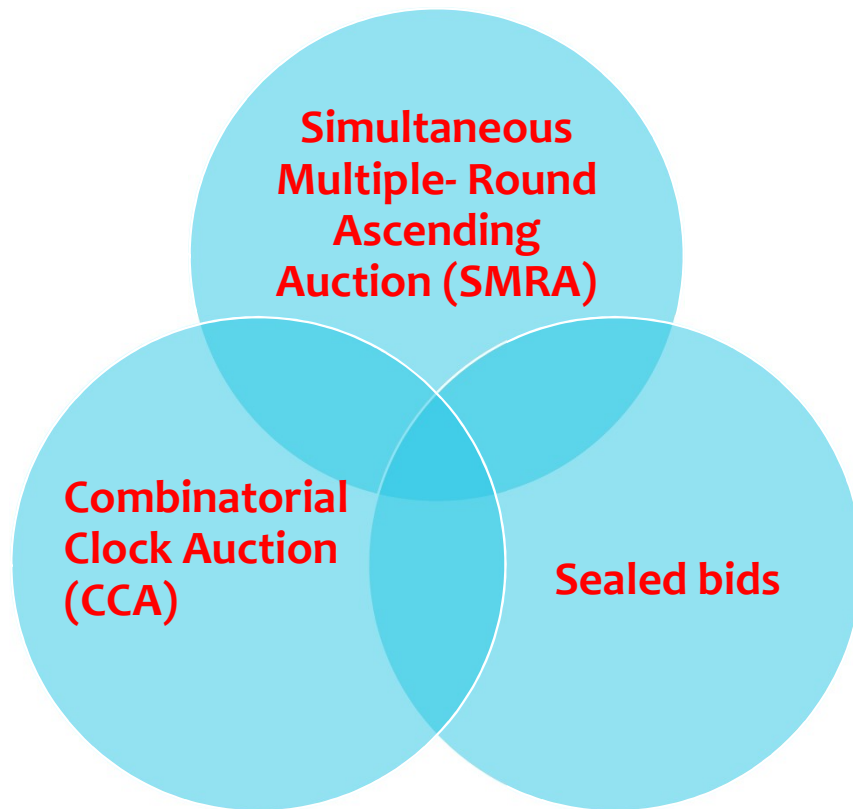


Auction mechanisms and their implications



Auction mechanisms and their implications

Regulators have used a variety of auction formats.



Auction mechanisms and their implications

Simultaneous Multiple- Round Ascending Auction (SMRA)

Lots are auctioned individually but simultaneously in separate bidding rounds

Bid information is usually revealed each round allowing bidders to respond

The auction continues until no more bids are submitted for any round Simultaneous stopping rule recognizes that there are synergies among the licenses, and a bid on one could cause another bidder to switch to a substitute



Auction mechanisms and their implications

Sealed bids

Each bidder submits a single offer and the license goes to the highest bidder

The bidder pays either their bid or, under a second price rule, the highest losing bid



Auction mechanisms and their implications

Combinatorial Clock Auction (CCA)

Multiple round auction allowing bids for packages of lots, rather than for individual licenses

An initial ascending clock phase continues for each package of generic spectrum blocks until excess demand for each group is eliminated, followed by a final round of sealed bids to determine specific assignments



Auction mechanisms and their implications

Clock Auction

Similar to SMRA

Typically used for allocating various lots of spectrum that are substitutes or complemented each other

All lots are auctioned simultaneously

In each round auctioneer announces price of each lot and bidder respond by bidding a number of lots

Bidder may bid and reduce the number of lots it is bidding on the auction progresses, but never increase it.



Auction mechanisms and their implications

The first spectrum auction in Saudi Arabia has raised SAR5.8 billion (\$1.6 billion), in 2017 for 50 MHz in the 700 MHz band and 66 MHz in the 1800 MHz band. This is the first time spectrum in the 700 MHz band has been allocated in MENA. By introducing free-market tools to estimate the value of spectrum and deferring payments over several years to ease the financial burden on operators, the Saudi regulator (CITC) has moved to a more modern approach to spectrum management.

In this auction, the Saudi regulator offered: 50 MHz in the 700 MHz band (the first time the Digital Dividend band has been offered in the country) at a reserve price of SAR2.1 billion (\$560.3 million), and 70 MHz of previously unassigned spectrum in the 1800 MHz band, also at a reserve price of SAR2.1 billion.



Auction mechanisms and their implications

To increase the level of competitiveness in the mobile Saudi market, CITC reserved 2×10 MHz in each of the auctioned bands to a new player.

All three existing Saudi mobile operators (STC, Mobily and Zain) participated in the clock auction, along with a new market entrant. Notably, it was the first successful assignment of 700 MHz to mobile services in MENA; the band was claimed by STC and newcomer GO Telecom. The remaining operators – Zain and Mobily – have invested in the 1800 MHz band only



Auction mechanisms and their implications

One of the KSA's strategic objectives in National Transformation Program (NTP) 2020 was to make available more spectrum for the provision of mobile broadband or IMT services .

In three years the CITC (Regulator) has carried out four auctions existing and new IMT bands:

June 2017: 700 Mhz and 1800 MHz

February 2018: 800 Mhz, residual spectrum and 1800 MHz bands

March 2019: 3.5 GHz for a total of 400 MHz

As a result operators in the KSA a total of more 1100 MHz of licensed spectrum IMT in the sub 6GHz range



Regional context of 5G awards



CIV

- 5G roadmap developed



Zambia

- 800 MHz and 2600MHz awarded to support 4G rollout



Rwanda

- New Broadband Policy issued, with stipulations that pave the way for Technology Neutrality



Kenya

- 60 MHz assigned to MNOs in the 2600MHz



Nigeria

- 100 MHz assignments to MNOs in the 3.5 GHz range
- EOI for 600 MHz invited



Namibia

- 5G Strategy developed with industry-recommended channel sizes in mid-band spectrum

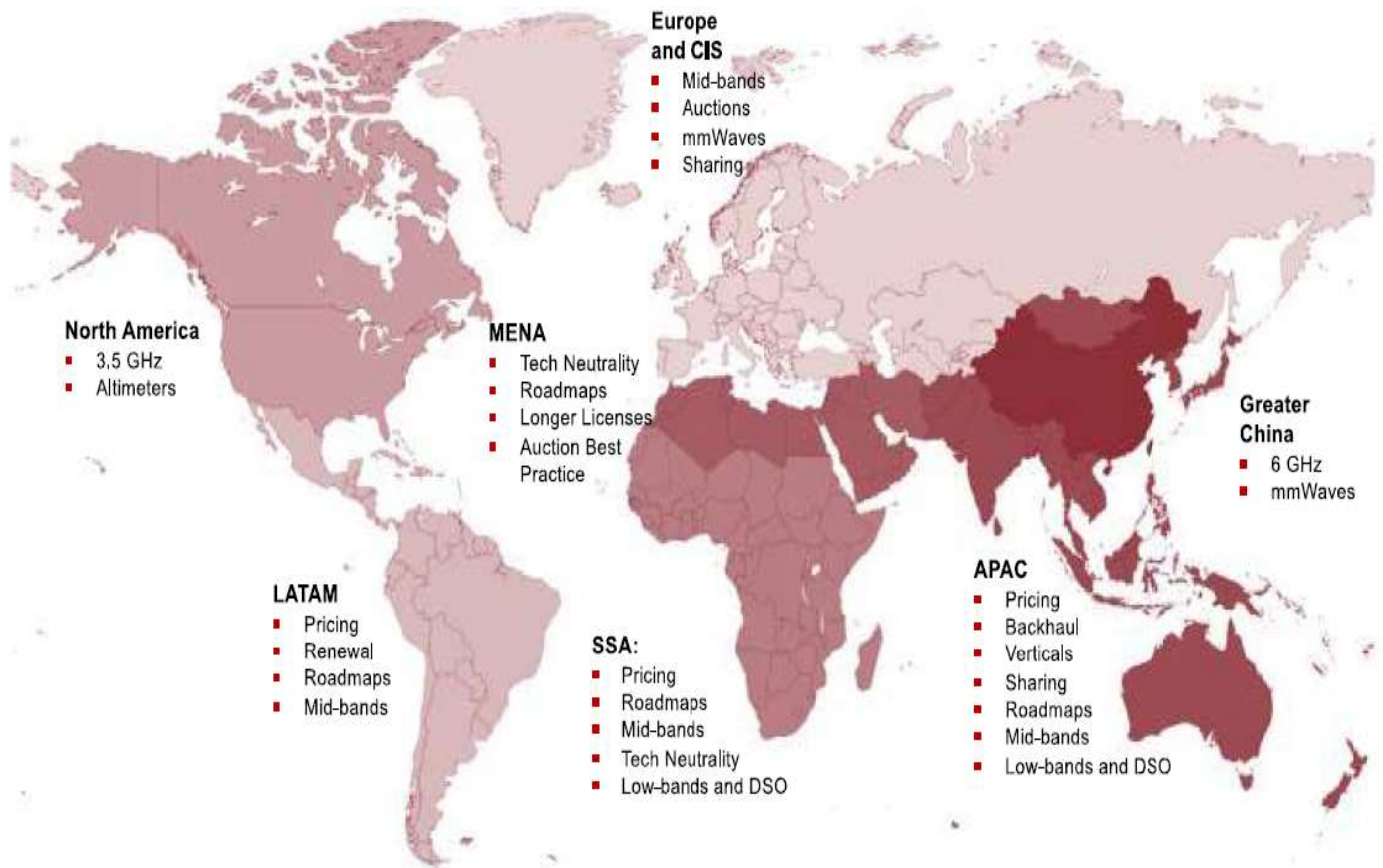


Congo

- 200 MHz lots available to MNOs in the 3.5GHz band for 5G



Overview around the world



Simultaneous Multiple- Round Ascending Auction (SMRA)

Benefits

Efficient spectrum assignment supported by revelation of bid information during auction
Bidders with highest spectrum valuations can outbid rivals
Costly for dominant bidders to deter entry which makes it more likely that smaller bidders will not have to pay higher average prices

Risk

Bidder strategy can be complex when trying to aggregate multiple lots



Seled bids

Benefits

Low susceptibility to collusion and can attract entry
Can raise more revenue than a multiple round auction where competition for the license turns out to be weak

Risk

Limited information available to bidders as they have no insight into rivals' values
Use of the first price rule can lead operators suffering the winner's curse, in which they have overestimated the true value of the license
May lead to spectrum being assigned inefficiently or left unused if winning bidder overestimates value



Combinatorial Clock Auction (CCA)

Benefits

Supports flexible lot structures which help avoid aggregation risks (i.e. bidders ending up with unwanted combination of lots)

Second price rule whereby prices paid by winners are set at the lowest hypothetical bid amount at which they could have still won encourages straightforward bidding based on own valuations

Risk

Less price revelation than in an SMRA

Extremely complex to administer and participate in as it requires bidders to develop valuations for many packages before the auction

CCA only works well if bidders can evaluate all the bidding options that are open to them

Can give rise to strategic gaming possibilities, allowing participants to raise rivals' costs, resulting in bidders potentially paying vastly different prices for spectrum

Limited use to date with varying degrees of success as a result of the complexity and other issues



Auction mechanisms and their implications



Regulatory Tools

In addition to the choice of auction format, there are also various tools available to regulators in designing auctions to promote competition or increase the likelihood of efficient outcomes, although there are often trade-offs involved in their use.



	Benefits	Risks
Lot sizes	Smaller lots can provide access to important spectrum for more operators than when larger lots are used	Lots that are too small increases the need for bidders to aggregate multiple lots and may lead to operators acquiring spectrum which they are unable to use.
Spectrum caps and set-asides	Set-asides can only be used after formal market review shows a) one player has clear market dominance and b) setting aside spectrum is then an appropriate, proportionate action	Both can distort fair market competition Set-asides may lead to spectrum being poorly used and can weaken incentives to grow customer base. Caps risk jeopardising an operator's ability to support growing consumer usage Regulators should define and set caps with care to balance, giving operators sufficient freedom to pursue their business strategies
Information available on bids	Providing transparent information leads to legal and regulatory certainty for the assignment process and for the full duration of the license, incentivising investments Limiting the bid progress information made available can block signalling behaviour	Limiting information weakens price discovery which may impede efficient outcomes as well as creating uncertainty for the overall process
Reserve prices	Reserve prices reduce gains from collusive behaviour and help governments achieve some minimum revenue for the spectrum even when demand is low They set a threshold to guarantee only bidders that can invest later can participate	If set too high can discourage marginal bidders from participating and spectrum may remain unsold



Spectrum Assignment

Spectrum
Assignment

3. Administrative
assignment and
its role in
spectrum
management



Administrative assignment and its role in spectrum management

Administrative assignments are most effectively used in cases of lower market demand. Just like **auctions**, administrative assignments have to be planned well to succeed. Importantly, the selection criteria and process must be clear, and the weight given to each objective should reflect its importance to society. The use of vague and subjective criteria, or a lack of transparency, increases the risk of favoritism and corruption as well as the potential for the outcome to be challenged in the courts. There may be a need to trade-off between policy objectives and the license fee. Even where the objective is clear, estimating the appropriate price can be challenging.



Administrative assignment and its role in spectrum management

Regulatory objectives which may be considered as part of an administrative assignment / beauty contest include:

- Coverage,
- Quality of service
- And potentially a variety of wider social and economic goals.

A particular problem of administrative assignment is the risk that successful applicants turn out to be unable to fulfil their offers, particularly if market or technology forecasts prove inaccurate. Licensing authorities should set out in advance what penalties will be imposed should commitments not be met.



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Administrative assignment and its role in spectrum management

Advantages

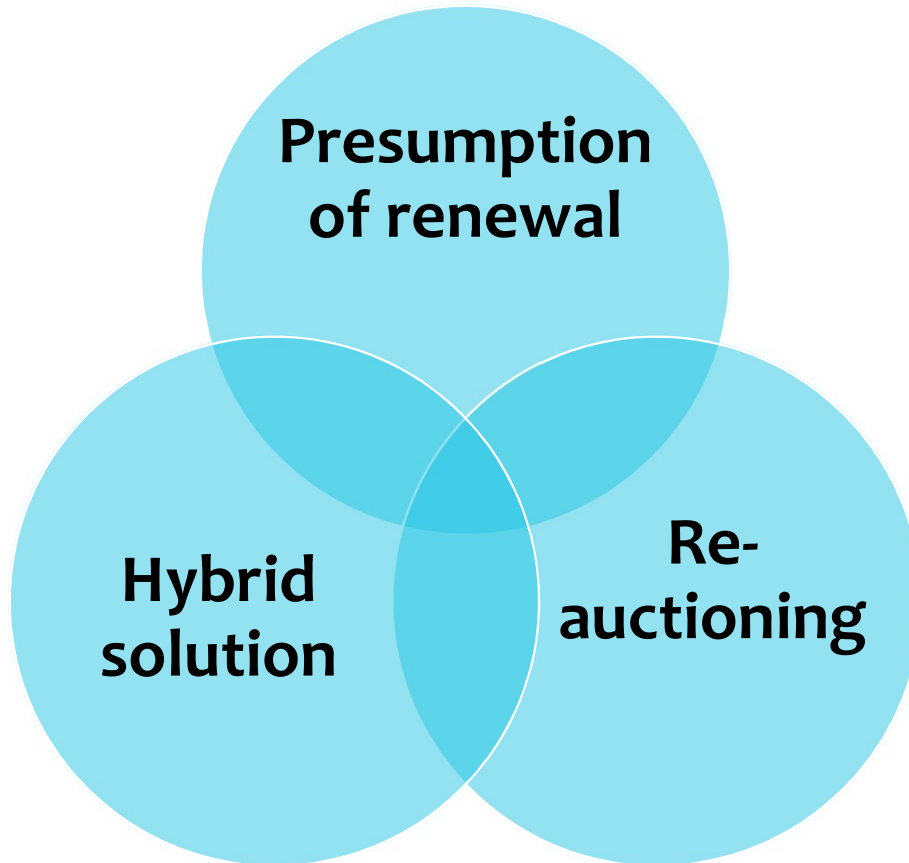
- Enables a range of criteria to be taken into account and for authorities to balance the trade-off between objectives
- Authorities can select the level of the license fee, which may improve operators' ongoing financial viability and assist in raising capital for network investment
- Ability to set network investment or coverage requirements to focus on delivering high quality services rather than raising state revenues
- Can be quick and affordable to organize

Disadvantages

- proposal rather than the candidate that can make best use of the spectrum
- When operators fail to meet commitments after the auction, authorities may face difficult choices as to whether to cancel the license or otherwise penalize the operator,
- Administrative assignment is vulnerable to bias or corruption. Even the perception of such issues can lead to protracted legal disputes that delay spectrum being put to good use



Administrative assignment and its role in spectrum management : Licence Renewal



Administrative assignment and its role in spectrum management : Licence Renewal

Regulators thus serve consumers best by creating that certainty and a minimum period for a license renewal decision should be five years ahead of renewal date.

Authorities should aim to minimize uncertainty by creating a presumption of renewal unless a breach of license condition has occurred, a fundamental reallocation of spectrum to a new service is required or an overriding policy need arises.

By the same the license renewal may have some advantages and disadvantages:



Administrative assignment and its role in spectrum management: Licence Renewal

	Advantages	Disadvantages
Presumption of renewal	<p>Offers certainty for future investment in the sector</p> <p>Minimizes customer service disruption from operators losing spectrum and needing to reconfigure networks or exit the market</p> <p>In conjunction with trading, supports efficient spectrum use over time</p> <p>In extreme circumstances, spectrum may be better re-assigned (for spectrum replanning, a serious breach of conditions, or if spectrum left idle)</p> <p>If not set out in original license terms, may be considered unfair to unsuccessful bidders</p>	<p>In extreme circumstances, spectrum may be better re-assigned (for spectrum replanning, a serious breach of conditions, or if spectrum left idle)</p> <p>If not set out in original license terms, may be considered unfair to unsuccessful bidders</p>



Administrative assignment and its role in spectrum management: Licence Renewal

	Advantages	Disadvantages
Re-auctioning	<p>Auction uses market to identify the true “opportunity cost” Promotes efficient outcomes / efficient use of spectrum (i.e., those that value it most are allocated the spectrum)</p> <p>Outcome is transparent and legally robust</p>	<p>investment May be disruptive to existing businesses as incumbent operators risk losing critical spectrum</p> <p>May be subject to ‘gaming’, therefore auction design is critical</p> <p>Auction prices carry a greater risk of the license cost undermining operators’ financial viability</p>
Hybrid solution	<p>Attempts to balance achieving some predictability and some flexibility</p>	<p>Risk to investment and service continuity/QoS</p> <p>Potential costs associated with reconfiguring networks</p> <p>Trading off predictability for flexibility would only be beneficial in some circumstances</p>



Spectrum Assignment

Spectrum
Assignment

4. The
significance
of coverage
obligations
in spectrum
licensing



Licence obligations – Coverage

Licensing authorities often impose additional obligations on licensees aimed at achieving particular policy objectives. These can include coverage and service commitments, as well as obligations meant to improve competition. Where a license is assigned using a beauty contest, rather than an auction, commitments to meet obligations can dominate the assignment process.

In today's competitive communications markets, there is a need to regularly make sure objectives remain relevant.

License obligations can often result in greater costs than benefits. Costs related to conditions and obligations should be deducted from spectrum costs.



Licence obligations – Coverage

Licensing authorities should consider:

- ❖ The benefits and costs of such obligations
- ❖ Whether there are less costly means to achieve the objectives

Whether regulatory obligations are needed or not depends on the market. All governments have to carefully consider whether their approach is likely to increase the quality and reach of mobile broadband compared with the well-proven approach of mobile operator competition.

A number of regulators have sought alternative ways to ensure access in rural areas while avoiding inefficient network duplication e.g.:

- ❖ ‘Shared’ obligations on all operators to ensure coverage in rural areas before rolling out to urban areas
- ❖ Obligations to provide mobile broadband to locations currently lacking access to other forms of broadband.



Licence obligations – Coverage

Stringent coverage or service requirements carry risks. Obligations may force operators to deploy networks and services faster than economically or commercially sensible to do so.

For instance, this could arise where technology is still at an early stage with a number of technical challenges remaining or where equipment prices are relatively high before more widespread international take-up.

Obligations also risk forcing operators to incur losses (e.g., by deploying networks in advance of sufficient demand for the services). This can create financial difficulties, particularly for entrants without established cash flows.



Licence obligations – Coverage

Where obligations are imposed, they should be made clear prior to the auction or assignment process so that operators can develop a viable business case. Costly obligations can be reflected in lower auction prices. Governments should therefore assess whether the impact on auction revenue is an appropriate trade off to extend mobile coverage or whether the adoption of an alternative approach would be more efficient



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Licence obligations – Coverage

Where operators fail to meet their license conditions regulators are confronted with the dilemma of whether to take the drastic step to revoke the license, with potential harm to competition or postpone, or abandon the license condition.

Relaxation of license conditions can lead to legal challenges by other operators who have met conditions or by potential new entrants who may have bid for the license if they had known the obligations would not be enforced.



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Merci de votre attention

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