



Communications for all in East Africa

EACO FREQUENCY SPECTRUM PRICING GUIDELINES

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1. Introduction

1.1. Background

The radio frequency spectrum is a scarce communication resource for which there is an increasing range of valuable uses. Since the radio frequency spectrum is an essential element of the communications infrastructure. It's use contributes to the social-economic development of the country.

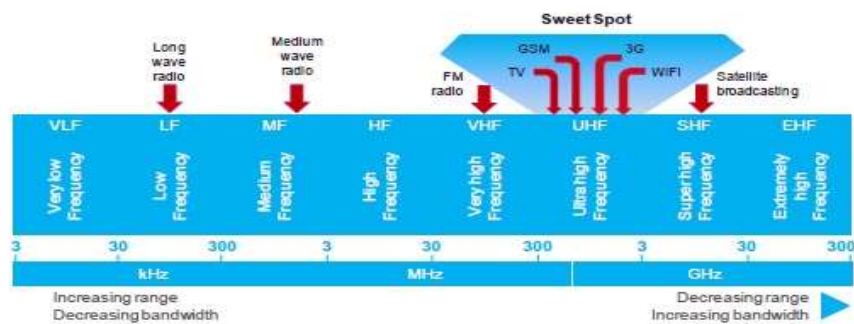
Different approaches to spectrum pricing have been adopted by the different EAC Member States, thus there are different challenges, limitations, and opportunities. It may be beneficial for countries to develop a harmonized approach to spectrum pricing for their mutual benefit that ensures efficient and effective spectrum management.

Spectrum pricing forms part of spectrum management practices, and it involves setting spectrum fees in a manner that will enable efficient use of this natural scarce communication resource when determining the pricing methodology for a given spectrum band. The National Regulatory Agencies (NRA) within the member countries will employ market-based and administrative mechanisms, as appropriate, in determining the price of the spectrum.

The availability of equipment designed for commercial operation within certain spectrum bands, and the demand for services requiring frequencies with certain characteristics such as high-speed mobility, combine to concentrate demand for radio spectrum, particularly in bands below 1.0 GHz.

Figure 1, depicts the spectrum sweet spot which is the term given to spectrum below 1 GHz and primarily situated in the UHF and VHF bands. Due to data capacity and propagation characteristics of the sweet spot spectrum, many of the high-value services such as cellular, broadcast, mobile radio, fixed links, and PPDR are located in these bands.

Figure 1. Spectrum sweet spot



Source: UK Ofcom

As a result, generally for radio-communications use that depends on technology standards, the radio frequency spectrum can be considered a finite and, in some cases, a scarce resource. Competitive demand for spectrum can therefore be high and supply limited, creating scarcity. This increases the economic and social value of the spectrum.

As a general matter, where demand for radio spectrum in a given band exceeds the available supply, setting spectrum fees that reflect market value for the right to use the band should encourage the highest-valued use of the band. Higher fees that weed out the less valuable uses of the spectrum will eventually curtail demand to the point where it no longer exceeds supply. The highest value use will create the highest consumer surplus, assuming markets are competitive, and therefore result in the licensee being willing to pay the most for a frequency license. Thus, in principle, the best ideas for how radio spectrum can be used should attract the highest amount of investment capital, and so for example the winner of an auction will be the bidder that can convince the market that it has the most profitable idea. For some public sector spectrum uses, the economic value placed on the spectrum is not easily quantifiable in pure market terms. The broad public benefits from these services rather than specific end-users that consume services and generate revenues for operators.

1.2. Purpose of these Guidelines

- 1) To provide regulators and radio frequency spectrum users with a better understanding of the purpose, objectives, principles, methods, and strategies to determine radio frequency spectrum prices and to prepare spectrum fee schedules.
- 2) To highlight the advantages and disadvantages of modern radio frequency spectrum pricing methods that achieve the primary goals of best practice spectrum management, which will ensure that radio frequency spectrum is used efficiently both technically and economically.
- 3) To further provide for methods of radio frequency spectrum pricing that more closely reflects the economic value;
 - to encourage efficient use of the spectrum and thus its most effective deployment for EAC member states;
 - to ensure that radio frequency spectrum prices are in line with the business plans of those able to make the best use of the radio frequency spectrum

2. Spectrum Pricing Objectives

The broad goals and objectives associated with spectrum pricing are:

- a) To promote and support the competitive development and operation of radio communications systems and services that rely on radio frequency spectrum;
- b) To ensure the equitable and fair allocation and assignment of the radio frequency spectrum to benefit the maximum number of users, including in under-served and unserved areas;
- c) To ensure that fees relating to licensing and use of radio frequency spectrum reflect its economic value, the administrative cost of regulating it, and other policies of the governments and;
- d) To promote innovation by facilitating the development & expansion of communication services through economic value pricing e.g spectrum pricing for rural connectivity, and scientific research.

3. Principles of Effective Radio Frequency Spectrum Pricing

- e) The simplicity of the radio frequency spectrum fee schedule. The simplest fee schedule would be one involving a flat fee payment; however, this may not promote efficient spectrum use.
- a) Efficient radio frequency spectrum use. The spectrum fees need to be balanced against the requirement to encourage efficiency of spectrum use if fees are set taking account of parameters such as bandwidth, frequency band or coverage.
- b) Periodic review of radio frequency spectrum fees. Spectrum fees should be reviewed at suitable intervals to cater for changes in economic KPIs (key performance indicators) or advancement in technologies resulting in increased demand

4. Methods of spectrum pricing

In line with the general microeconomics principles, the following are the considerations to be adopted as a standard technique for determining the price of the radio frequency spectrum.

On a step-by-step basis as appropriate for different bands, types of uses, and types of users (private and public), the National Regulatory Agencies (NRA) will introduce pricing for radio frequency spectrum using market-based methods, administrative methods, or a combination of both market-based and administrative methods.

- i. **Market-based** mechanisms for setting spectrum prices typically involve a market exchange such as spectrum auctions and (in the secondary market) spectrum trading.
- ii. **Administrative** mechanisms include administrative incentive pricing (AIP) and spectrum fee formulas that recover the NRA's cost of spectrum management.

Using both methods, the Member states shall commence a process by which it will price spectrum according to economic value, using spectrum auctions, spectrum trading, and AIP, as well as using fees to recover its administrative costs.

	Market based	Administrative
Economic value	Spectrum auctions and spectrum trades	AIP
Cost recovery		Spectrum management fees and fees related to administrative processes

4.1. Market-based economic value

- 1) In the case of auctions and spectrum trading, willing and active participants in a competitive auction or engaged in a spectrum trade will determine the price at which spectrum rights will be obtained by license from the relevant agencies or transferred between parties.
 - a. In an auction, the economic value is reflected in the price paid by the successful bidder, which will meet or exceed the reserve price established for the auction. It will be composed of bidding deposits paid at the outset and the applicable winning price.
 - b. In the case of spectrum trading, the economic value is reflected in spectrum trading prices and the spectrum fee will include any transaction costs imposed on the participants in the trade.
- 2) When spectrum prices are determined through market mechanisms, price levels at a given time may be influenced by several factors such as geography, competition amongst potential users, advances in technology, the present value of cash flows derived from a particular service over time, and the general economic climate.

4.2. Administratively-calculated economic value

- 1) Administrative incentive prices used to set spectrum fees are intended to reflect the economic value calculated according to an administrative method. It will typically estimate the opportunity cost of spectrum in particular use, but may also include monopoly rents and option value.
- 2) In the case of spectrum management fees and other fees related to specific administrative processes, the NRA shall introduce adjustments to fees with a view to aligning them toward cost recovery of associated administrative activities. During the early years of the introduction of market methods for pricing spectrum demand for which exceeds supply, the member states may also include in spectrum prices a modest premium to recover a portion of the economic value of the radio frequency spectrum.

4.3. Choice of spectrum pricing method

The NRA shall consider various factors when deciding upon the spectrum pricing method, financial basis, and the timing of payment of fees in respect of a particular spectrum band, type of use, or type of user, and in particular:

- funding the respective member state operations
- particular objectives of the relevant spectrum fee
- scarcity of and demand for the spectrum
- technological change
- type and duration of the spectrum license
- fiscal context

4.3.1. Funding the Member States Operations

The radio frequency spectrum management activities of the member states depend upon a financially stable and sustainable operating model where sufficient spectrum fees cover both direct and indirect costs. It will set fees in a manner that ensures that its operations will be adequately funded.

4.3.2. Particular objectives of the relevant spectrum fee

The respective Regulatory agencies of the member states shall consider the purposes of applying a spectrum fee, such as collecting revenues to cover the agency's costs, and in the case of scarce spectrum, promoting economic and technical efficiency, extracting excess rents, and reducing windfall gains for licensees.

4.3.3. Scarcity of and demand for the spectrum

The Administration may consider the scarcity of spectrum, i.e., excess of demand over its supply when choosing the appropriate method for setting spectrum fees. A member state may consider the level of existing congestion under the current use of the band, and likely congestion if artificial constraints such as license restrictions are removed, or if the spectrum were made available for alternative use.

4.3.4. Technologies, standards, and market developments

- I. Changing technologies, international and national decisions on spectrum allocations and harmonization, consumer demand, and the commercial availability and cost of radiocommunications equipment, all affect the value of the radio spectrum. These factors may greatly affect both demand and supply:
 - a) Demand for radio spectrum may increase as consumer demand rises for the applications that use it (e.g., social media). Technologies that shift demand to other bands, such as the digitalization of television, may reduce demand for previously heavily utilized spectrums.
 - b) Supply may increase as it becomes possible to use a technology platform on the radio frequency spectrum previously used for less valuable means (e.g., digital switchover). Technologies, such as multiplexing that increase the

throughput over the same bandwidth, and technologies that allow greater reuse of spectrum on a shared basis may also increase supply.

- II. Technologies and standards may affect the mechanism for spectrum pricing. For instance, they may influence the conditions of spectrum auctions (e.g. license durations, block size, and channeling arrangements of bands auctioned).

4.3.5. Type and duration of the spectrum license

- I. Different types of spectrum licenses are available or in force in EAC member states. For example, some allow private companies to operate national networks to provide telecommunications services to the public, some allow public bodies to provide public services, and some permit amateur radio frequency spectrum use. Some spectrum use is exempt from license requirements, although regulations and standards may govern the types of devices, use, and power levels that are permitted.
- II. Where spectrum is to be licensed, the licenses have different durations, with some being renewed annually and others having terms of 10 years, 15 years, or another lengthy duration. The NRAs will typically set fees for one-year spectrum licenses administratively to recover costs, and will not charge separate application and renewal fees. No fees will apply in respect of the license-exempt spectrum.
- III. Where a lengthy license for scarce spectrum expires, the agency may auction the spectrum or renew the license for an administratively calculated fee. Where it does the latter, it will typically seek to price the spectrum to economic value using AIP based on opportunity cost or, to avoid windfalls to licensees, priced at a full market value considering business modeling and/or benchmarking.

4.3.6. Fiscal context

When it considers it appropriate, the Administrations may consider the impact that fee levels will have on the viability of the radiocommunications sector. This might include considering the total amounts being paid by the sector for income taxes, VAT, excise, regulatory fees, and other charges and assessing the impact of these charges on growth opportunities and attractiveness, sector valuation, investment, and in license compliance.

4.4. Timing For Charging Spectrum Fees

- 1) Fees may be chargeable on a one-time basis, in instalments, or annually. In some cases, an annual price may be payable for a license granting access to a band. In other cases, a fee may be a one-time sum that provides access to the radio frequency spectrum for many years. Annual prices and a price covering multiple years are linked by the mathematical calculation of net present value.

- 2) The timing of payment of spectrum fees shall, as is currently the case, generally be associated with particular regulatory steps, administrative activities, and the budget cycle of the Administration as follows:
- a. annual fees in the case of one-year authorizations, or recurring annually over the term of the license in the case of multi-year licenses;
 - b. fees charged in connection with the authorization of the spectrum;
 - c. spectrum renewal fees which may apply when a spectrum license expires and a renewed authorization is made to the licensee; and
 - d. administrative fees at the point of service or action to be completed by the NRA, such as type approval applications, radio operator certifications and examinations, interference complaint investigations, and inspections.
- 3) To a large extent, fees shall be paid annually to support the NRA's operations. Where the fees charged in connection with the authorization are set by auction or AIP calculation, the fees are related to an economic/financial value which in turn depends principally on the spectrum being assigned and the duration of the license. The timing of fees will depend on certain factors:
- a. **Cost recovery fees and one-year licenses:** Fees set to recover administrative costs of the NRA shall typically be charged annually. The radio frequency spectrum which is licensed on an annual basis will not face separate application and renewal fees but will have a simple annual fee. Where spectrum is licensed on an annual basis and a fee is paid in respect of the year but the licensee surrenders its license for a substantial portion of the given year, the NRA may introduce a rebate mechanism to refund a reasonable proportion of the fees for the given year.
 - b. **Fees set by AIP:** Private sector licensees with multi-year authorizations subject to AIP-calculated fees shall also generally pay these on an annual basis over the duration of their license, though alternative lump sum instalments may be used instead.
 - c. **Fees involved in auctions:** Some fees such as application fees and bidding fees may be set with a view to recovering auction costs whereas other fees related directly to the value of the spectrum being awarded may consist of deposits approximating or equal to the reserve price and subsequent deposits as the bid prices increase. Final payments will either be made upon award and issuance of the spectrum license or financed in instalment payments over the term of the license. The NRA will make a judgment on the level of risk of payment default it wishes to assume (zero if total fees are payable on the issuance of licenses) in assessing when auction fees should be paid.

5. Market-based Pricing Through Auctions

Under this approach;

- 1) The administrations consider that well-designed and well-managed auctions, when conducted under the right conditions, represent the best way of awarding spectrum where demand for it exceeds its supply, particularly in the case of large bands of newly available spectrum. The award of the spectrum to those who value it most highly is more likely to be led to its most efficient use and promote welfare for the consumers.
- 2) In an auction, spectrum users themselves rather than the NRA will set the spectrum price according to the value the spectrum represents as an input to their business opportunity (even if prices are influenced by the NRA's determination of auction method, design, and reserve prices). Market prices can encourage the rapid rollout of services by putting pressure on competing operators to extend coverage quickly to generate cash flow to cover the investment in the auction price.
- 3) Auctions will also ensure that the rental value of the scarce national resource is made available to the State for public services. Prices set in spectrum auctions are also free from political influence and collusion among users than other methods.
- 4) Spectrum auctions also further the other important objective of encouraging competition. Because spectrum is an essential element of many high-value commercial and public services for which there are not good wireline substitutes, the operator controlling sufficient spectrum can also control (or heavily influence) downstream services sold to end-users. Hence, improving access to the radio frequency spectrum for competitors or new entrants will reduce barriers to entry into existing and new markets.
- 5) Accordingly, the NRA will, on a step-by-step basis, where conditions are appropriate, introduce auctions for scarce spectrum.

5.1. Elements of an Auction

The NRA will take various steps when considering its approach to a given band or bands that are or will soon be available for assignment and then in implementing an auction. The elements described below are not necessarily sequential.

	Stage	Activity
1	Consultation	The NRA shall seek to consult with the likely users of the radio frequency spectrum and relevant stakeholders both before deciding to carry out an auction and while developing the elements of the auction itself. The NRA will seek to ensure that any auction is suited to the realities of demand in the market.
2	Assessing the appropriateness of an auction	The NRA shall first review demand for and available supply of the relevant spectrum in order to determine whether it is subject to scarcity. It may also consider whether the benefits of assignment through an auction process outweigh the costs of such process as opposed to other assignment processes. Where there are few users, or services and data requirements are

	Stage	Activity
		tolerant to interference and lower power devices are commonly used, an auction is unlikely to be appropriate.
3	Defining the band or bands to be auctioned	The NRA shall consider the object of the auction, including whether the band should be auctioned in combination with another band. It may consider for example linkages between business cases for the bands, timescales in which bands will be available for use, and timescales of availability of relevant equipment.
4	Selecting the auction method	The NRA shall determine the method of auction to employ, such as for example simultaneous multiple-round ascending (SMRA) auctions, simple clock auctions, combinatorial clock auctions (CCA) and sealed bid auction.
5	Designing the auction	<p>The NRA shall consider a number of issues in relation to auction design depending on the circumstances. Among others, these may include:</p> <ul style="list-style-type: none"> • packaging the spectrum, including through setting the number of licences on offer in the relevant bands and the size of spectrum lots; • addressing market power concerns, such as through use of spectrum caps; • promoting specific social goals, such as through coverage and roll-out obligations; • promoting innovative uses of spectrum; • encouraging new entry and growth, such as through spectrum set asides; • optimising competition through bidding rules and increments; • limiting risk of collusion through communication and activity rules; • sending appropriate price signals and securing a minimum economic rent through reserve prices; and • increasing the option value of the spectrum through the subsequent tradability of licences and clarity regarding renewal.

	Stage		Activity
6	Conducting auction	<i>the</i>	The NRA shall tend, particularly in its early years, to engage specialist spectrum auction advisers to assist with preparation for and conduct of an auction.
7	Reviewing results	<i>the</i>	The NRA shall review auction results in order to draw lessons, including in particular to the degree to which and manner in which the auction was competitive.

6. Administrative Incentive Pricing

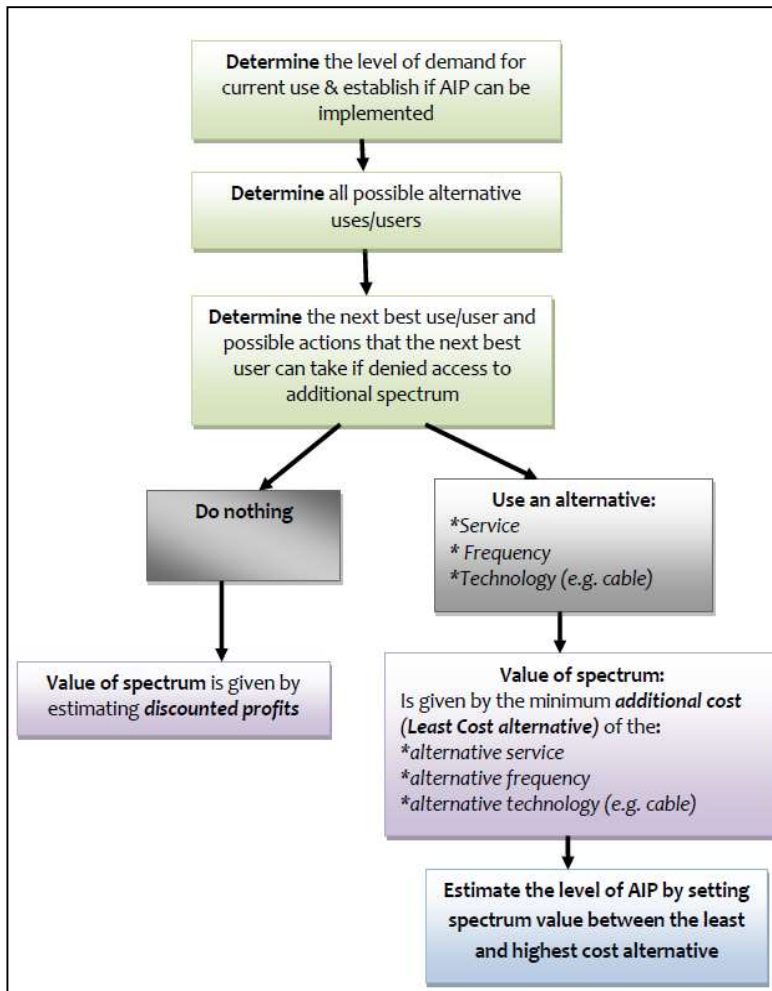
Where spectrum is scarce but an auction is impractical (e.g., due to the amount of spectrum involved), the NRA shall on a step-by-step basis introduce the AIP method of setting spectrum fees.

The benefit of the AIP method of pricing radio frequency spectrum is that it assigns a scarcity value to the radio frequency spectrum for which there is more demand than supply, and thereby encourages more efficient use of the spectrum. The NRA does not expect a single AIP price for a single spectrum band in isolation to be immediately effective in improving the use of that band. Rather, the NRA regards the key goal of using AIP to be to provide long-term signals of the opportunity cost of spectrum across a range of bands, sometimes when compared with market-based prices. It intends to use AIP as part of a range of other spectrum management tools to serve the objective of securing optimal use of the radio spectrum in the long term.

6.1. Application of Opportunity Cost

- 1) An increasingly common means of setting an administrative price for spectrum is to set it equal to its “opportunity cost.” This can be calculated by estimating what additional costs a firm would incur if it chose to produce the same services but did not have access to that particular band and had to replace it with the next cheapest band, or with a non-spectrum input (such as a fiber optic cable). Those extra costs measure the loss of opportunity to use the spectrum in question.

Figure 2. AIP decision steps



- 1) As shown in Figure 2, an opportunity cost of this kind may be calculated by comparing the cost for a representative firm of producing a particular service using the spectrum band currently assigned to it with the cost of producing the same service using another technology.
- 2) The estimates of cost savings can be expressed per MHz of spectrum saved. In the absence of the band currently used, the firm would use the cheapest replacement, with the lowest additional cost per MHz. For example, the value of spectrum used for ubiquitous digital terrestrial broadcasting can be compared with the cost to a representative firm of:
 - a. satellite broadcasting;
 - b. constructing a ubiquitous cable or fiber network capable of providing the same service;
 - c. using a transmission technology that economizes spectrum but requires more sites; and
 - d. switching to a different transmission technology standard.

- 3) Where possible, the NRA may adopt a simplified approach. For example, in the case of the wireless access spectrum used for mobile services, base stations working on lower frequencies provide mobile services at lower cost and possibly higher quality than base stations operating on higher frequencies. One reason for this is that signals at lower frequencies have a larger range; as a result, fewer base stations are required to deliver the same area of coverage.
- 4) Where possible, in considering opportunity cost, the NRA shall consider the opportunity cost of withdrawing increments of the spectrum (e.g., 1 MHz) in the relevant band, but may take into account the opportunity costs of withdrawing the whole band. Where a given service is simply not technically or financially feasible without the relevant spectrum band (i.e., it cannot be replaced), the opportunity cost may not be a useful means of calculating value.
- 5) There are several challenges in the pricing spectrum based on opportunity cost, such as identifying and costing alternatives to the band in current use. Complexities sometimes arise due to the many ways some bands may be used. Uncertainty in estimating opportunity cost may arise from uncertainty in the likelihood of demand for feasible alternative uses of the spectrum appearing.
- 6) Notwithstanding these uncertainties, in the case of scarce spectrum, the NRA considers AIP pricing to be better than alternative administrative methods of pricing given the importance of price signals in encouraging the most valuable use of spectrum. The NRA may consider the risks of setting fees too high or too low in light of the specific circumstances. It will generally seek to assess excess demand, congestion, and feasible alternative use over a timeframe that reflects the typical economic lifetime of existing users' radio equipment.

6.2. Use of business Modeling and benchmarking

- 1) Access to spectrum may confer benefits additional to the opportunity cost that the NRA may at times take into account:
 - a. **monopoly rents:** the extra profits the licensee will make as a result of the market power that exclusive use of the spectrum may confer on it; and
 - b. **option value:** where the license allows a use change, or where it can be traded, or where it is subject to renewal, the "option value" available to the licensee to convert the spectrum to a more advantageous use, to sell it at a profit, or to have an advantage in a renewal competition.
- 2) In order not to underprice the radio frequency spectrum, the NRA may take these factors into account by estimating the full market value of the spectrum through a business model approach or benchmarking. Given the challenges in both these approaches, the NRA will typically not rely on the business model and benchmarking alone but as a means of broadening the inputs to its AIP analysis or as inputs to reserve prices in auctions.

6.2.1. Business Modeling

- 1) A business model approach involves seeking to replicate the business planning processes of firms seeking to estimate the maximum they can bid for a spectrum license without falling into a loss. They are assumed to do this by calculating the net present value of operating the radio system over its life, including a terminal value if appropriate, but excluding the cost of acquiring the license. The value calculated is assumed to represent the maximum bid the firm in question will rationally make.
- 2) The primary challenge in using this approach is the level of detailed sectoral knowledge of actual and projected revenues and costs and development of the market. The NRA may enlist expert support in such exercises.

6.2.2. Benchmarking

- 1) The NRA may also carry out benchmarking by drawing inferences from market prices in other jurisdictions for similar spectrum bands. Such prices will usually have been derived from spectrum auctions, but over time might potentially be derived from spectrum trading prices. Benchmarking will typically involve taking into account:
 - a. prices on a “per MHz per population” basis, adjusted for differences in GDP per capita;
 - b. the price relationships across different bands in countries where auctions in higher and lower value bands have occurred;
 - c. differences in license durations; and
 - d. differences in the timing of payments.
- 2) The primary challenge in using benchmarking is adapting findings in light of differences in countries’ stages of market development, income levels, market structure, auction design, number of bidders, and numerous other factors. The NRA will typically enlist expert support in such exercises.

7. Secondary market pricing

- 1) Secondary markets may introduce price signals that lead to more efficient spectrum use because a spectrum licensee holding onto spectrum faces the opportunity cost of revenues foregone from not disposing of it. Secondary markets also allow for the fact that spectrum valuations can change over time as a result of changing technologies and patterns of demand.
- 2) Primary award mechanisms are never perfect. Secondary markets can help correct imperfections, allowing particularly in the case of the spectrum that has been administratively assigned for it to move to those who value it more than those initially licensed. In the case of auctions, where the licensee acquires the right to use spectrum through a market mechanism, the ability to trade or lease the spectrum allows the licensee also to dispose of it through a market mechanism. Such possibility of exit increases the option value of the spectrum.

- 3) For these reasons, the NRA will, on a step-by-step basis, allow increasing levels of secondary markets in the radio frequency spectrum through permitted spectrum trading and spectrum leasing.

7.1. Consideration of trade and lease requests

- 1) The NRA may consider requests to trade spectrum rights and lease spectrum, taking into account factors including:
 - a. the proposed change in the use of the spectrum, including whether any proposed change of technology may cause harmful interference;
 - b. qualification requirements, including whether the transferee meets any qualification requirements that applied to the transferor;
 - c. license obligations, including how obligations associated with the spectrum rights to be transferred will be treated;
 - d. the impact of the transfer on competition in the market;
 - e. whether the transferor and transferee are in good standing under applicable laws and regulations; and
 - f. national security.
- 2) Where it is satisfied that the proposed trade or lease is not likely to lead to more harm than benefit, the NRA will allow it to proceed.

8. Spectrum Management Cost Recovery Fees

- 1) Over the long run, for spectrum bands where there is scarcity, there is no inherent reason to charge fees that are higher than administrative costs once market-based and AIP pricing are introduced and are fully and satisfactorily functioning.
- 2) For spectrum bands where there is no scarcity, the NRA will, therefore, on a step-by-step basis, move towards a system whereby spectrum-related fees are set only to cover its administrative costs of spectrum management.
- 3) The NRA shall approach cost recovery with a view to ensuring that it can operate an efficient and sustainable radio spectrum frequency management system of professional quality that interacts effectively with spectrum users, Government departments and agencies, international and regional counterparts, as well as the NRA's other internal organs.
- 4) Its objective will also be to ensure its costs are allocated equitably without employing disproportionate administrative resources to the process. Thus, where detailed accounting is not available, it may apportion costs based on reasonable estimates.
- 5) The NRA shall also take into account objectives that may allow for a departure from cost recovery principles, including fee exemptions for spectrum for national security, public safety, and emergency services. Other occasions where fees may be set at a level lower than full cost recovery may include the objective of avoiding pricing out demand for "non-operational" licenses that support test and development activities or to promote innovative uses of spectrum.

8.1. Costs considered in spectrum management fees

Various direct and indirect costs are involved in the NRA's spectrum management functions, such as:

- 1) **Direct costs** are likely to include the immediate and identifiable cost of specific regulatory procedures and events, such as issuing licenses pursuant to applications for specific frequencies. This would include the cost of staff time in the frequency assignment process, site clearance, interference analysis required to clear the band, and international and regional coordination specific to a spectrum band among other costs. There may be particular monitoring costs associated with a given band for particular reasons, such as legacy overhang from refarming or proliferation of equipment in that band; and
- 2) **Indirect costs** are likely to include the overhead of operating the NRA's spectrum management responsibilities. These will involve costs that are not directly attributable to specific spectrum licenses but are required for spectrum management. Examples of such costs include general international and regional cooperation, spectrum planning, spectrum monitoring, research, preparation of regulations and guidelines, interference investigations, as well as the cost of support staff, equipment, and premises.

8.2. Steps to develop cost recovery fees

Introducing such a fee system may involve the following steps:

1. **Internal accounting:** The NRA shall develop its internal accounting to enable it to estimate direct and indirect costs attributable to spectrum management as opposed to its various other administrative activities. Where possible, it will attribute such estimated costs to categories of its various spectrum management activities. Such categories might include, for instance, spectrum licensing, spectrum monitoring and enforcement, spectrum policy programs and projects, international coordination, ICT costs, and common costs such as property, human resources, and facilities;
2. **Apportionment of costs:** The NRA shall apportion such estimated costs across the various types of spectrum licenses, taking into account the relative administrative burdens of effort for different spectrum bands and spectrum uses; and
3. **Application to license types:** The NRA shall then develop a process for introducing cost-based fees for the spectrum to which the NRA has determined cost-based fees should apply.

9. Public sector spectrum pricing

9.1. The proposed approach to the pricing of Radio Frequency Spectrum for Public Use.

- 1) Substantial amounts of radio spectrum is assigned to the public sector for various uses. A key differentiator between public sector and private sector users is that each may value the same band differently because they approach decisions from fundamentally different perspectives and use spectrum for different purposes (e.g., profit maximization versus broader public interest).
- 2) In some cases, the public interest suggests that minimal or no cost should be imposed on the provision of certain public services. The NRA will not impose spectrum fees on national security, public safety, and emergency services.
- 3) The NRA considers that efficient use of scarce spectrum by the public sector would also be enhanced by taking into account the value of the spectrum in public sector decision-making.
- 4) The NRA shall therefore dialogue and engage with the various major public sector users of scarce spectrum in particular, as well as with the Ministry of Finance, to examine the choices involved in using such spectrum for the public as opposed to commercial purposes. The NRA will seek to understand the value of the spectrum bands in question, and the potential benefits to the broader economy of more efficient or alternative uses, and share this understanding more widely, before taking specific action.
- 5) The sorts of steps that the NRA shall consider and discuss with public sector spectrum users may include:
 - a. **spectrum audit**, examining particular bands used by the public sector to understand better the scale of current public sector use, potential alternative uses, the possibility of refarming, and the implicit policy choice of maintaining the status quo;
 - b. **spectrum refarming**, potentially involving subsidies was required to cover costs of equipment changes, particularly where such funding may be available from the proceeds of spectrum fees from new licensees;
 - c. **spectrum valuation in procurement processes**, reflecting the value of the spectrum used by the public sector when choosing between different wireless communications systems that employ different bands where one is more valuable than another;
 - d. **spectrum sharing**, whether allowing for sharing on a geographic or time basis or even dynamic sharing; and
 - e. **spectrum fees**, including cost-based fees, and ultimately even on an AIP basis in the case of the spectrum that has a high value if put to other uses.