

RWANDA UTILITIES REGULATORY AGENCY



CONSULTATION DOCUMENT ON REVIEW
OF THE FREQUENCY
SPECTRUM FEE STRUCTURE

October 2011

Definitions and Acronyms used in this Report

Definitions

Administered Incentive Prices – administered because they are set by the regulator with potential incentive properties. AIP is used by some regulators (Ofcom in the UK and ACMA in Australia) to promote efficiency in spectrum use within a framework of administrative spectrum management since AIP's are intended to be set at a level which reflects the scarcity of spectrum and encourages economy in its use.

Location Zone Factor – coefficient used in spectrum usage formulas taking into account the differences in geography and population density.

Frequency Band Factor – coefficient used in spectrum usage formulas taking into account the relative scarcity and higher historical demand for lower bands.

Technology Efficiency Factor - coefficient used in spectrum usage formulas taking into account the relative efficiency (data compression, channel width) of alternate technologies.

Utilization Factor - coefficient used in spectrum usage formulas taking into account the relative utilization of assigned frequencies.

Spectrum Auctions - essentially a method for assigning spectrum at the time of its first issue by the spectrum regulator to those who value the spectrum most highly. It is normal for the bids to be made in money terms, where the competitor offering the largest monetary sum wins the licence.

Opportunity Cost in AIP – found by estimating the savings in other resources if the same spectrum were redeployed to produce another service, or the extra costs which would be incurred if the additional spectrum is not available to provide the service for which it is currently employed.

Spectrum Management Fees – fees collected from spectrum users on annual bases that are geared to recover the cost of spectrum management activities of the RURA.

Spectrum Usage Fees – fees collected from spectrum users as a resource rent and intended to encourage efficient use of assigned frequencies.

Acronyms used in the Report

ACMA – Australian Communications and Media Authority

AIP - Administered Incentive Prices

GHz – Gigahertz

GNI – Gross National Income

GSM – Global System for Mobile (2G)

GSR – Global Symposium for Regulators

ICT – Information Communications Technologies

ITU – International Telecommunication Union

MHz - Megahertz

PPP – Purchasing Power Parity

RURA – Rwanda Utilities Regulatory Agency

TDD – Time Division Duplexing

UMTS – Universal Mobile Telecommunications System (3G)

1.0 Introduction

In the last decade, the Information and Communication Technology (ICT) in Rwanda has experienced a significant growth in terms of both the diversity and the quality of the services provided.

In order to keep up with the development of the ICT sector while maintaining a favourable environment for new and innovative services, a regular review of the framework is necessary to align with the changes in the sector.

It is in this line that RURA, with the assistance of the International Telecommunication Union (ITU) has initiated an exercise to review the frequency spectrum utilization and fee.

The first phase of this exercise comprised of collecting data on the current frequency utilization and related fee structure and drafting a report.

The second phase entails involvement of all stakeholders through consultation meetings.

The purpose of this document is to provide a summary of the report of the review of the Spectrum fee structure conducted by Mr. ADRIAN FOSTER the consultant hired by ITU.

2.0 Background for Consultant

Adrian Foster, MBA, CMC. Mr. Foster is a Senior Spectrum Expert with the ITU, Telecommunications Development Bureau and the World Bank and the European Bank of Reconstruction and Development. He is the lead author and project director of the ITU / infoDev Radio Spectrum Management Module V on Spectrum Management which includes a comprehensive section on Spectrum Pricing. He has prepared numerous papers and reports on spectrum management topics including Spectrum Sharing, Spectrum Pricing, Auctions, and most recently for GSR 2010 in Dakar a paper on Digital Switch-over He advises in all areas of spectrum management: planning, engineering, authorization, and monitoring. He has advised numerous regulators on spectrum valuation, spectrum pricing and revisions to fee structures including:

- Canada
- United States
- Thailand
- Laos PDR
- Pakistan
- Moldova
- Kenya

- Liberia
- Mozambique
- Suriname
- Tunisia

He has published papers with Prof. Martin Cave including Solving Spectrum Gridlock - a better way to manage spectrum. Other papers have been published on a range of topics including spectrum sharing, spectrum trading, and innovation in spectrum management. He has been a panellist at the ITU Global Symposium for Regulators on several occasions and prepared Discussion Papers on Spectrum Sharing and, as mentioned earlier, Digital Switchover and the Digital Dividend. Adrian Foster is a founding partner of McLean Foster & Co.

He has been on assignment and missions in over 30 countries.

3.0 Background

The following legislation and regulations were provided by RURA at the outset of the project and reviewed by the consultant during the first mission conducted on site in Kigali, January 31 to February 5, 2011:

- Telecommunication Law, Law N°44/2001: Governing Telecommunications, Chapter VI - Radiocommunication, Articles 32, 33, 34, 35, and 36
- LAW N°39/2001 OF 13/09/2001 ESTABLISHING AN AGENCY FOR THE REGULATION OF CERTAIN PUBLIC UTILITIES (especially in its article 13, 22 and 35);
- Law N°39/2001 of 13/09/2001: Establishing an Agency for the Regulation of Certain Public Utilities (especially Article 35);
- Ministerial Decree n°03 of 2005: Determining fees for radiocommunication licences (especially Articles 3, 4, 5, 6 and 7).

3.1 Summary of the Telecommunications Law relating to Spectrum

Chapter VI, Articles 32-36 deal with Radiocommunication:

- Article 32 - empowers RURA to manage radio frequencies according to the National Plan which solely governs radio allocations in Rwanda. Government users are exempt from the application of the Telecom Law;
- Article 33 – establishes the requirement to have a license to use or operate a radio station or network. Where demand is excessive RURA is required to conduct a Public Auction for spectrum. Spectrum assignments can be withdrawn by RURA immediately in the case of national security and otherwise once 2 years notice has been given;
- Article 34 – governs licence term and conditions. Licence conditions can be changed at anytime by RURA. Spectrum Fees are determined by Ministerial Decree based on recommendations from RURA. Fees may be initial application and annual fees;
- Article 35 – governs prohibitions on causing interference;
- Article 36 – restricts any person or organization from leasing, unauthorized interception of radio signals, divulging private information or endangering public safety through the use of radiocommunication equipment.

3.2 Review of the Telecommunications Law

Modern telecommunications law emphasizes the need for effective management of the spectrum resource through liberalized approaches and recognizes the convergence taking place between broadcast and telecommunications. With respect to the Law Governing Telecommunications (the Telecom Law) of Rwanda, several observations can be made upon application of the following principles:

1. Radio spectrum is an extremely important resource in a modern economy and needs to be managed to achieve both economic and technical efficiency.
2. Spectrum also has significant value especially below 1 GHz and this value should be reflected in prices.
3. The regulation and management of spectrum should be done in ways which are transparent, objective and fair and promote competition in services.

4. The management of spectrum involves planning, authorization, engineering, and control and must be guided by policies and objectives to ensure effective management of the resource benefiting the maximum number of users.
5. Spectrum planning takes time and involves a comprehensive understanding of markets, uses and users, and innovations in technologies and services. Planning must address future demand and supply of spectrum and begin to incorporate flexible approaches to spectrum use.

The Telecom Law takes a narrow view of radio spectrum and spectrum management by focusing primarily on administrative and legal (National Frequency Plan and interference) while leaving the details of the economics aspects to the RURA.

3.3 Regulatory Effectiveness

There are few rules governing how the responsibilities, functions and activities involved in spectrum management should function, organized and be adequately performed – licensing data, engineering analysis, demand analysis, client service, and enforcement and inspection.

As we know there are important questions to consider and many challenges lying ahead particularly with the implementation of new technologies. Some of these important tasks include:

1. Valuation and Pricing of Spectrum;
2. Synchronizing digital switchover - such as with GE06 2012 and 2015 timeframes;
3. Implementing Convergence into the regulatory framework

To better understand the issues and possible options for implementing change consideration of best practices and their applicability to Rwanda has been suggested. This takes place in the next section.

4.0 Best Practices

4.1 Best Practice - Spectrum Management Objectives

The development and evolution of spectrum management best practices has been guided by several broad objectives¹. A general objective for spectrum management is to ensure that a wide range of necessary and cost-effective radiocommunication services are available to users of the spectrum resource including the public, government users and customers of commercial services while ensuring the most efficient use of this limited resource.

¹ ICT Regulation Toolkit – Section V on Spectrum Pricing (revised). See www.ictregulationtoolkit.org.

Core objectives for spectrum management in support of improved ICT services should include:

1. Planning for future needs and management and monitoring the utilization of the spectrum resource in accordance with legislative and public policy objectives and international agreements;
2. Improving the efficient and optimum use of the spectrum resource through increased use of market-based mechanisms such as spectrum transfers/trading (subject to appropriate guidelines) and adoption of advanced spectrum allocation, management techniques and authorization processes based on operational requirements and technical and economic viability;
3. Ensuring flexibility and adaptability and ease of access to the spectrum resource in response to technological advances, and economic, social and market factors;
4. Ensuring national interests are protected while striving for global harmonization of spectrum along with coordinated spectrum policies and utilization working with regional and international organizations and in compliance with treaty obligations, including those of the ITU;
5. Spectrum fees, user charges and spectrum prices are necessary means of ensuring spectrum management costs are recovered, a fair return is derived from the use of a scarce resource, and users are encouraged to use spectrum efficiently. These fees, rents and prices should be based on the extent of spectrum use, the scarcity of available and assignable frequencies and the physical properties of different spectrum bands (i.e. propagation);
6. Supporting and promote innovation, research and development in radiocommunication techniques and spectrum-based services and applications;
7. Coordinating and establishing well balanced national spectrum and radiocommunication policies and plans by widely consulting with all interested parties and the general public;
8. Support initiatives by communities and public institutions by ensuring accessible, sufficient and low cost spectrum availability including unlicensed spectrum (e.g. the ISM bands). For example, the use of Wi-Fi using unlicensed bands should be broadly encouraged;
9. Special consideration should be given to promote use of spectrum in rural and remote areas, to support the achievement of affordable universal access;

10. Increase private investment in the radio based services and support and promote local manufacturing of radio based systems.

4.2 Best Practice – Framework Principles.

Best practice for appropriately structured and organized and hence effective regulatory functions suggest three characteristics of effective regulation which are:

1. Fair management;
2. Financial sustainability;
3. Effective and Transparent Regulatory Processes.

Proper management of spectrum requires skills and competencies in governance and management across a range of relevant skills such as radio and electronic engineering, policy, economics and finance. A key role of spectrum managers is to strengthen governance practices, development of spectrum management regulation, and provide better balance to a range of user interests. Governance and decision making in the spectrum management authority are best served when interests extend beyond government departments and agencies. Wider ranging input from the public and more transparent decision making processes should be expected to ensure political interference is minimized.

Financial sustainability of the spectrum management Regulatory Agency is necessary in order to properly exercise regulatory responsibilities, appropriately perform duties such as planning and authorization, ensure compliance with authorization conditions, preventing harmful interference in the assignment of new authorizations and solve interference problems. A Spectrum Revenue Policies are required to describe the purpose and objectives for spectrum fees, user charges, etc. and to identify the means and methods used to recover costs and to generate a fair return for the use of the spectrum resource and the treatment of surplus revenues, if applicable.

Processes for long range planning, demand analysis, band planning, market-based assignments such as auctions, re-allocation and refarming initiatives should be adequately described in administrative policies and decisions related to these processes uniformly transparent. An important condition of effective transparent processes is to include public enquiry and consultation.

4.3 Best Practice - Spectrum Revenue and Pricing Objectives

Revenue objectives and strategies relate directly back to the primary objectives; spectrum users pay for spectrum use, covering management costs, spectrum efficiency, and achieving economic and social development goals.

The total amount of revenue to be raised from some or all spectrum uses falls into three categories:

- Partial cost recovery – not all of the costs of regulation are obtained;
- “Full” cost recovery – all costs are covered;
- Greater than “full” cost recovery – a surplus is generated which may be related to several other objectives.

Given that the amount of revenue to be raised is determined and from whom, the next question to be resolved is –how should the revenue be applied.

- Cost recovery – if the amount of revenue obtained is less than or equal to the cost of spectrum management, the decision on application has been already determined.

Where surplus revenues exist and are approaching revenue maximization they may be related to spectrum usage or to other benefits.

- Spectrum Usage – revenues associated with mechanisms to promote efficient
- Economic benefits for the public – revenues associated with other regulatory or government objectives: employment, technology innovation and diffusion.

Spectrum pricing refers to a range of spectrum management activities and tools including administrative fees, spectrum usage, and spectrum prices determined by way of market mechanisms. Developing spectrum pricing strategies invariably involves alignment with the government’s and regulator’s revenue goals and objectives, setting targets, and discussion with key stakeholders such as the Ministry of Finance and key sector groups – telecommunications service providers

In general, for any resource, including radio spectrum, the primary economic objective is to maximize the net benefits generated from the resource such that there is an efficient distribution resulting in maximum benefits to society. Spectrum prices are used as an important mechanism to ensure the spectrum resources are used efficiently by users.

1. The pre-eminent objective for spectrum pricing is that it should be done in a way which promotes spectrum efficiency. Spectrum is a vital natural resource and the price of spectrum is sufficient enough to ensure it is valued and used wisely.
2. Use of the spectrum provides considerable benefit to the economy and the benefit derived from spectrum should be maximized.

3. Managing radio frequency spectrum costs money and these costs should be recovered from those who benefit from spectrum management activities.
4. In general a user pay principle should apply which extends to all users of spectrum: public and private.
5. Finally, important social and cultural objectives can be advanced by use of the spectrum and spectrum pricing should facilitate the achievement of government social and cultural objectives.

4.4 Best Practice - Spectrum Pricing and Fees Guidelines

A sound legal and framework are the foundations upon which sound spectrum management practices are built. The authority to establish the appropriate method and means to set spectrum prices, levy and collect spectrum application fees and spectrum charges such as spectrum usage charges, assign, and licence spectrum should be established by the adequate legislation and regulatory framework.

Beyond these principles, best practice also includes such measures as communication and publication of schedules for spectrum application fees and spectrum charges. Legislation often also provides for stakeholder input in the form of stakeholder consultation and where difficulties or infringements of rights are perceived mechanisms for raising objections, seeking redress and dispute resolution.

The approach taken by the spectrum authority should be:

- Spectrum pricing should be efficient by being fair to all sides;
- Methods should be objective and measurable;
- There should be transparency in decision-making and access to information;
- Practices and procedures should be administratively simple to manage.

4.5 Best Practice – Demand Considerations

An important task of spectrum managers when setting rules concerning spectrum prices is the assessment of spectrum supply and demand. There are two situations to be considered and determined after measurement and evaluation - demand and non-demand situations:

- Demand Situations exist where demand exceeds supply which usually depends on the type of service and the spectrum in question. Typically below 1 GHz. There is very high demand for spectrum. Several methods are appropriate:

- Administrative cost/revenue basis usually associated with Comparative Review (Beauty Contests)
- AIP – Administrative Incentive Prices
- Market-based pricing
- Non-Demand Situations exist where there is no spectrum scarcity. Generally there are few users, services and data requirements are tolerant to interference and lower power devices are commonly used. The bands associated with non-demand situations include the ISM bands and bands above 15 GHz.
 - First come, First Served Assignment Approach
 - Administrative Prices – a published fee schedule

4.6 Best Practice – Spectrum Pricing Methodologies

There are three main approaches to spectrum pricing which have already been referred earlier in the report that are now expanded upon and discussed as best practices in this section. They are:

- Administrative Price Methodologies
- Market-based Methodologies
- Administered Incentive Price Methodologies

4.6.1 Administrative Price Methodologies

The administrative assignment of spectrum usually includes the imposition of fees associated with the assignment process such as processing of applications for receipt and renewal of licences as well as charges imposed on spectrum users for spectrum use. These fees can take the form of simple charges set at a level sufficient to recover the costs of spectrum management and which can also guide users in making decisions to use spectrum more efficiently.

The activities of each licensee impose direct costs on the spectrum management organization. These include the costs of issuing, maintaining data, spectrum monitoring and enforcing its individual licences. Some costs are common to a band or to a radio service (such as band planning); whereas others are common to a group of bands and some, such as management overheads, will straddle all licensees.

Regulators often tackle the issue of setting prices to recover costs in several ways:

- Some regulators create detailed costing models to establish licences which have imposed allocated costs. There are few examples of operating systems like these. The principle reason is the complexity involved in establishing and maintaining such ultimately arbitrary cost allocation systems.
- Most regulators have established rules such as setting charges on the basis of calculations based on the number of devices or a percentage licensee's turnover. In these circumstances, a simple model of direct costs can be developed and related to revenues derived from fees. As well, some method of allocating indirect or common costs will be needed – for example, based on the number of licensees in proportion to the direct costs which they impose. Or they can be allocated in accordance with the amount of spectrum (e.g. in MHz) allocated to the various services.

4.6.1.1 Universal System Performance Pricing Model

A spectrum price can be formulated from a number of separate elements based on any or all of various criteria such as the amount of spectrum used, number of channels or links used degree of congestion, efficiency of radio equipment, transmitter power/coverage area, geographical location and so forth. The basic principle for this approach is to identify various technical parameters in order to measure the spectrum volume used or define the “pollution area” of a radio system as a common basis for establishing spectrum fees.

When it comes to using administrative formulas for calculating spectrum usage fees several models have been developed. A universal model for spectrum price determination based on system performance has been developed and is described in more detail below².

$$P = \frac{V}{M} \times \frac{K_f K_s}{K_m} \times C_s \times K_p$$

Where P = spectrum price;

V = volume of space or geometric area occupied [2];

M = useful results obtained from the radio equipment considered, for example the number of channels to be provided or users to be served;

K_f= coefficient reflecting specific characteristics of range used;

² ITU-R, Spectrum Pricing, Vadim Nozdrin, Paper delivered at the ITU-BR Regional Radiocommunication Seminar, Lusaka, 2003.

K_s = coefficient taking into account the region of the radio station installation;

K_m = coefficient reflecting social benefit of radio system;

C_s = annual spectrum management costs;

K_p = coefficient reflecting the level of spectrum access demand in the band in question.

On one hand, the application of this method can stimulate more efficient spectrum utilization; on the other hand various problems with the practical use of such formulas remain to be resolved. One difficulty with this technique is choosing coefficients which may vary in effectiveness on a case by case basis in taking into account specific features of service, spectrum demand, etc.

4.6.2 Examples of Administered Prices Methods

A several examples of the system performance model follow:

1. Lebanon: Telecommunication Regulatory Authority Commission - an example of the system performance model with forecasts of spectrum costs and congestion factors;
2. Thailand: National Telecommunication Commission – an example of a simplified system performance model including application and band factors;
3. Canada: Industry Canada – license renewal fees using a simplified system performance model for a single transmitter and several repeaters including transmitter and receiver frequencies.
4. New Zealand: Ministry of Economic Development – an example of a simplified financial and statistical model used to determine broadcast licensing fees.

4.6.2.1 Lebanon: Application of the System Performance Model

The Telecommunication Regulatory Authority (TRA) has completed a study of Spectrum Administrative Charges (SAC) and proposed changes in regulation to the Minister of Telecommunications. The purpose of the study was to revise the charging regime to ensure that it is non-discriminatory and transparent. SAC will be applied to spectrum licensees and are intended to recover TRA's administrative costs for spectrum management, control, and enforcement. One of the important goals of the new fee regime is that fees should not in any way hinder the development of innovative services and competition in the market.

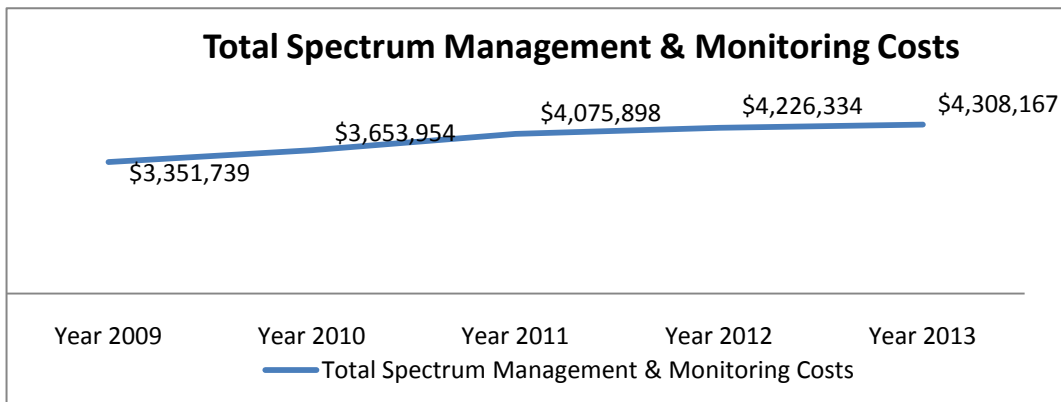
SAC are based on values that are directly proportional to the allocated band, occupancy and congestion. The cost of any band is derived by calculating the effective management and monitoring system cost that is based on the functions and activities that will be performed on such band in order to:

- manage spectrum efficiently;
- optimize spectrum usage;
- protect licensed spectrum;
- avoid harmful interference; and
- Detection and location of unauthorized users.

Other parameters were introduced when finalizing SAC charges for each service including: power of transmission, number of sites and cells, and directivity. These variables have a direct impact on the nature and extent of spectrum management and monitoring activities. Hence resources needed to handle such activities and functions are determined accordingly. These factors are used in most countries in different ways to calculate spectrum fees and different methods are applied without any common base relation (different countries studies have different approaches). Furthermore, most of the countries do not differentiate between the Right to Use (RTU) fees and administrative charges.

The fees in a given year and over forecast period are based on the capital and operating costs incurred in managing spectrum. TRA developed a five year forecast of these costs. Figure 1.0 illustrates the forecast of spectrum management costs.

Figure 1.0 - Example of a Forecast of Spectrum Management Costs



An additional interesting aspect of the work done by TRA is the development of a set of Congestion Factors which are applied to different ranges of bands and change over time. The concept is straight

forward – over time as demand in certain bands increases, the effort and costs required to make new non-interfering assignments increases. Figure 2.0 illustrates the congestion factor formula which is a multiplier factor and ranges from 0.5 to 4.5 based on the following formula:

$$\text{Congestion Factor} = 0.5 * \text{EXP}^{(2.2 * X)}$$

Where x = occupancy

Figure 2.0 - Formula for Congestion Factors

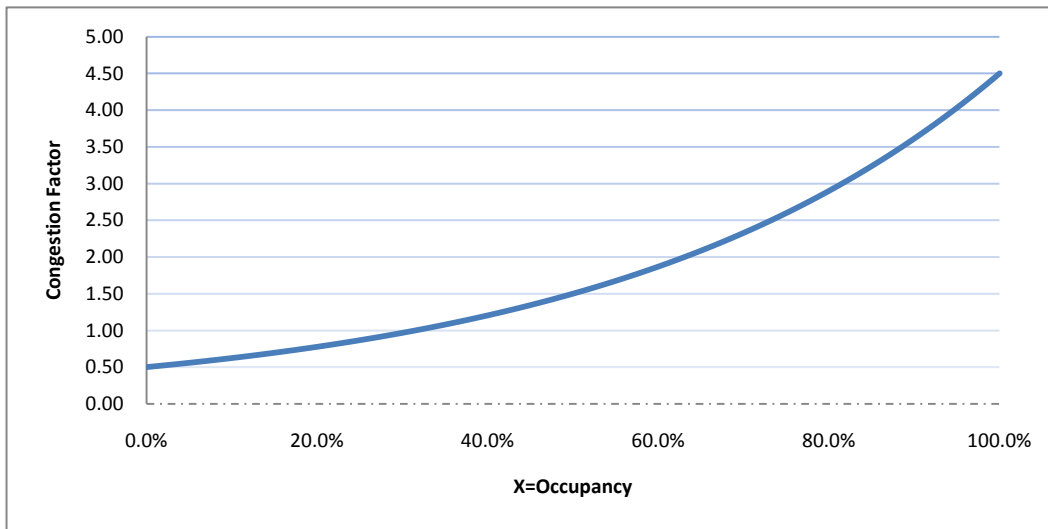


Table 1.0 shows the derived congestion factors to be applied over time to various bands.

Table 1.0 Congestion Factors by Band

	B1	B2	B3	B4
	30KHz-3GHz	3GHz-6GHz	6GHz-18GHz	18GHz-40GHz
2009	2.19	1.27	3.82	0.61
2010	2.26	1.29	3.98	0.61
2011	2.33	1.32	4.15	0.61
2012	2.40	1.34	4.33	0.62
2013	2.48	1.37	4.51	0.62

By analyzing and consolidating methods used in different countries and using the data available for Lebanon, the general formula was deduced in such a way to serve the Authority's approach to apply the proper SAC for each service (such as PMR, PMP, P2P, analogue and digital broadcast) and to reflect efforts required in managing and monitoring each service

$$SAC(i)(n) = C(i)(n) * BW * Kp$$

Where SAC (i) (n) is the cost per band (i) in year (n), Band Width (BW) is the Occupied Bandwidth per service; Kp is a factor or multiple of factors that depend on the requested service. A list of Kp factors appear in Table 2.0.

Table 2.0 Kp Factors for Various Services

Service	Kp =
<i>Mobile & DSP (PMP)</i>	Cell Factor (F_{TX})
<i>MVDS (digital transmission)</i>	Power Factor (F_p)x Site Factor (F_{SF})
<i>Broadcast (TV& FM-analogue transmission)</i>	Weight Factor (Wf)x Power Factor (F_p)
<i>MW Links (P2P)</i>	Service Factor (F_s)x Direction Factor(F_D)
<i>PMR (n is the number of Fixed Stations, p is the number of Mobile Stations; q is the number of Portable Handheld Stations)</i>	$\left[\sum_{k=0}^n \binom{n}{k} F_p + \sum_{j=0}^p \binom{p}{j} F_p + \sum_{l=0}^q \binom{q}{l} F_p \right]$

4.6.2.2 Thailand: Application of the System Performance Model

The formula used for calculating rates of frequency fee for the utilization of radio frequency follows:

$$FF = (BW \times FC \times AC) + MC$$

FF= Frequency Fee in currency per year,

BW= Bandwidth at the unit of kilohertz, (necessary or assigned bandwidth)

FC= Frequency Constant - Lower frequencies have a higher value than high frequencies

AC= Application Constant - commercial and civil services have higher values than public safety services

MC= Minimum Charge to recover administrative costs

4.6.2.3 Canada: Industry Canada – Example for Land Mobile Radio Service with one base station communication to mobile stations through a repeater.

Base Station Communicating with Mobile Stations via a Repeater

This example describes how to calculate your radio licence fee if the radio system that you intend to use is made up of a base station communicating with 8 mobile stations via a repeater. In this example, the stations are in the Land Mobile Service and not part of a radiocommunication service provider system. You intend to install your base station in June in an area that is not considered metropolitan under Schedule IV.

(System Configuration)



Base Station

1. From Schedule III, Part II, Item 1, the fee for a fixed station communicating with another fixed station is the sum of the issuance fee or \$10 plus the monthly fee of \$2.80 times 10 months, which covers the period from June to March the following year.
2. Since the fee is based on the number of assigned transmit and receive frequencies, and there is one transmit and one receive required, the total fee for the base station is:

$$(\$10 \times 2) + ((\$2.80 \times 2) \times 10 \text{ months}) = \$76.00$$

Frequency (MHz)		Communicating with	Channel		Licence Fee Calculation		
Transmit (TX)	Receive (RX)		TX	RX	Issuance	Renewal	Monthly / Short-term
160.000	161.000	mobile stations via repeater	1	1	\$10 + \$10	\$34 + \$34	\$2.80+ \$2.80

3. For a short-term licence (one month duration) the licence fee would be the issuance fee plus the monthly fee: $(\$10 + \$2.80) \times 2 = \$25.60$
4. The renewal fee for the following year will be \$68.00

Source: Industry Canada – Guide for Radio Station Licence Fees, RIC-43, 2003

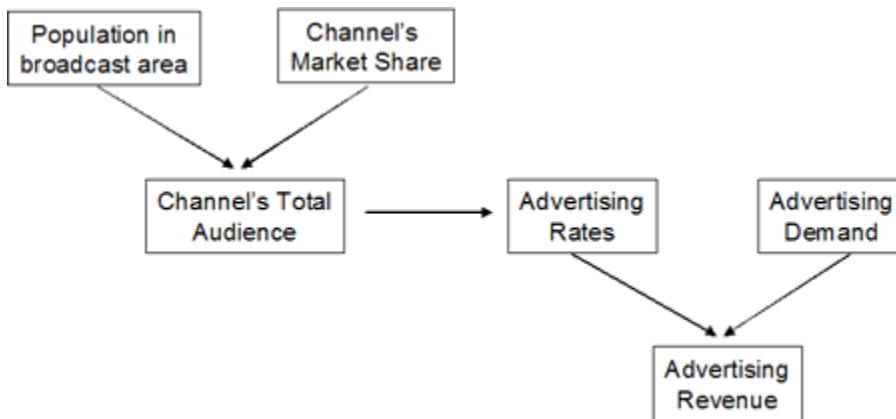
4.6.2.4 New Zealand: Ministry of Economic Development (the NZ regulator)

Review of the Broadcast Licensing Regime

The Ministry of Economic Development (MED) was concerned that the then existing licensing fee regime for broadcasting was inappropriate. MED conducted a review and study updated in 2005 to develop a better approach. The main task was to identify a set of variables (i.e. drivers) that more accurately predict future television and radio advertising revenues and to base the licence fee on future expected cash flows. Once the variables are identified forecasts are then used to yield estimates of advertising revenues. These latter forecasts are then used to calculate implied annual growth rates.

The study revealed that all other things being equal, the most reliable predictor of future advertising revenues is population growth. As audience grows, the station can charge higher advertising rates. As advertising rates increase, so too does advertising revenue. Thus, population and advertising revenue are closely correlated. This relationship is illustrated in the Figure 3.0 below.

Figure 3.0 - Relationship between Population and Advertising Revenue



Revenue growth is driven by population growth. Population varies noticeably by region. Therefore there needs to be an adjustment to take account of population growth in the broadcast area. The basic formula illustrated in Figure 4.0 was adjusted to include a variable for regional growth.

Figure 4.0 – Basis Formula

$$V2 = \frac{\left[1 + \text{revenue growth} \times \left(\frac{\text{regional population growth}}{\text{national population growth}} \right) \right]^{20}}{(1 + r)^5} \times V1$$

Where $V1$ = value for the broadcast licence in Year 1

Where $V2$ = the derived value for the broadcast licence

Where r = the prescribed rate of interest

Based on Statistics New Zealand's medium national population growth projections, the equation for television spectrum licenses follows.

Television Spectrum Licence

$$V2 = \frac{\left[1 + 2.02\% \times \left(\frac{\text{regional population growth}}{0.75\%} \right) \right]^{20}}{(1+r)^5} \times V1$$

Similarly, the corresponding equation for radio follows.

Radio Broadcast Spectrum Licence

$$V2 = \frac{\left[1 + 1.95\% \times \left(\frac{\text{regional population growth}}{0.75\%} \right) \right]^{20}}{(1+r)^5} \times V1$$

Implementing the Formulas

To implement the adjusted formula for a given television or radio spectrum licence, the following steps are to be followed:

- Identify the region(s) that the licence covers;
- Use appendices 1 and 2 to obtain estimates of population growth for the area(s) that best match the region covered by the licence;
- For television licences, substitute the regional population growth estimate (from the appendix) into the equation. For radio, substitute the growth estimate into the equation;
- Decide on an appropriate discount rate (r);
- Calculate the result;

- If the renewal period or the license period is not equal to 20 years, use to adjust the renewal fee to account for this;
- If payments are to be made annually rather than lump sum, use a single year formula to calculate the annual payments for each year of the renewal period.

By way of example, suppose we wanted to assess the renewal fee for a television licence covering Auckland, where population growth between 2001 and 2021 is estimated at 1.54%. Suppose that the licence sold for \$100,000 at the last auction and the appropriate discount rate is 11%. The renewal fee would be calculated as:

$$V2 = \frac{\left[1 + 2.02\% \times \left(\frac{1.54\%}{0.75\%} \right) \right]^{20}}{(1 + 0.11)^5} \times V1$$

$$= 1.3378 \times V1$$

$$= \$133,777$$

Hence the licence renewal fee will be \$133,777, 34% higher than the price paid for the existing licence.

Note: the key driver of the formulae's final value is the price of the initial license. The best method used in developing the initial licence price would be an auction. If that is not done a business case valuation of spectrum value should be formulated. The value of spectrum to the broadcaster would be the price which when formulated equates cash flows of the specific broadcast to levels similar to normalized cash flows.

Note: the result is highly influenced by the presence of a discount factor in the denominator to reflect renewal fees being levied 5 years prior to the commencement of the licence period. If these fees were calculated at the outset of that period the renewal fee in this instance would be 125% higher than the price paid for the existing licence.

Source: New Zealand – Ministry of Economic Development. Development of Price Setting Formulae for Commercial Spectrum Rights at Expiry, 2005

4.6.3 Administrative and Economic Based Spectrum Pricing

Radio spectrum is a potentially scarce national resource characterized by an increasing number of valuable uses. The framework for spectrum management which currently dominates legislation and regulation is

based on assumptions about the need to regulate thereby reducing interference, to utilize radio spectrum more efficiently, and to encourage innovation. Development of best practices for spectrum pricing up until recent times have been premised primarily on improving administrative tools and practices such as improved methods for demand and cost assessment and price formulation tools. As the demand for spectrum increases and innovative and efficient technologies appear, best practices continue to evolve towards market-based methods such as administered incentive prices and auctions. More detail on administrative and market-based practices will be provided below. Additional references can be found in the ICT Regulation Toolkit³.

In summary, given increasing demands for spectrum and advancing technology, it is becoming increasingly important to include economic considerations in spectrum pricing:

As the frequency spectrum is a scarce resource, decisions concerning spectrum management should also consider the economic point of view. Therefore, to improve national spectrum management all available means including economic methods are needed⁴.

Having said this, it is important to note that spectrum pricing is one of several tools to ensure spectrum is used efficiently and that maximum benefit is obtained from its use.

4.6.3.1 Market-based Prices

Spectrum prices can emerge through an authentic market transaction such as an auction or secondary trading. The design and usefulness of auctions in the assignment of spectrum is based on the general theory of prices which involve:

- assumptions regarding the economic behaviour of consumers of resources;
- the rationale preference for positive outcomes;
- utility (maximizing efficiency and profit);
- And information availability and access.

³ ICT Regulation Toolkit – Section V on Spectrum Pricing (revised). See www.ictregulationtoolkit.org.

⁴ ITU, 2005: REPORT ITU-R SM.2012-2, Economic Aspects of Spectrum Management, p.7.

The last statement is important. The value of spectrum is determined by users and based on information – private and common amongst potential users. Differences in value can be explained by different business models, cost structures, tastes and expectations for the future. As we can see not all information will be available to all potential users, especially private values and future expectations. Expectations about future use can be both powerful determinants of value and very imprecise. The 3G auctions of 2001 and 2002 in Europe attained unprecedented high values for various reasons, one of which was the unrealistic expectations around timing of availability and take-up of services.

Auctions are essentially a method of assigning spectrum at the time of its first issue by the spectrum regulator to those who value the spectrum most highly. It is normal for the bids to be made in money terms, where the competitor offering the largest monetary sum wins the licence. Spectrum prices emerge as a consequence of winning bids in auctions or from secondary trades of existing licences. Auction and spectrum trading transaction prices not only embody ‘opportunity costs’ – the cost-saving potential of the spectrum licence, but also any excess profits which the licence holder can derive through exclusivity or market power. As a result, they should be used with caution.

Competition for licences can take forms different than money. For example, competitors can bid against one another over which of them will offer service over the largest geographical area. Or the competition can be in terms of which operator will charge the lowest amount for service or requires the least amount of subsidy. Once the rules are established, however, the winner is determined by the operation of the competitive process, not by an administrative decision. It is important that the winner of an auction is not effectively tied down as a firm granted a licence by any other means.

The key differences between auctions and comparative hearings or administrative decisions are that:

- An auction assigns the licence to the firm which bids the most, and that may in certain conditions be the most efficient firm;
- A competitive auction will, if it operates properly, direct any expected excess profits from providing the service to go to the Government, rather than the operator as would be the case if the operator were chosen via a competitive hearing.

Literally hundreds of spectrum auctions have been conducted in the past ten years. Some have attracted great attention by generating billions of euros or dollars from bidders. Most have been on a much smaller scale. Even so it still remains the case that most of the spectrum in use in all countries has been allocated by administrative methods. In practice, auctions tend to be confined to cases where:

- The spectrum available is in scarce supply;
- Many firms want to acquire licence;

- The service to be provided with the spectrum can be precisely defined;
- The monetary value of the licence is relatively high, justifying what can be a complex assignment procedure.

4.6.3.2 Administered Incentive Prices

In the absence of a primary or secondary market for spectrum (or even in their presence), it may be desirable to incite licensees to economies on spectrum use, in order to discourage extravagant use or hoarding. This applies both to private sector (or commercial) users and to public sector users.

This is called 'administered incentive pricing or AIP': 'administered' because they are set by the regulator with potential 'incentive' properties. AIP is used by some regulators (See Ofcom in the UK and ACMA in Australia) to promote efficiency in spectrum use within a framework of administrative spectrum management since AIP's are intended to be set at a level which reflects the scarcity of spectrum and encourages economy in its use.

These types of licence fees are designed to not simply recover the cost to manage spectrum but also promote efficient spectrum use. The idea is that if a user has unused spectrum, they will choose to return it rather than pay the charge. Also, if a user can pay a lower fee by using spectrum more efficiently, that user may adopt more spectrum-efficient operations.

At first sight, cost recovery fees might seem to fall in this category since cost recovery prices may motivate a user to return excess spectrum or to use spectrum more efficiently, but the primary motivation for this method is to fund the spectrum regulator (and perhaps gain some additional revenue) and prices are more likely to be set too low to impose an appropriate level of discipline on licensees. This arises because the value to a nation of its spectrum greatly often exceeds the cost of operating the spectrum regulation organization.

Spectrum should be priced in any use at its opportunity cost by applying the right level of price pressure without forcing excessive economies which result in valuable spectrum being unused.

The right level of price is found by estimating the value other resources saved if the same spectrum were redeployed to produce some other service, or the extra costs incurred if it were not available to provide the currently employed service causing the current service to be produced with less spectrum. Doing this in practice will require the regulator to identify the relevant alternative or alternatives, and perform the necessary cost calculations, as exemplified in the practice note below. This will inevitably produce results which are only approximately accurate, but the regulator may conclude that it is better to apply incentives for cost efficiency via a price which is only approximately right, then not to charge any price at all.

If AIP's are based on opportunity cost, then it follows that they should be zero (and replaced, probably, by cost recovery prices based on direct cost only) if the spectrum has no alternative use. This might arise because there is no:

- No shortage of spectrum in the relevant frequency, so that all users can be accommodated;
- A legal impediment to using the spectrum in question for other purposes; this might apply for instance, to spectrum used for the purposes of aeronautical communication under the auspices of the International Civil Aviation Organization (ICAO).

In summary, AIP is another tool available to the regulator to encourage spectrum efficiency. It is applicable in an administrative regime for spectrum assignments and can be applied to private and public sector users. It is especially well suited to fixed links.

To be effective the regulator must be sure that the AIP are taking effect. For example, if a ministry paying AIP on spectrum simply has its budgetary allocation increased to allow it to pay, there is no incentive to economize and the regime is ineffectual.

5.0 Rwanda Market Overview

5.1 Economic Indicators

Economic theories of pricing underlie the best practice approach to spectrum pricing. Economically efficient and equilibrium spectrum prices are established in a competitive market place. Since prices established in a competitive market-place do operate to ensure the right mix of goods and services are produced and at the lowest possible cost, spectrum manager are interested in setting spectrum prices (including fees) that approach efficient and equilibrium prices. Spectrum prices established in a competitive market place are ideal. Hence the advantage of using market-based pricing mechanisms which act to ensure users chose the right amount of spectrum and use it efficiently for the application they are using – broadcast, cellular, wireless broadband, etc.

If market-based prices are not or cannot be used, it is very important for the spectrum regulator to set prices which reflect economic reality and financial reality for users otherwise administrative prices can lead to distortions resulting in inefficient use (hoarding) or the wrong mix of services (excessive producer welfare or use of obsolete and inefficient radio equipment).

When setting new administratively determined prices for spectrum fees or for spectrum usage, it is important to grasp the market context in which they are being set. Ideally markets are operating

competitively providing consumers with adequate choice services and competitive prices and service providers and operators have sufficient flexibility to select technologies and develop new services. Overtime, spectrum prices set by the regulator need to respond market conditions. The overall approach and level of prices should be set conservatively since the risk of high prices and regulatory failure outweigh the costs associated with underutilization and barriers to access.

With these considerations in mind a brief review of the Rwanda telecommunications market place was conducted looking at broad economic indicators such as per capital income, overall indicators of ICT use and ICT basket prices and specific indicators of mobile use and prices. A summary of the brief review of indicators of the Rwandan market is provided.

5.1.1 Rwanda Economic Performance

Rwanda is the most densely populated country in Africa and yet highly rural; it is landlocked and has few natural resources and minimal industry. The Rwandan economy is based on the largely rain-fed agricultural production of small, semi-subsistence, and increasingly fragmented farms. It has few natural resources to exploit and a small, uncompetitive industrial sector. Primary exports agricultural commodities - coffee and tea.

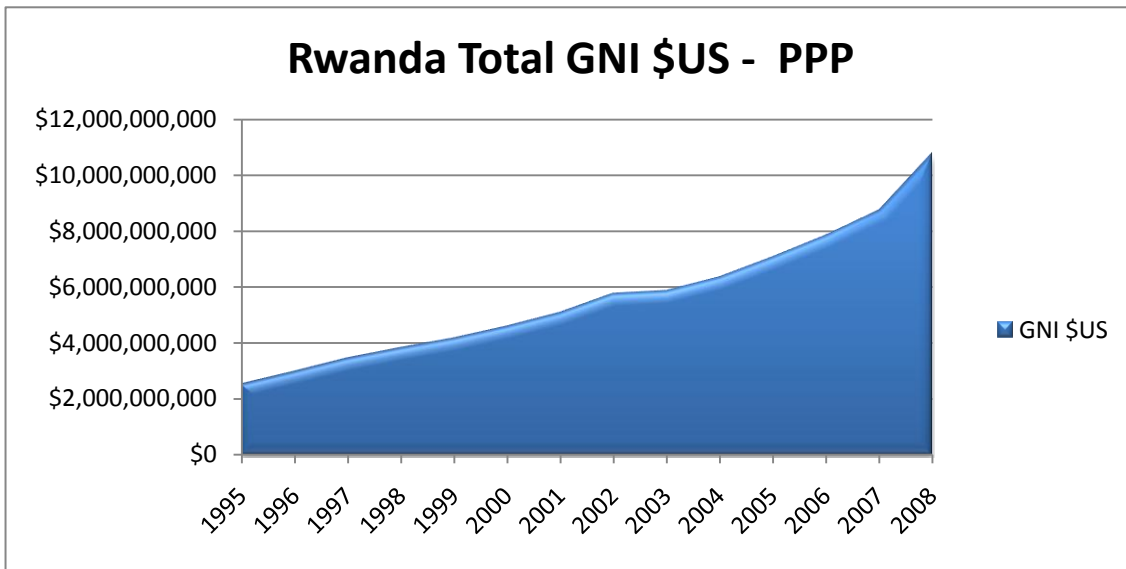
Rwanda's economic base is fragile and has suffered severe shocks in the past leading to an impoverished population, particularly women, and eroded the country's ability to attract private and external investment. In spite of these challenges, recently Rwanda has made significant progress in stabilizing and rehabilitating its economy.

Rwanda, as developing country, Per Capita GNI and ICT penetration are low.⁵ Recovering population growth and continued political stability have encouraged increases investment and consumption and led to significant progress being made. GNI per capita has increased by 53% in the last 5 years.

As well since June 1998, Rwanda has utilized several International Finance Institute (such as the World Bank and Africa Development Bank) programmes to stimulate adjustment and growth. The World Bank Enhanced Structural Adjustment Facility and embarked upon an ambitious privatization program. Continued growth depends on the maintenance of international aid levels and the strengthening of world prices of coffee and tea.

⁵ GNI per capital is a measure of resident producer prices plus production taxes and primary salaries less subsidies.

Figure 5.0 - Rwanda Total GNI \$US - PPP



Source: World Bank Economic Data prepared by MCF & Co. 2011.

5.1.2 Broad Indicators of the Economy

Table 3.0 illustrates trends in several broad indicators of the overall Rwandan economy and trends in development. In general, GNI per capita and use of ICT's all show high levels of growth above 10%. Population is showing lower growth at approximately 2.5% per annum. Rwanda is country with one of the most highly rural populations in the world with about 90% of the population engaged in agriculture. The rate of increased urbanization is estimated at 4.4% per Annum⁶.

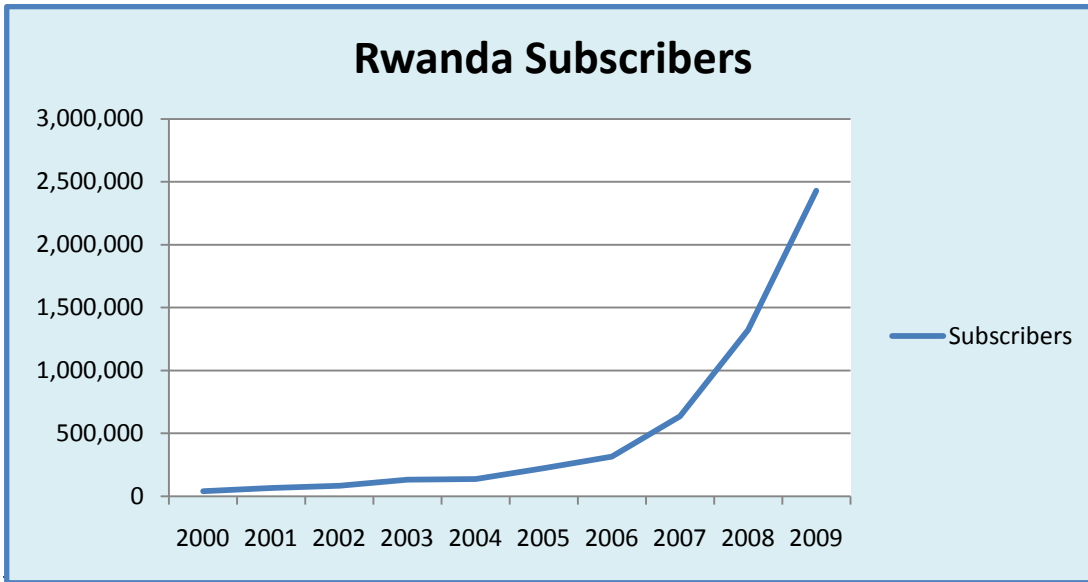
Table 3.0 Selected Broad Economic Indicators

	2007	2008	2009
Population	9,209,997	9,454,534	9,792,000
% Urban	16%	17%	18%
GNI/Capita US -PPP	\$852.10	\$924.8	\$1,101.57

⁶ Central Intelligence Agency (CIA) Factbook, 2010.

Cell Phone Teledensity (#/100) ⁷	6.75	13.79	24.81
Broadband Penetration (#/100)	.095	2.40	4.60

5.1.3 ITU ICT Development Index (IDI)⁸



6.0 Current Methodology – Assessment

6.1 Review of Current RURA Regulation and Methodology

⁷ This is a measure of active SIMS. It is difficult to obtain a true measure of penetration since it is known that many users have 1 or 2 phones and chase deals on a monthly basis. Actual penetration could be 30% lower than the quoted figure

⁸ The ITU publishes the report annually while the IDI index lags by 1 year. The most recent report uses 2008 IDI data.

The formula used by RURA to administratively determine spectrum user fees is a very simplified modified version of the Universal System Performance Model described earlier in Section 4.5.1.1 Best Practices. It can be generally shown as:

$SPECTRUM\ FEE\ (SP) = (RWF)(UNITFEE)$ the unit varies by band and by service

RF = volume of space or geometric area occupied. For example the number of assigned frequencies to be provided or users to be served [2];

Unit Fee= Simple Fee for the defined unit. For example, 50,000 RWF per MHz.

6.2 Review of the Existing Fee Schedule Approach

General observations are summarized below:

The sources of revenue are not directly related to the use of funds. The basis of fees is a spectrum usage charge. It is most likely the case that the level of spectrum usage charges is insufficient to provide an incentive to promote or encourage optimal utilization of assignments and efficient use of spectrum by way of more efficient use of technology. Evidence of this can be found in several instances:

- The price of cellular spectrum in terms of price per MHz seems low in comparison to other countries such as Kenya and Tunisia;
- Fixed links in the 7.0-8.0 GHz are congested suggesting non-exclusive spectrum assignments should be considered;
- Fee model does not promote better utilization or spectrum sharing.

The linkages between spectrum usage charges and spectrum use are unclear and the amounts are inadequate to promote efficient use then spectrum will be used inefficiently. The methodology should take into account parameters such as geographical location, population coverage and the amount of assigned spectrum actually utilized. The formulas should differentiate between shared and exclusive use of bands.

Incentives for use of higher bands have not been incorporated into current RURA formulas. For example the same rate for spectrum applies to cellular, point to multi point, and broadcast (RWF 1,200,000 per MHz) even though the revenue per MHz is vastly different with cellular greatly outstripping broadcast.

Even so, overall price levels are most likely insufficient to promote efficiency by encouraging higher utilization and the use of higher bands, and more efficient technologies/modulation techniques. Broadcasters currently are assigned frequencies to be used in a defined regional area such as Kigali but are transmitting well beyond the intended coverage area. They do this by locating antenna masts on mountain peaks and by significantly boosting transmission power. Some broadcasters are able to cover 60-70% of the country with a single transmitter.

6.3 Detailed Observations

Observations were made on specific formulas and the analyses of problems and these have been documented in this section.

6.3.1 *Broadcast Radio and TV*

Radio broadcast transmitters use less bandwidth than TV broadcast transmitters. Transmitter Power is not used as a factor in determining spectrum usage fees - most Radio broadcasters transmitters are operating \geq 2 kW Effective Radiated Power (ERP). The same fee applies to Radio and TV in most cases and yet TV broadcast is more valuable⁹.

Bandwidth factors are not being applied implying that TV spectrum is as valuable as radio spectrum. No attempt is made to consider financial and economic factors such as population coverage or earned revenues from advertising.

There were few private/commercial broadcasters prior to 2005. The sector has opened up and there are now approximately 20 operating radio broadcasters. We understand that the sector is showing positive signs of growth in terms of the listening audience and advertising revenues with some operators now breaking even financially or making profits. Spectrum fees do not represent a significant part of the ongoing operational costs for operators. A big concern of the radio operators has been access to additional spectrum whereas RURA is concerned about efficiency and wants to encourage re-use. The recently acquired Spectrum Management and Monitoring System (SMMS) should greatly improve RURA's ability to make better assignments and improve re-use.

As noted previously, broadcasters currently are assigned frequencies to be used in a defined regional area such as Kigali but are transmitting well beyond the intended coverage area.

⁹ Generally, Digital Dividend Spectrum in Region I occupies 74 MHz from 790-862 MHz. Source GSR 2010 Discussion Paper on the Digital Dividend by Adrian Foster, McLean Foster & Co.

6.3.2 Cellular

The formula for cellular networks consists of:

- Spectrum Assigned in MHz,
- Unit Fee of RWF 1,200,000 per MHz.

The current spectrum fee structure does not differentiate between lower (more valuable) and higher cellular bands. The same rate of RWF 1,200,000 applies to GSM and 3G bands even though GSM bands are scarcer and have superior propagation characteristics. Very valuable spectrum below 1.0 GHz, including Digital Dividend spectrum (790-862 MHz) is the same cost even though the efficiency of these lower bands is estimated to be at least 10 times more cost effective¹⁰. The formula does not reflect more efficient use of spectrum as in more sectors per site and spectrum re-use.

6.3.3 Fixed Links

The Spectrum fee structure currentl in force does not make a difference between the technologies used for fixed links. For example, 16 QAM modulated technology is 25% more efficient at 2 MBit/s than QPSK modulated equipment¹¹. The current structure reflects fees for Spectrum Assigned only which is one of the three components of the fee formula.

The formula for fixed links has three components:

- Spectrum Assigned Fee of RWF 15,000 per channel. The structure does differentiate between lower bands and higher bands and there does appear to be greater use of higher bands. Whether this is a result of fees, spectrum availability, or operator requirements is not known.
- Station Fee derived from on the number of links deployed. The formula does not reflect more efficient use through non-exclusive licences or geographic spectrum re-use.
- Effective Radiated Power (ERP) Fee for MF and HF band transmitters

¹⁰ Based on a recent study in S.E. Asia it is approximately 13 times cheaper to build a mobile telephone network using UMTS 450 compared to using UMTS 2100 if only the radio frequency costs are taken into consideration.

¹¹ Ofcom, The Guide to Fixed Terrestrial Cost Modeling.

6.3.4 Broadband Wireless (Fixed Wireless Access or WiMAX)

The Spectrum fee structure currently in force does not make a difference between the technologies used for Broadband wireless. The existing formula could be modified to include a band factor for the amount of spectrum assigned, a location factor, and a service factor – fixed or mobile broadband. Ideally, RURA should assign spectrum by way of an auction

6.5 Concerning the Use of Market-based Mechanisms

Currently, RURA does not use market-based mechanisms like auctions or spectrum trading or market approximate prices such as AIP. There is, however, recognition that market-based mechanisms are becoming more prevalent elsewhere as the means to assign scarce and highly valued spectrum.

7.0 Recommended Improvements to the Current Approach

Recommended improvements to the existing approach are discussed here. Changes are recommended in structural modifications and computational enhancements.

7.1 Cost Allocation – All users should pay

Firstly, all users should pay an appropriate amount of overall spectrum management costs to cover their share of activities conducted on their cost conducted on their behalf. Implementation considerations are described below:

1. The cost of managing spectrum needs to be fully understood in terms of direct, indirect, and overhead costs.
2. The cost of spectrum management should be apportioned to each user group or service based on criteria such as the amount of spectrum allocated, the number of licences or the amount of spectrum management activity related to licensing, monitoring, and interference problem solving. For example, air and marine mobile will be monitored heavily to ensure compliance and safety along with land mobile and satellite which have frequent interference issues.

7.2 Spectrum Revenues should be linked to Objectives

Secondly, spectrum revenues should be linked to spectrum management objectives and specific revenue budgets derived. A principle of performance management is what can be measured can be managed. We need to ensure the outcomes we desire for effective management of spectrum are linked to things we can measure – spectrum fees and prices:

1. Spectrum usage – where exclusive assignments or scarcity does exist, spectrum usage charges should be collected from spectrum users:

Where licences are granted on a first come first serve basis, spectrum usage charges should be nominal. This is the case where the supply of spectrum exceeds demand and is expected to remain so for the foreseeable future.

2. Maximizing revenue – where demand is in excess of supply, attempts should be made to optimize spectral efficiency – technical and economic. In the absence of auctions, ongoing fees, as a percent of revenues, could be levied in addition to one time fees levied at the outset of a concession award.

7.3 Location Matters – Urban and Rural

Next, a location zone factor has been used to reduce the cost of spectrum in areas where there is lower demand for spectrum such as non urban centres. Areas of highest population density and mobile penetration correspond with urban areas. Rwanda is a densely populated country although usage in rural areas is extremely low.

Three zones – urban, semi-urban and remote – have been discussed. The East Province has the lowest population in the country, more whereas population density in the capital is very high. Low population densities and utilization has been considered in developing a revised methodology.

8. Implementation Steps

Implementation of a revised fee schedule will require the following steps. The first two steps are described subsequently in more detail:

Activity	Date
Collection of Frequency spectrum utilization in Rwanda	Jan - March 2011
Submission of the review report	March 2011
Review of the report by RURA	March – September 2011
Consultation with Stakeholder	October 8 – 15 th 2011
Compilation of Stakeholders comment and Submission of Final report	31 st October 2011
Development of new pricing regulations based on the new structure	November 2011
Publicize New Spectrum Fee Regulation along with implementation schedule	15 th January 2012