



Final Draft Document

Recommendations for a Spectrum Management Policy

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1 Introduction

The Government of the Republic of Trinidad and Tobago (GoRTT) has, over the past few years, launched a series of initiatives which collectively seek to further develop and transform the national economy leading to “the development of an Information Society and the attainment of developed country status by Trinidad and Tobago by the year 2020”[1].

One of the major initiatives undertaken was the development of a National Information and Communications Technology (NICT) Plan [1] in which several programs aimed at the development of the Information and Communications Technology (ICT) sector were identified.

A key ingredient of the NICT plan was the requirement for the de-monopolization and liberalization of the telecommunications sector thereby opening the telecommunications market to competition in Trinidad and Tobago.

In order to establish the required legal and regulatory framework to guide the liberalization of the telecommunications sector, a Telecommunications Act was passed in 2001 which was subsequently amended via the Telecommunications Amendment Act of 2004 and which was fully proclaimed on 30th June 2004 [2]. This led to the establishment of the Telecommunications Authority of Trinidad and Tobago, hereinafter referred to as “the Authority” or “TATT”, on 1st July 2004.

The commitment given by GoRTT under the General Agreement in Trade in Services (GATS) to open the telecommunications market to competition by 2009 was another factor which contributed to the liberalization of the telecommunications sector [3].

One of the first imperatives of the Authority was the development of the overall regulatory framework including the various telecommunications’ policies required in order to establish the relevant regulations under the Telecommunications Act.

One such policy is the Spectrum Management policy which is essential in establishing the framework for the granting of access to the radio frequency spectrum for the provision of telecommunications services, on a commercial and non-commercial basis, both to the general public and for private use.

1.1 Relevant Legislation

The relevant Sections of the Telecommunications Act which were taken into consideration in the framing of the Spectrum Management policy are stated hereunder.

Section 18 (1) (i):

*“Subject to the provisions of this Act, the Authority may exercise such functions and powers as are imposed on it by this Act and in particular –
Plan, supervise, regulate and manage the use of the radio frequency spectrum, including-*

(i) the licensing and registration of radio frequencies and call signs to be used by all stations operating in Trinidad and Tobago or on any ship, aircraft or other vessel or satellite registered in Trinidad and Tobago;

(ii) the allocation, assignment and reallocation or reassignment of frequency bands where necessary;”

Sections 36 – 44:

These deal with issues relating to Licences and Spectrum Management particularly Sections 41, 42 and 43.

Section 41:

(1) The Authority shall regulate the use of the spectrum in order to promote the economic and orderly utilization of frequencies for the operation of all means of telecommunications and to recover the cost incurred in the management of the spectrum.

- (2) *The Authority shall develop a spectrum plan in order to regulate the use of the spectrum.*
- (3) *The National Spectrum Plan shall be made available to the public in the manner prescribed by the Authority.*
- (4) *The National Spectrum Plan shall state how the spectrum shall be used and the procedures for licensing frequency bands.*
- (5) *The procedures referred to in subsection (4) may include, but are not limited to-*
 - (a) procedures for licensing frequency bands by auction;*
 - (b) procedures for licensing frequency bands by tender;*
 - (c) procedures for licensing frequency bands at a fixed price; or*
 - (d) procedures for licensing frequency bands on stated criteria.*

Section 42:

- (1) *Subject to subsection (2), the Authority may, in accordance with the spectrum plan allocate and reallocate frequency bands.*
- (2) *In the allocation or assignment and reallocation or reassignment of frequency bands by the Authority priority shall be given to the needs of the State in respect of matters of national security.*

Section 43:

“The Authority, in exercising the functions under Sections 36 to 42, shall take into account-

- a) the objects of the Act;*
- b) the impact of the spectrum plan on existing and future use;*
- c) the efficient use of the spectrum;*
- d) the Convention;*

- e) *applicable international standards, conventions and other agreements; and*
- f) *any other relevant matters having regard to the circumstances of the case.”*

1.2 Policy Objectives

The primary objective of the Spectrum Management policy is to provide an effective framework for the management of the radio frequency spectrum in order to:-

- derive an effective mechanism for the management of the spectrum in the era of converged technologies and telecommunications services so that a wide range of services can be made available to the public
- provide a responsive, effective and flexible approach to meeting the needs of users of spectrum
- make adequate provision for spectrum in respect of national security, law enforcement and emergency services
- promote the economic and orderly utilization of spectrum for the operation of all means of telecommunications
- allocate radio spectrum resources for the provision of telecommunications services in an effective and efficient manner
- recover the cost incurred in the management of spectrum and to realize an adequate economic benefit to the country for the use of spectrum resources
- provide an efficient, equitable and transparent system for the establishment of the fee regime for the use of spectrum, taking into account both the commercial and non-commercial use of spectrum and
- promote the country’s interest at regional and international fora with respect to the use of the radio frequency spectrum.

1.3 Review Cycle

This document will be modified as deemed necessary by the Authority in order to adapt to the needs of the telecommunications industry and to meet changing circumstances. When the need for modification is identified, the Authority will announce its intention to review the document and any interested party or entity in the telecommunications sector or any appropriate industry forum may suggest changes to the document.

Questions or concerns regarding the maintenance of this document may be directed to the Authority via email at policy@tatt.org.tt.

1.4 The Consultation Process

The Authority sought the views and opinions of the general public and other stakeholders regarding the proposals made in this document, in accordance with the Authority's *Procedures for Consultations in the Telecommunications Sector of Trinidad and Tobago* [4]. The comments and recommendations received during the second round of consultation were considered in revising this document (See the Decisions on Recommendations (DOR) Matrix at Annex I).

This revised draft policy will be made available for consultation for a period to be prescribed by the Authority.

1.5 Other Relevant Documentation

The Spectrum Management policy is prescribed alongside other policies, plans and regulations prepared by the Authority including the following:-

- Framework for the Authorization of Telecommunications Networks and Services and Broadcasting Services in Trinidad and Tobago
- Radio Spectrum Regulations
- National Frequency Allocation Table

2 Background

The radio frequency spectrum is a scarce national resource that is essential to the provision of a wide range of activities, including national defence, public safety, air, land and sea transportation, broadcasting and commercial telecommunications services. Careful management of the radio spectrum is essential to ensure that the unique social and economic benefits that it provides are fully realized.

Under the Telecommunications Act 2001, frequency spectrum is defined as “the continuous range of electromagnetic wave frequencies used for telecommunications.” The allocated radio spectrum, as defined in the ITU Radio Regulations, covers the frequency range 9 kHz to 1,000 GHz.

Use of the radio spectrum is indispensable for the provision of a wide range of telecommunications services and over the past few years the developments in telecommunications technologies and the demand for new telecommunications services have placed an even greater demand on the use of the radio frequency spectrum.

Some of the telecommunications services facilitated through the use of radio frequency spectrum include voice, data and multimedia telecommunications services, broadcasting and other services such as national security, public safety, disaster warning, weather forecasts, aeronautical and marine communications.

It is widely acknowledged that the availability of a good telecommunications infrastructure and high quality cost effective telecommunications services are essential to the social and economic development of a country. It is therefore imperative that the frequency spectrum resource is effectively managed to optimize the delivery of telecommunications services in Trinidad and Tobago thereby realizing the potential benefits to facilitate the social and economic objectives of the country.

The International Telecommunications Union (ITU) defines frequency spectrum management as “the combination of administrative, scientific and technical procedures necessary to ensure efficient operation of radio communication services without causing harmful interference”.

2.1 Key Factors in Frequency Spectrum Management

Traditionally, the management of the radio spectrum has involved the consideration of both the technical and economic efficiencies of spectrum use within the context of a broad telecommunications policy.

Technical efficiency was generally achieved by optimizing the use and/or sharing of the spectrum resource by users/systems within acceptable limits of interference to ensure acceptable quality of services provided.

Interference occurs when radio waves in the same vicinity are propagated at the same frequency or at harmonic rates of each other which can cause corruption of the propagated signals resulting in a loss of integrity of information transmitted/received via the radio waves.

Historically, spectrum allocations were largely determined by technology constraints which limited particular services to particular parts of the spectrum - mostly below 1 GHz; but as technology has evolved so has the flexibility to use the radio spectrum in different ways. This increased flexibility and the concurrent growth in demand for radio spectrum has led to greater emphasis on economic considerations to ensure that limited spectrum resources are used in a manner that optimizes economic benefit and social welfare. Effective spectrum management has a key role to play in achieving this objective.

2.2 Optimization of Technical Efficiencies

In order to minimize the effects of interference, a framework for the global co-ordination of the use of frequency spectrum was established via the International Telecommunications Union (ITU), a specialized agency within the United Nations, in which the responsibility for the international co-ordination of the efficient and equitable use of the radio spectrum and satellite orbital resource was placed.

Within the ITU, the Radiocommunication Sector (ITU-R) is the agency which is charged with the responsibility to "maintain and extend international cooperation among all the Member States of the Union for the improvement and rational use of telecommunications of all kinds" [5]. Specifically, the ITU-R is responsible for the development of *Radio Regulations* which are annexed to the *Convention*.

As a member of the ITU and a signatory to the *Constitution and Convention of the ITU*, the Republic of Trinidad and Tobago is obliged to develop its spectrum management policies and procedures generally in accordance with those of the ITU.

Within the *Radio Regulations*, a broad framework for the management of the radio spectrum at the international level has been established. A *Table of Frequency Allocations* [5] has been compiled in which frequency bands are allocated to broadly defined services according to three global geographic regions namely Regions 1, 2 and 3.

The Republic of Trinidad and Tobago falls within Region 2.

Within these broad service categories, certain services are classified as 'primary' whilst others are classified as 'secondary'.

Spectrum users providing ‘secondary’ services are not guaranteed protection from interference from ‘primary’ services providers and are also mandated not to cause interference to spectrum users providing ‘primary’ services.

At the national level of spectrum management, regulators, in most cases a government agency, grant privileges to users, in some cases exclusively, for use of frequencies generally in conformity with the ITU’s *Table of Frequency Allocations*.

This has historically tended to be done on a ‘first come – first served’ basis.

2.3 Optimization of Economic Efficiencies

Some of the services that are delivered using radio spectrum, such as mobile communications and broadcasting have an intrinsically high commercial value and consequently there is a high demand for spectrum to deliver these services. Furthermore, the need for mobility and sufficient bandwidth in the delivery of these services means they are confined to within a relatively small part of the radio spectrum between 30 MHz and 3 GHz . The available spectrum in this range is further limited by the need to cater for other vital applications such as aeronautical, maritime and military communications. Therefore spectrum shortages can arise, limiting the number of competitive service providers that can be accommodated in the available spectrum. Shortages may also arise in higher frequency bands that can be used for the delivery of broadband wireless access (e.g. 3.5 GHz) or for the provision of backhaul links.

It is therefore important to ensure that the spectrum that is available is used in the most efficient way and by those who will provide the optimal economic and social benefits. To support this objective it is important that the price paid by commercial users to access radio spectrum reflects as far as possible the true economic value to the user. This can be achieved by either market based methods such as auctions or trading, or by the levying of fees which reflect the economic value of the spectrum.

Liberalization of the spectrum management regime, for example, by providing greater flexibility over the types of service that can be provided by licensed spectrum users, can also help to enhance economic efficiency by enabling the market to respond more quickly to changes in technology or public demand for new services. This is particularly important at the current time, as there is increasing convergence between telecommunications and broadcasting. For example, television and radio programmes can now be delivered to mobile phones and spectrum used for the delivery of TV programmes can also be used to deliver telephony and broadband Internet access and other interactive data services so called “triple play”.

2.4 Social Benefits arising from Radio Spectrum

The use of radio spectrum has also played an important role in supporting universal provision of telecommunication services, and particularly in extending the reach of mobile and broadband services into rural and underserved areas. Radio coverage can provide a faster and more cost-effective solution than alternative wired infrastructures. In many countries, appropriate incentives are given to operators to provide equitable access to telecommunication services by rural communities (to what and to whom) and to extend coverage to wherever demand exists.

Radiocommunication also plays a vital role in supporting the effective operations of law enforcement agencies, national security and transportation (land, sea and air).

3 Spectrum Management Regime in Trinidad and Tobago prior to the Telecommunications Act 2001

Prior to the proclamation of the Telecommunications Act on 30th June 2004, the applicable legal instrument for the regulation of the telecommunications sector was the *Wireless and Telegraphy Ordinance* (WTO Ordinance) of 1936.

Under the WTO Ordinance, a licence was required for the use of any ‘wireless apparatus’ and as such, the licensing framework was driven by the equipment or “apparatus” used in the provision of the telecommunications service.

The regulatory function was performed under the Ministry responsible for Telecommunications and licences were granted by the Minister.

Prior to 1990, public telecommunications services were provided by the *Trinidad and Tobago Telephone Company* (TELCO) with responsibility for public domestic telecommunications services and the *Trinidad and Tobago External Telecommunications Company Limited* (TEXTEL) with responsibility for public international telecommunications services.

TELCO operated under the Telephone Act 1968 and TEXTEL operated under a Special Licence granted under the WTO.

In 1990, TEXTEL was vested into TELCO which essentially resulted in a “merger” of the two companies and *Telecommunications Services of Trinidad and Tobago Limited* (TSTT) was formed with responsibility for both public domestic and international telecommunications services.

TSTT was granted a Special Licence under the WTO to provide public international telecommunications services.

During this period, several companies were also granted Special Licences under the WtOrdinance to provide radio and television public broadcasting services.

In all cases, whether directly under the WtOrdinance or via Special Licence, spectrum was assigned based on the telecommunications equipment/system or ‘wireless apparatus’ used.

3.1 Procedures under the previous regime

The spectrum management function was carried out by a department within the public service, the “Telecommunications Division”, within the Ministry responsible for Telecommunications.

The general procedural framework adopted for spectrum management was generally in accordance with that prescribed by the ITU but the framework and associated resources had not evolved in line with the growth in demand for radio spectrum over the years. This led to increasing delays to the processing of licence applications. The accuracy of the departmental records of spectrum licensing and occupancy also began to suffer and as a result of the above, many applicants simply established systems without procuring the required licences.

Notwithstanding the above, prior to the proclamation of the Telecommunications Act of 2001, through the infusion of additional technical resources in the Division, efforts were initiated to improve the procedural framework in dealing with the day to day functioning of the Division and also to implement the necessary plans and systems to increase the efficiency and effectiveness of the Division.

3.2 Technical Considerations – Frequency Allocations

The spectrum allocation framework used under the WTOrdinance was generally in conformity with the *Table of Frequency Allocations* as established by the ITU and except in certain cases, specifically in accordance with the allocations for Region 2.

Adequate spectrum was made available to meet the needs of the Ministry of National Security (police, regiment and coast guard).

Spectrum was assigned to ‘wireless apparatus’ for the provision of telecommunications and broadcasting services based generally on the Region 2 allocations on a ‘first come – first served’ basis.

Spectrum licences were granted for ‘wireless apparatus’ in respect of the provision of the following broad categories of telecommunications services:-

Fixed Services

- *point to point telecommunications services*
- *point to multipoint telecommunications services*

Mobile Services

- *land mobile*
- *trunked mobile*
- *public mobile*

Maritime Services

- *coast station operation*
- *ship to shore*

Aeronautical Services

- *air traffic control*
- *air to ground*

Satellite Services

- *satellite station*
- *VSAT station*

Amateur Radio Services

- *experimental use*

Special Licences were granted for the provision of public telecommunications or broadcasting services.

Licences were also granted to “wireless dealers” for the importation and sale of telecommunications equipment.

As noted under section 3.2 above, in preparing for the proclamation of the Telecommunications Act and the establishment of a Telecommunications Authority, several initiatives were undertaken to improve the overall efficiency and effectiveness of the Telecommunications Division.

One such initiative included the award of a contract which included the participation of spectrum management consultants to:-

- conduct a frequency spectrum audit of the spectrum band from 88 MHz to 5800 MHz
- prepare a draft spectrum plan (Frequency Allocation Table) for the above frequency band
- prepare draft technical specifications for the implementation of a frequency monitoring and management system

At the time of the full proclamation of the Telecommunications Act in June 2004, work on the above was ongoing.

3.3 Economic Considerations – Pricing of Spectrum

Until the 1980s and 1990s, the global approach to spectrum pricing policy was relatively straightforward. There was little emphasis on optimizing the economic benefit to the country for the use of spectrum and pricing of spectrum was based either on a ‘flat rate’

or a 'percentage of revenue' basis. Licence fees were usually paid on an annual basis for the duration of the licence period. The objective was to ensure that the administrative costs of managing spectrum use were recovered. There was minimal consideration given to the economic value of the spectrum to spectrum users.

In Trinidad and Tobago, a very conservative licence fee regime existed in which no attempt was made to recover even the administrative costs associated with the management of the spectrum. A "flat rate" structure was used in respect of licences granted directly under the WtOrdinance. These fees were relatively small and were collected by the Customs and Excise Division of the Ministry of Finance. A "percentage of revenue" (typically 2%) was used for most of the Special Licences granted for public broadcasting and public telecommunications services. The Permanent Secretary of the Ministry responsible for Telecommunications collected these fees. All fees collected were deposited into the Consolidated Fund (Treasury).

For many years, the above framework adequately served its purpose but over the last few years the demand for spectrum has grown so dramatically that, coupled with the developments in the telecommunications sector and the convergence of technologies and services, the framework was placed under severe strain.

4 New Demands for Spectrum and Emerging Trends in Spectrum Management Policy

4.1 Background

The tremendous changes in the telecommunications sector over the last few years have contributed to increased demand for use of the radio spectrum.

Principally, there has been an increased demand for wireless services which has resulted in increased requirement for radio spectrum. In fact, the ITU noted that over the past decade, the number of frequency spectrum assignments made exceeded the total number of assignments made over the entire history of radio. [6].

The maturing of the Internet has given impetus to the development of an Information Society in which demand for access to the Internet is now more than ever required on an “anywhere, anytime” basis. This paradigm has created new demands for radio spectrum, for example to provide mobile access to services or to extend broadband connectivity into rural areas that are currently underserved. The penetration of broadband Internet connections in Trinidad and Tobago is relatively low and wireless services could provide significant benefits in promoting competition and reducing prices for broadband access.

The availability of new technologies has also accelerated the development of new telecommunications services and products requiring access to the radio spectrum. There is a growing demand for mobile multimedia services and content that is driving convergence of the fixed, mobile and broadcast communications sectors. This convergence has been facilitated by technology developments, particularly migration to digital transmission and the increasing bandwidth capacity of networks. Growing demand for high bandwidth content and services stimulates a corresponding growth in demand for radio spectrum for wireless delivery, which places a greater demand on spectrum regulators.

4.2 Emerging Technologies

In the face of the burgeoning demand for radio spectrum to meet the requirements for new telecommunications products and services, perhaps one mitigating factor is the emergence of new telecommunications radio technologies which can provide some avenues for regulators to meet the increased demand for spectrum.

The developments in technologies revolve around the following key areas:-

- improved utilization of spectrum through “spread spectrum” techniques
- WiMax
- developments in antenna design – “smart antennas”
- increased processing power in radio receivers – “software defined radios”

4.2.1 Spread spectrum

Spread spectrum technologies use either a “direct sequencing” or “frequency hopping” technique to “spread” the transmitted information over a wide range of spectrum.

This enables a large number of different transmitted signals to co-exist in the same bandwidth whilst minimizing the risk of interference to existing, non-spread spectrum services. Examples of spread spectrum technologies are Bluetooth and WiFi (IEEE 802.11b).

4.2.2 WiMax (Wireless Microwave Access)

WiMax is a set of standards being developed to deliver broadband, wide area wireless communication over a wide range of frequencies between 1 and 60 GHz. Standards are being developed within the US IEEE standards body, under the IEEE 802.16 banner. WiMAX can be used to backhaul Wireless LANs to the Internet or to enable a wireless alternative to cable and DSL for last mile broadband access. The WiMax industry forum claims up to 50 km service area range where a line of sight is available and a typical

working range of 5 – 8 km under non-line of sight conditions, with data rates of up to 280 Mbps per base station. It is suggested that WiMAX technology will be incorporated in notebook computers and PDAs in early 2006 allowing for urban areas and cities to become “hot zones” for outdoor broadband wireless access.

There are two main versions of WiMAX, 802.16d and 802.16e. The former is intended for fixed (indoor or outdoor) access, similar to existing FWA services, while the latter provides mobility (albeit limited, more properly described as “nomadic”, in that features like seamless handover are not available). The WiMAX Forum is currently focusing on the 2.5 GHz (licensed MMDS), 3.5 GHz (licensed FWA) and 5.25 - 5.85 GHz (licence-exempt FWA) bands; however the forum is also lobbying within the ITU to expand the frequency allocations. WiMax will also provide interoperability with HiperMAN technology.

4.2.3 Smart Antennas

Radio systems with “smart antennas” utilize digital signal processing techniques which seek to ascertain the particular locations from which signals are being received and as a consequence, determine the specific direction to which signals should be transmitted.

The above systems are heavily reliant on adaptive directional antenna beam patterns for successful implementation.

Two of the main techniques used are:-

- Switched beam antennas

In this application, the sensitivity of the antenna can be adjusted to a specific “sector” co-incident with the direction of the received signal.

- Adaptive array antennas

This application, as the name implies, uses an adaptive approach and can continuously and dynamically adjust the sensitivity of the antenna based on the actual direction of the received signal and not based on any specific “sector”.

Smart antennas are being deployed in some fixed wireless and mobile networks to increase the capacity and speed of rollout of the networks.

4.2.4 Software Defined Radios

These are radios which are software driven and as such, their essential characteristics can easily be modified via software whether such modifications are in relation to modulation type, bandwidth, protocol, etc.

A specific type of software defined radio which ensures efficient spectrum utilization is the agile radio which “searches” for available spectrum within a given band and then proceeds to use this “free” spectrum. When it senses that another radio is attempting to use this spectrum, the agile radio moves to another part of the band which is temporarily “free”.

4.3 New Spectrum Management Policies

In an attempt to optimize the economic and social benefits derived from radio spectrum and to take full advantage of the above technology developments, regulators throughout the world are seeking new ways to manage radio spectrum and are implementing innovative spectrum management policies to deal with these new developments.

In particular, the ITU has announced its intention to have the issue of managing spectrum with respect to applicability of the current approach prescribed by the ITU, debated at the next World Radio Conference in 2007.

It is also instructive to note that the USA government, in 2002, issued a policy directive to undertake a review of the spectrum management policy currently in place in that country [7].

Several other countries have already taken initiatives to amend their existing spectrum management policies in order to deal with the growing demands for spectrum. Regional bodies such as the European Union are also developing new policies in this area as well as United Kingdom [8], Australia [9], India [10] and Canada [11].

These countries have adopted market-based approaches towards the licensing of spectrum and several of them have allowed licences to be treated as “tradable” assets thereby creating a secondary market for spectrum. In some cases, the licensed spectrum can be aggregated or disaggregated and the use of the spectrum can be changed. Some of the approaches taken by the countries include a phased implementation of the desired changes introduced by the new policies and licensing framework.

Prior to the implementation of new spectrum policies, most countries were generally required to enact new legislation in order to facilitate the new spectrum management and licensing regimes. In some cases, a new Spectrum Management Authority was created separately from the Regulatory body and in others, a new Regulatory body empowered with both the spectrum management and regulatory oversight, was established.

4.3.1 Licensing

In most cases, reforms which were introduced in spectrum management allowed other forms of managing spectrum apart from the traditional ‘*apparatus*’ licensing approach. Indeed, for some services, notably public telecommunications and broadcasting, there has been a general shift away from apparatus licensing to spectrum licensing, under which traditional licences have been replaced with “rights of use” for frequencies which are not as constrained in terms of equipment, technology or service. In some cases, even within the framework of ‘apparatus’ licensing, trading has been permitted.

Some of the newer approaches introduced are highlighted in the following:-

Apparatus Licence

Traditional *apparatus* licensing which was technology, site and service specific, was continued except that, in some cases, trading has been permitted.

Class Licence

Many countries have introduced a *Class licence*, which is effectively an exemption from the need for an individual licence or “right of use”, and services operating under class licences are often referred to as “licence-exempt”. There is an increasing trend towards global allocations of spectrum for such systems (e.g. at 2.4GHz, and 5GHz). Class licences allow the use of specific radiocommunication devices so long as they operate within specific technical and operational parameters.

This type of licensing has generally been applied to low power mass consumer market devices such as cordless telephones, cellular mobile handsets, citizen’s band two-way radio, etc which do not need to be individually co-coordinated to minimize the potential for interference to other systems and services.

Spectrum Licence

A *spectrum licence* was created to allow licensees, or in some cases, persons authorized by a licensee, to operate radiocommunication devices within a specified frequency band (and/or time and/or geographic area, as required).

Flexibility is allowed with respect to changing of equipment, antenna, etc and this type of licence is therefore seen to be technology neutral, subject to compliance with certain technical limits in order to avoid harmful interference.

The *spectrum licence* is regarded as a ‘property right’ and trading of spectrum may generally be allowed with other licensees.

Disaggregation of licences is also allowed and licensees are sometimes allowed to divide their licences into smaller parts and trade surplus requirements.

4.3.2 Pricing of Spectrum

It was generally noted that in some countries, certain key objectives of pricing of spectrum were to:-

- serve as a rationing device and thereby encourage efficient use of the spectrum.
- deliver a fair return to the country for use of the country's scarce spectrum resource.

It was recognized that while market mechanisms such as auctions provide the most direct way of ensuring that the economic value of spectrum is reflected in the price paid, it was also important to set a reserve price which would reflect the potential opportunity cost of the spectrum in the event that there were insufficient bidders. It was also important to ensure that other broader social or economic objectives, such as coverage, were addressed as pre-qualification criteria and that the cost of meeting these was taken into account in setting the reserve price. Setting too high a price could deter market entry, thus leaving spectrum unused and reducing overall welfare. Conversely, fees should not be so low that they encourage inefficient use.

Formula-Based Pricing

Generally, an administrative approach was undertaken in the assignment of licences usually on a "first come, first served" basis.

Formulae based on the following specific parameters were used to define the pricing regime:-

- range of spectrum required (location within the spectrum band)
- amount of spectrum required
- coverage required
- output power of transmitters

Market Based Pricing

Where there was congestion in frequency bands (demand exceeding supply) or where there was a scarcity of spectrum, a market based pricing scheme, including auction, was used.

Market values were established using the following:-

- use of reserve prices in auctions
- shadow pricing against alternative (non wireless) options
- observing trends in the trading of spectrum in the secondary market
- gradually increasing the spectrum fees in areas where there was excess demand for spectrum

5 Devising a New Spectrum Management Framework for Trinidad and Tobago

In view of the many facets of change affecting the telecommunications industry including the demands for radio spectrum, the emergence of new technologies, the rapid convergence of networks and services, the trend towards adopting market based measures for the assignment of spectrum and the new strategies being employed by regulators to adapt to the changes in the ‘spectrum landscape’, it is incumbent upon the Authority to ensure that an appropriate and adaptable framework is instituted to manage the scarce spectrum resources of Trinidad and Tobago for the benefit of the entire country.

Since the radio spectrum resource belongs to the people, the Authority must ensure that an appropriate return for use of the spectrum is obtained, whilst ensuring that the policy objectives noted at the beginning of this document are also supported. For example, the spectrum management framework should provide for wider availability of wireless broadband services for the benefit of industry and consumers throughout the country.

5.1 Use of Radio Frequency Spectrum

5.1.1 Spectrum to support the attainment of the Government of Trinidad and Tobago’s socio-economic developmental objectives

It is recognized that telecommunications will play a pivotal role in assisting GoRTT to meet its objective of transforming the national economy leading to “the development of an Information Society and the attainment of developed country status by Trinidad and Tobago by the year 2020”[1].

Indeed, as mentioned earlier in the document, under the National Information and Communications Technology (NICT) Plan, several programs aimed at the development of the Information and Communications Technology (ICT) sector have been launched.

The use of spectrum in providing the required telecommunications infrastructure will be of great importance.

There is now a growing need for mobile access to telecommunications services and this can only be facilitated via wireless means, thereby placing a heavier demand on spectrum resources.

Much innovative and affordable use is currently being made of various spectrum bands for providing wireless broadband services, which are deemed to be the cornerstone of the development and evolution of the Information Society.

The Authority will place emphasis on making spectrum resources available to enable the “build-out” of this wireless broadband infrastructure.

Spectrum Management Policy Guideline

The radio frequency spectrum, as a scarce national resource, will be used in the ‘public good’ and to facilitate the Government of Trinidad and Tobago’s public policy and socio-economic objectives.

5.1.2 Spectrum for national security, law enforcement and emergency services

The use of radio frequency spectrum to provide services for the security and protection of the sovereignty of Trinidad and Tobago must, of necessity, receive high priority in the allocation of spectrum resources.

Also, spectrum for the provision of telecommunications services for law enforcement, the safety of life and property and emergency services must also be accommodated.

TATT will work closely with the authorities responsible for providing these services to ensure that sufficient radio spectrum is made available to fully satisfy their requirements and that such spectrum is used in the most efficient manner. In view of the nature of services to be provided, spectrum will be made available on an administrative cost basis.

Alternatively, consideration could be given to the UK approach whereby Government users are charged an economic (opportunity cost) rate for the spectrum, which is reimbursed by central government as part of the overall funding for the services concerned. Should the users then reduce spectrum use, they are allowed to keep some or all of the money reimbursed. This provides an incentive for users to make more efficient use of spectrum to reduce their fees, potentially freeing up some spectrum for other uses.

Whatever approach is taken, the Authority will need to ensure that spectrum granted is efficiently and effectively utilized.

Spectrum Management Policy Guideline

Radio frequency spectrum will be provided for radiocommunication services for national security, law enforcement, public health and safety and emergency services on a priority basis using an administrative cost recovery approach.

5.1.3 Spectrum to facilitate public telecommunications (radiocommunications) services

With the proclamation of the Telecommunications Act and the opening of the market to competition, there is likely to be a heavy demand for spectrum for the provision of public telecommunications networks and services.

Competition will fuel the demand for ‘modern’ telecommunications services and the Authority will need to respond to the demand for spectrum resources for the provision of public telecommunications services.

Spectrum Management Policy Guideline

Radio frequency spectrum will be provided for public telecommunications services using a market-based approach to ensure an equitable return for use of the spectrum resources.

5.1.4 Spectrum to meet Universality requirements

Under the Telecommunications Act, provision has been made for the establishment of a Universal Service Fund that will be used to assist in the development of telecommunications infrastructure and provision of services to underserved and geographically remote areas in Trinidad and Tobago. This will be funded by certain concessionaires and licencees e.g. telecommunications network and service providers.

One of the measures now used to determine the level of penetration of telecommunications services and the overall ability of citizens to use these services is the Digital Access Index (DAI). The DAI for Trinidad and Tobago is currently 0.53 compared to that of the highest ranked country at 0.78. As mentioned previously, several access technologies, mostly wireless, which rely on the availability of spectrum, are currently being deployed in various countries across the globe. The Authority will allocate spectrum for the provision of wireless access services to facilitate the penetration of telecommunications networks and services in Trinidad and Tobago which ultimately will enhance growth of the DAI.

Spectrum Management Policy Guideline

Radio frequency spectrum will be provided for public radiocommunication services using an administrative cost recovery methodology to assist in the provision of Universal Service.

Consideration may also be given to developing fee formulae that provide direct incentives for rolling out telecommunications networks and services and broadcasting services in underserved and uneconomic areas.

5.1.5 Spectrum to provide commercial Radiocommunications Services

As mentioned earlier, the growth of the telecommunications sector is moving at a rapid pace and more and more there will be reliance on telecommunications in meeting private and commercial business needs. The 'engine of economic growth' is to a very great extent, facilitated through the private sector. Commercial telecommunications

applications will abound with the liberalization of the telecommunications sector, as it seeks to meet the demands of business.

An important consideration is the relative economic attractiveness of, and demand for different parts of the spectrum. Whilst the main cellular and broadcast bands are likely to be highly sought after, the bands mainly used for private mobile radio are likely to be under-utilised and substantially lower fees would be justified. Similarly, if congestion arises in the existing bands for fixed links (below 6 GHz), higher frequency bands could be made available at lower fees to encourage their utilization. It would also be appropriate to apply lower fees for fixed links at sites that are not heavily used. Fees charged for spectrum access should reflect the opportunity cost where there is current or potential future excess demand for spectrum (i.e. reflect the cost of denying access to spectrum for other users).

Spectrum Management Policy Guideline

Radio frequency spectrum will be provided for commercial radiocommunications services using an appropriate administrative costing methodology or market based approach to ensure an equitable return for use of the spectrum resources.

5.1.6 Spectrum to provide Aeronautical Radiocommunications Services

Radiocommunications facilities to enable the work of air traffic controllers, air to ground communications and ancillary services are critical to the safety and efficiency of air transportation.

Currently, allocation of spectrum within agreed bands are co-ordinated with the International Civil Aviation Organisation (ICAO) and the ICAO plays a major role in the international and regional co-ordination of the use of the allocated frequencies.

Aeronautical spectrum is generally allocated internationally for the exclusive use of the service and, given the safety-critical nature of the service, cannot be shared by other users. The Authority's role in regard to these services is essentially to ensure that the

spectrum is accorded protection in accordance with ITU and ICAO regulations and take effective enforcement action in the case of any interference or other infringement arising.

Spectrum Management Policy Guideline

Radio frequency spectrum will be provided for aeronautical radiocommunications services using an administrative cost recovery methodology.

5.1.7 Spectrum to provide Maritime Radiocommunications Services

Maritime radiocommunications services are required for a variety of purposes including:-

- Global Maritime Safety and Distress System (GMDSS) and Safety of Life at Sea (SOLAS)
- Radio navigation
- Weather warnings
- Commercial use
- Leisure
- Coast station operation
- Port operations

A range of frequency bands including MF, HF, VHF, UHF and satellite bands (via INMARSAT) are used to provide the above.

Maritime spectrum is generally allocated internationally for the exclusive use of the service and, given the safety-critical nature of the service, cannot be shared by other users. The Authority's role in regard to maritime services is essentially to ensure that the spectrum is accorded protection in accordance with ITU and International Maritime Organisation (IMO) regulations and take effective enforcement action in the case of any interference or other infringement arising.

Spectrum Management Policy Guideline

Radio frequency spectrum will be provided for maritime radiocommunications services using an administrative cost recovery methodology.

5.1.8 Spectrum for Amateur Radio and other Experimental Purposes

Internationally, amateur radio operators have been allocated radio spectrum in various frequency bands to undertake non-commercial radiocommunications activity including experimental work. Many of the allocations are on a secondary basis and may be shared with other users.

The benefits of amateur radio include fostering technical radio skills that may be of subsequent value to the commercial or state sectors, as well as a potential emergency response role. Provision should be made for accommodating licensed amateurs from other countries, who are likely to visit Trinidad from time to time.

It is recommended that suitable spectrum allocations be made for radio amateurs consistent with international practice.

Spectrum Management Policy Guideline

Radio frequency spectrum will be provided for amateur radio operations using an administrative cost recovery methodology.

5.1.9 Spectrum for private non-commercial radiocommunication services

The use of radiocommunications equipment is part of everyday life – from the ubiquitous mobile telephone, the home cordless telephone to the car alarm system. Spectrum resources will need to be made available to facilitate this widespread use of radio technology. Generally, these radio devices operate at relatively low power levels and use

shared spectrum. A mechanism will need to be instituted to allow for the pervasive use of these radiocommunications devices within an enabling spectrum licensing framework.

Spectrum Management Policy Guideline

Radio frequency spectrum will be made available for private use within an enabling spectrum licensing framework.

5.1.10 Spectrum for emerging radiocommunications services

There are significant developments taking place in the global marketplace with respect to the establishment of new standards and technologies to enable the delivery of wideband telecommunications and broadcasting services via wireless access/delivery systems. In many cases, these standards and technologies are being fostered by Regulatory bodies through a “soft” regulatory regime in order to facilitate a less costly and easier deployment of systems.

It is anticipated that such systems will greatly assist in the development of the national telecommunications infrastructure and will contribute to the ready access of telecommunications services thereby contributing to the overall improvement of the Digital Access Index of the country.

Spectrum Management Policy Guideline

Radio frequency spectrum will be made available for fostering the delivery of emerging radiocommunications services within an enabling spectrum licensing framework.

5.2 Allocation of Spectrum

Some of the major factors to be taken into consideration in devising a frequency allocation strategy include:-

- ensuring that spectrum is made available for the provision of required services on a structured basis, i.e. allowing for future growth or technology migration
- the availability of equipment to be used in the frequency bands allocated
- harmonization of the use of the various frequency bands
- regional and international technical co-ordination for minimizing interference
- international treaty obligations

It will therefore be appropriate to adopt a strategy for the allocation of spectrum generally consistent with that adopted by the ITU as outlined in the *Table of Frequency Allocations* as applied to Region 2.

As mentioned under Section 2.2 of this document, frequency bands within ITU's *Table of Frequency Allocations* are allocated to broadly defined services (in reality, to systems providing the identified services), for example:-

- FIXED
- MOBILE
- AERONAUTICAL
- MARITIME
- SATELLITE
- RADIO NAVIGATION
- AMATEUR
- BROADCASTING
- EARTH EXPLORATION
- SPACE RESEARCH
- RADIO LOCATION etc.

Services which are deemed to be “primary” in a particular band are identified by uppercase characters, while services which are deemed to be “secondary” are identified in lowercase characters.

It is to be noted that in this allocation scheme, spectrum users providing ‘secondary’ services are in ‘double jeopardy’ since they are not guaranteed protection from interference from ‘primary’ services providers and are also prohibited from causing interference to spectrum users providing ‘primary’ services.

While there is some debate as to the effectiveness of this priority based approach in the allocation scheme, the above strategy does provide a degree of flexibility in the use of the spectrum resource and it is recommended, at least in the medium term, that this overall allocation methodology should be maintained.

Trinidad and Tobago is located in ITU Region 2 and will in general conform to the Region 2 allocations. However in some instances it may be appropriate to make alternative provisions which could bring specific national benefits. These may include provisions to accommodate Region 1 allocations to facilitate additional wireless services and which would not conflict with Region 2 allocations.

Spectrum Management Policy Guideline

Radio frequency spectrum will be allocated in a manner that is generally consistent with the allocation methodology adopted by the ITU for Region 2 with the incorporation of such changes as may be required to reflect Trinidad and Tobago’s specific requirements.

A key element in the formulation of the Trinidad and Tobago’s Frequency Allocation Table is the insertion of “footnotes” in the Table to denote the specific areas in which the Trinidad and Tobago’s Table differs from the ITU’s *Table of Frequency Allocation* or,

where particular allocations are permitted either due to legacy systems operating at frequencies not consistent with the Table or due to unique circumstances.

A draft Frequency Allocation Table (FAT) has already been proposed for adoption in Trinidad and Tobago. This FAT currently covers the frequency bands from 88 MHz to 5850 MHz and has already been issued for public consultation. The FAT is currently under review and a second version will be issued for a second round of public consultation shortly.

5.3 Efficiency of Use of Spectrum

An important element in the spectrum management strategy will be ensuring efficiency of use of the spectrum resource.

Towards this end, allocation of spectrum will be made within the Frequency Allocation Table for the diverse range of services which will need to be provided namely; national security, commercial, private, aeronautical, maritime, public health and safety, etc. Efficient use of spectrum assigned within the various frequency bands will therefore need to be ensured.

Several approaches will be instituted in order to ensure efficient use, including:-

- a market based approach to pricing of spectrum to be employed wherever appropriate
- providing full justification for requests for bandwidth
- the use of modern spectrum optimization techniques must encourage sharing of spectrum
- implementation of Spectrum Utilization Plans (Band Plans) within the allocated bands as appropriate
- the establishment of Channeling Plans within the Utilization Plans
- monitoring the use of frequencies assigned
- reservation of bands to cater for expansion, technology migration, etc.

Spectrum Management Policy Guideline

Special attention will be given to the efficient use of spectrum and policy measures and plans will be implemented to ensure that such efficiency is realized.

5.4 Sharing and Trading of Spectrum

Traditionally, spectrum was granted to users on an “exclusive use” basis that did not always result in the efficient use of spectrum. In many cases, spectrum assigned was used minimally by licensees and only over relatively short periods of time.

Intrinsic to arrangements involving the sharing or trading of spectrum is a requirement that the licensees must retain the responsibility for technical co-ordination of the use of the spectrum with the regulator.

Opportunities are now available for sharing of spectrum through the use of newer technologies which permit several users to use the same band(s) of spectrum by employing low power devices utilizing specialized modulation techniques e.g. spread spectrum.

A necessary condition for the trading of spectrum is that enabling legislation must also be instituted to allow the treatment of a licence as a “property right” in order to allow licensees to re-sell, trade or sub-let parts of the spectrum assigned to them under certain specific conditions.

Spectrum Management Policy Guideline

Opportunity will be taken to adopt a licensing regime that will facilitate the sharing of spectrum through the use of emerging technologies.

Sharing of spectrum in the provision of commercial and public telecommunications services will only be permitted if quality of service standards are not compromised to end users.

The Authority will continue to monitor the developments in countries which have adopted the secondary trading of spectrum for possible introduction in Trinidad and Tobago, if it is proven in the medium to long term, to be an effective mechanism for optimizing the use of the spectrum resource.

5.5 Re-Allocation and Re-Assignment of Spectrum

In the formulation of the Frequency Allocation Table, there will be some cases where already existing legacy systems fall within bands that are not allocated for these types of services. These systems will be viewed as “non-standard” and systems may be allowed to operate within the particular band(s) until “end-of-life” or until such time as these bands are required for “primary” services.

In the event that the assigned frequencies are required for use before “end-of-life” of equipment, the affected systems will be assigned new frequencies in an appropriate band, if migration is possible, or the systems will need to be taken out of service and replaced in an appropriate band.

Additionally, as new technologies emerge, and as more efficient ways of utilizing spectrum are discovered and new techniques of managing spectrum are introduced, it may become necessary, from time to time, to re-allocate the use of spectrum within the Frequency Allocation Table.

Such re-allocation or re-assignment could result in the displacement of incumbents from particular frequency band(s). One solution, in such cases, may be the use of “overlay auctions”, where spectrum is auctioned with incumbents present and the incumbents are given a deadline to vacate the spectrum (typically several years). The buyer of the spectrum is then able to negotiate an earlier release date with the incumbent if desired.

It should be noted that the licensing process will not confer any “property or vested rights” of the spectrum to the licensees and as such, the Authority shall retain the governing right to modify or amend the Frequency Allocation Table, as deemed necessary.

TATT may consider a move to some form of property right in some cases, if it decides to proceed with a trading approach in the future.

Furthermore, the Authority shall bear no liability to provide financial compensation to licensees displaced as a result of any modification or amendment to the Frequency Allocation Table.

Spectrum Management Policy Guidelines

The Spectrum within the Frequency Allocation Table will be re-allocated only after careful analysis and planning and only if such re-allocation is necessary to provide overall benefits to the country and users as a whole.

Spectrum assigned to users may be re-assigned if there are compelling reasons to do so and the Authority will provide adequate notice to affected users in order to ensure minimum disruption of services.

The Authority shall bear no liability to provide financial compensation to users displaced as a result of any re-allocation or re-assignment of spectrum used.

5.6 Pricing of Spectrum

One of the key tenets which will be involved in the pricing of spectrum is that the economic value of the resource should be realized for use of the resource.

The following approaches will be adopted in the pricing of spectrum by the Authority:-

5.6.1 Administrative Pricing

In this approach, pricing will be formula based and will be dependent on the following parameters:-

- recovery of administrative cost (spectrum management, etc)
- actual spectrum band (commercial versus non-commercial band)
- quantum of spectrum - bandwidth (kHz/MHz)
- coverage area / location
- opportunity cost (e.g. resulting from the denial of the spectrum to other users or services)

This approach will generally be used for licences granted on a “first come, first served” basis.

5.6.2 Market Based Approach - Competitive Process

The Authority will generally utilize either of the following approaches where demand for certain spectrum blocks exceeds supply and especially for spectrum required for the provision of public telecommunications and/or broadcasting services. Other market based approaches which are available may be considered, as deemed appropriate.

5.6.2.1 Comparative Evaluation

This approach will involve the issuance of “Requests for Proposals” by the Authority and awards will be based on the evaluation of proposals received according to the specified criteria.

Based on the competitive nature of this process, a market-based pricing approach will be applied. This could, for example, involve benchmarking against prices paid at auction for similar licences in Trinidad and Tobago or other similar markets. Alternatively, an opportunity cost or least-cost alternative based approach could be considered, for example where there is no immediately comparable licence to switch to benchmark.

5.6.2.2 *Competitive Bidding (Auction)*

This process will be used primarily for spectrum to be used in the provision of public telecommunications services.

Spectrum granted will be on an exclusive basis and there will be little restriction on the use of technology to be used.

The reserve price for auctions will be based on achieving a true market price for the spectrum, in a similar manner to the setting of prices for spectrum awarded by comparative evaluation.

Spectrum Policy Guideline

The pricing of spectrum will seek to achieve a fair economic return for the use of the spectrum resource and market based approaches will generally be applied for spectrum used to provide public telecommunications and/or broadcasting services.

5.7 Licensing of Spectrum

With the increasing demand for wireless services and the challenges faced in meeting the requirements for spectrum, flexible strategies will need to be deployed in the licensing of spectrum in order to meet the growing demand and to facilitate the effective management of the scarce spectrum resource.

It is recognized that several innovative approaches have been deployed in various countries to meet this growing demand for spectrum and it will be prudent, therefore to examine these approaches and adopt proven measures which can be facilitated, in the short term, within the framework of the Telecommunications Act.

In this regard, longer term measures can also be identified which would require amendment to the existing legislative framework not limited to the Telecommunications Act.

In view of the above and in accordance with the provisions of the Telecommunications Act, there will be three types of radiocommunications licence that may be issued by the Authority, namely

- a) spectrum licences;
- b) station licences; and
- c) class licences.

5.7.1 Spectrum Licence

A *spectrum licence* will be granted to users to operate radiocommunications systems within a specified frequency band on a technology neutral basis i.e. no restrictions will be placed on the type of technology used. Additionally, some flexibility will be applied to the range of services which can be provided within the given frequency band.

This type of licence will be generally made available for the provision of public or closed user group telecommunications services or “wireless cable” broadcasting services.

Systems for which a *spectrum licence* will be granted include, but are not limited to, the following:-

- Mobile systems (public or closed user groups)
 - land mobile
 - satellite mobile
- Fixed Wireless Access systems
 - wireless cable television
 - wireless telecommunications services
- Point to Point/Point to Multipoint systems
 - only those for which frequency assignments are made on an exclusive basis.

5.7.2 Station Licence

This approach will be based along the lines of the traditional “apparatus licence” and will generally be location and equipment specific.

Specific requirements pertaining to the technical parameters of the equipment/systems deployed i.e. antenna characteristics (gain, directivity, front to back ratios, etc), transmitter power output levels, polarization, frequency, modulation techniques, etc. will need to be maintained by the licensee.

Site specific details including the location, height and orientation of the antennae will be required.

A *Station Licence* will be required in respect of the following systems:-

- a) Aeronautical Stations, including:
 - i. Aircraft stations
 - ii. Aeronautical mobile ground stations
 - iii. Radio navigation and radiolocation systems.
- b) Amateur Stations
- c) Broadcasting Stations, including:
 - i. Television transmitting stations
 - ii. Sound broadcast transmitting Stations
- d) General Radiocommunication Stations, including:
 - i. Point to point links
 - ii. Point to multipoint links
 - iii. Private mobile radio
 - iv. Trunked mobile radio
- e) Satellite Stations, including:
 - i. Earth Stations
 - ii. Very Small Aperture Terminals;
 - iii. Portable Satellite Communication Terminals.

- f) Maritime Stations, including;
 - i. Ships' stations
 - ii. Coastal stations
 - iii. Radionavigation and radiolocation systems
- g) Citizens Band (CB) Stations
- h) Stations used at Special Events;
- i) Stations used for Test and Development purposes

5.7.3 Class Licence

A class licence is an open authorization for persons to use specific radiocommunication services which are to be used within specific technical and operational parameters.

This licensing regime will be applied to a variety of low power, short range, mass consumer market devices which utilize specific bands of spectrum on a shared basis.

These devices will generally be for personal use.

No protection from interference is guaranteed under this licensing regime and therefore quality of service issues could arise. Also, these devices shall not be permitted to cause interference to any individually licensed systems.

No individual licences will be required and the Authority may require a "once off" administrative fee on specific devices or may waive payment of any fees entirely.

Radio devices for which class licensing will apply, subject to compliance with relevant technical standards as specified in the licence, may include the following:-

- Alarm systems
 - Automotive (security, keyless entry)
 - Personal safety

Emergency

- Computer peripherals
- Cordless telephones
- Equipment/Crane controllers
- Speed guns
- Doorbells
- Electronic surveillance
- Garage door openers
- Handheld data terminals
- Meter reading equipment
- Point of sale devices
- Radio controlled models/toys
- Radio frequency identification devices
- Radio LANs/WANs
- Family Radio Service (FRS)
- Wireless projection systems
- Wireless microphones
- Wireless subscriber devices (mobile handsets, etc.)
- Any other service that the Authority may determine, from time to time.

Spectrum Policy Guidelines

The Authority will utilize a flexible and innovative approach towards the licensing of spectrum.

The Authority will not, at this time, allow the secondary trading of spectrum but will continue to monitor relevant developments on spectrum in the regulatory arena.

The licensing regime to be adopted by the Authority will include three types of licences namely spectrum, station and class licensing. Spectrum and station licences will be made available on either a “first come, first served” basis via a general application procedure, an administrative pricing (formula based) approach or a selective basis using a competitive process (comparative evaluation or bidding), in which market-based pricing will prevail.

5.8 Monitoring and Compliance of Spectrum Use

A key component in effective spectrum management will be the Authority's capability to plan and monitor the use of spectrum resources and to ensure that users comply with the particular technical and operational parameters included in their licences.

It will therefore be imperative that a suitable "real time" computerized spectrum monitoring and management system should be implemented by the Authority.

5.8.1 General Monitoring

General monitoring of the spectrum to determine the level of occupancy of the various frequency bands, unauthorized use of frequencies, etc will be critical both from an operational and planning perspective.

Occupancy levels will determine the availability of spectrum to potential users and will also inform the planning process.

Unauthorized use of spectrum could pose interference problems to existing users and will also translate to a loss of revenue to the Authority. Detection of such unauthorized use will be of paramount importance.

5.8.2 Interference Analysis and Monitoring of Interference

In accordance with its objective to manage the national spectrum resource and act to avoid or eliminate any harmful interference, the Authority will maintain oversight over the sites of operation of any licensed user. The oversight shall include the review of all radio transmitting equipment facilities and the maintenance of such facilities.

Prior to the assignment of frequencies in the granting of licences, the Authority should ensure that the frequencies to be assigned to a new system will not create any interference to existing users and that the new system is not subjected to interference from existing users.

The spectrum monitoring and management system must therefore have the capability of performing interference analysis for potential system(s) as well as monitoring to detect cases of interference among existing systems.

In this regard, the spectrum monitoring and management system will comprise of both fixed and mobile units in order to accurately determine the location of interference.

5.8.3 Compliance with technical parameters

After licences are granted by the Authority, it will be incumbent on the Authority to ensure that licence holders adhere to the terms and conditions of their licences.

The spectrum monitoring and management system will be critical in the detection of non-compliance with respect to technical issues e.g. power levels, frequency drift, etc.

One area of particular concern will be the level of RF activity that is electromagnetic radiation in the vicinity of radio transmitting equipment which should at all times conform to the established ICNIRP (International Commission on Non-Ionising Radiation Protection) limits for exposure to the public.

Spectrum Policy Guideline

A suitable “real time” computerized spectrum monitoring and management system shall be implemented by the Authority in order to effectively manage the use of spectrum resources.

5.9 Radiocommunication Standards

In order to ensure that radiocommunications systems operate without interference, it is essential that systems adhere to certain minimum standards.

Interoperability of radiocommunication systems will be required in some cases, e.g. to facilitate roaming between networks.

Technical co-ordination of radiocommunications systems will also be greatly facilitated both in the local and international context, if common standards apply.

Spectrum Policy Guideline

The Authority will work with other relevant national and international bodies to adopt required standards and ensure that systems are in compliance with such technical standards.

5.10 International and Regional Co-ordination

The Republic of Trinidad and Tobago is a member of the ITU and signatory to the *Constitution and Convention of the ITU*. The spectrum management policy is therefore guided to a large extent on *Radio Regulations* which are annexed to the *Convention*.

It is incumbent on the Authority, therefore, that the Radiocommunications Standards, as recommended by the ITU are adopted by the Authority.

It may be necessary to establish bilateral or multilateral agreements from time to time in order to co-ordinate the use of spectrum with neighbouring countries.

Spectrum Policy Guideline

The radiocommunication standards recommended by the ITU will be adopted, as far as possible, by the Authority in managing the spectrum resource.

The Authority will develop agreements with neighbouring administrations for the purposes of co-ordinating frequencies.

6 Related Policies , Plans and Procedures

This Spectrum Management policy will be supported by, among other documents, specific Spectrum Utilization and Channeling Plans which will be developed for specific Frequency Bands, for example:-

- Plan for Public Mobile Telecommunications Services
- Plan for Broadcasting Services
- FM Broadcasting Band Plan
- etc

These Plans will be produced on an ongoing basis and will be added to the set of documents which, jointly with this Spectrum Management Policy, will reflect the overall spectrum management policy of the Authority.

References

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ANNEX I: Decisions on Recommendations

The following summarises the comments and recommendations received from stakeholders on the second draft of this document (dated September 26th 2005), and the decisions made by TATT as incorporated in this revised document (dated November 21st 2005).

Document Sub-Section	Submission Made By: Stakeholder Category¹	Comments Received	Recommendations Made	TATT's Decisions
General				
Procedures for licensing frequency bands		<p>Section 78(1)(c) of the Act requires that these procedures for management of spectrum be made in regulations. Finally, Section 18(4) of the Act requires the Authority to consult on any regulations made pursuant to Section 78.</p> <p>Hence, the Authority needs to consult on the formulation of its procedures for licensing frequency bands, and these procedures are to be made public. However, this spectrum management policy does not make any reference to this requirement of the Authority.</p>	TSTT recommends that the Authority, pursuant to the Telecommunications Act, should state its policy as it pertains to the licensing of frequency bands, including the process in which it will engage in defining the respective procedures.	<p>The policy as it pertains to the licensing of frequency bands is stated in the Authorisation Framework.</p> <p>The Authority is in the process of developing the licensing procedures for particular bands, as may be required, on an ongoing basis and will consult as and when required as stipulated under the Act.</p>
Section 1				
1.1 Relevant Legislation		The Authority has not included Section 78(1) of the Act, which states that the Minister shall make such regulations, as may be required for the purposes of this Act, "including regulations prescribing (c) procedures for the management of the spectrum."	TSTT recommends that this Section should also be included as part of the Relevant legislation	The making of regulations under section 78 of the Act is not addressed in this policy and therefore section is not relevant legislation for the purposes of this document.

Document Sub-Section	Submission Made By: Stakeholder Category¹	Comments Received	Recommendations Made	TATT's Decisions
1.2 Policy objectives		TSTT notes that the policy objectives do not include the achievement of Government's objectives as it pertains to ICT development, which should be one of the major drivers pertaining to spectrum management.	TSTT believes that included in the policy objectives should be the achievement of Government's objectives as it pertains to ICT development.	While the effective management and efficient use of spectrum facilitates the Governments objectives as pertaining to ICT Development, ICT development by itself is not an objective of Spectrum Management.
Section 2				
2.3 Optimizing of Economic Efficiencies 3 rd Paragraph; 2 nd sentence: ...this is particularly important at the current time, as there is increasing convergence between traditionally distinct telecommunications services. For example, television and radio programmes ...		Just a note for clarification the convergence as used herein by example is convergence between telecommunications and broadcasting and not between distinct telecommunications services.	Clarity is needed as to whether the convergence herein is between telecommunications and broadcasting.	Noted. The text has been amended accordingly.
Section 3				
Acronym for Wireless Telegraphy Ordinance at Section 3 page 15 and Section 3.3 page 19.		There are two different acronym used for the Wireless Telegraphy Ordinance in this document: WTO and WT Ordinance. For consistence one should be adhered to, preferably WT Ordinance or just "Ordinance" given that WTO has an	TSTT recommends the use of "Ordinance" for the Wireless Telegraphy Ordinance.	Noted.

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		international connotation for the World Trade Organization. The use of “ordinance” is further emphasized by the fact that this document would be read internationally.		
Section 5				
Spectrum Management Policy Guideline at Section 5.1.1 pg. 29		It is recommended that the use of the phrase ‘public good’ be replaced with that of ‘public interest’. While it can be argued that spectrum constitute a public good, its utilization would be in the public’s interest.	TSTT recommend that ‘public good’ be replaced with ‘public interest’.	Do not agree.
Spectrum Management Policy Guideline at Section 5.1.3 pg. 30		TSTT welcomes the Authority’s market-based approach to spectrum utilization. However, while this approach may ensure equitable return for spectrum use it should be conditioned by prevailing socio-economic factors especially in small open economies where the limiting factor is that or marker size. This limiting factor may hinder the ability of investors to recoup investment in spectrum acquisition	TSTT recommends that this policy statement be conditioned by socio-economic factors. Hence it should reads. “Radio frequency spectrum will be provided for public telecommunications services using a market-based approach conditioned by socio-economic factors to achieve a balance between an equitable return for use of the spectrum resources and incentives for network investment.	Do not agree.
Spectrum Management Policy		A served or underserved community can be uneconomic and	TSTT recommends that	Agreed.

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Guideline at Section 5.1.4 pg. 31		would therefore require some form of investment incentives to encourage network deployment.	“uneconomic” be added to the last policy statement in this section. Thus it should read: Consideration may also be given to developing fee formulae that provide direct incentives for rolling out telecommunications networks and services and broadcasting services in underserved and uneconomic areas.”	Amendment has been made.
		TSTT also believes that the Authority should consider waiving spectrum fees for provision of public telecommunications and broadcasting services in underserved and uneconomic areas.	TSTT recommends the policy statement should read: Consideration may also be given to developing fee formulae that provide direct incentives for rolling out telecommunications networks and services and broadcasting services in underserved and uneconomic areas, including the possibility of	This issue will be dealt with in the Universality Regulations and Policy.

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			waiving any relevant fees.”	
Spectrum Management Policy Guideline at Section 5.1.5 pg. 32		TSTT is not sure as to what is meant by commercial radiocommunications and what is the difference between that and a public radiocommunications services	TSTT seeks clarity from TATT on its definition of commercial radiocommunications services	Where spectrum is used by commercial entities but not for the provision for a Public telecommunications or Broadcasting service, it is considered to be commercial radiocommunications service.”
Spectrum Management Policy Guideline at Section 5.4 pg. 40		TSTT notes that the Authority uses commercial and public telecommunications services simultaneously. Previous usage of commercial was accompanied by radiocommunications services. TSTT enquires as to the distinction between commercial and public telecommunications services.	TSTT seeks clarity as to the distinction between commercial and public telecommunications services.	See above.
Spectrum Management Policy Guideline at Section 5.5 pg. 41		<p>TSTT draws to TATT's attention its policy statement “<i>The Authority shall bear no liability to provide financial compensation to users displaced as a result of any re-allocation or re-assignment of spectrum used.</i></p> <p>In its previous submission TSTT argued that such a position may violate providers' fundamental right to protection of property. It can be further argued that administrative expropriation by TATT can impact negatively upon the development of a competitive market and even stymie investment in the industry. TSTT reminds the Authority of its mandate to encourage investment, as prescribed by Section 3(f) of the Act.</p>	TSTT recommends that this policy statement be revisited and that mechanisms for recouping financial outlay be given consideration where providers are displaced by re-allocation and re-assignment of spectrum.	TATT will consider such mechanisms on a case by case basis, as may be required.

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		Seeing that TATT has stated that it shall not bear any liability to provide financial compensation, TATT must then explicitly answer who would bear the costs to displace the spectrum incumbent.	TSTT requests that TATT state in its policy statement how the costs for the displacement of the incumbent licensee will be recovered.	See above.
Spectrum Management Policy Guideline at Section 5.6 pg. 43		TSTT believes that this policy statement should be conditioned by socioeconomic factors and the size of the domestic market as previously articulated in our comments at Spectrum Management Policy Guideline at Section 5.1.3 pg. 30.	TSTT recommends that this policy statement be modified to include “a market-based approach conditioned by socioeconomic factors will generally be applied for spectrum...”	Do not agree.
5.7.3 Class Licence		The use of Class Licence herein is at variance to the definitional construct used for Class Licence at page 14 in the Draft Authorization Framework. TSTT supports the definition included here, as it seems practical and facilitates the convenient and beneficial use of low-powered wireless devices by the public.	TSTT recommends that this version of class licence be used in the Draft Authorization Framework.	Agreed.
- These devices will generally be used for personal use		This statement is very prohibitive, and does not support Government's stated intent to increase access to broadband services. This statement will limit the use of WiFi to deliver services in public areas such as hotspots at airports and cafes.	TSTT recommends that this statement be re-worded “These devices will generally be used for personal use, but may be used by concessionaires to	Do not agree. The statement as it stands is not limiting.

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			provide their services within defined technical specifications.”	
- No protection from interference is guaranteed under this licensing regime and therefore quality of service issues could arise.		In addition to no protection from interference for class licensees, class licensees should also not interfere with any other individually licensed system.	TSTT recommends that the following be added to this statement: “These devices shall not cause any interference to any individually licensed system.”	Agreed. Amendment has been made.
Spectrum Policy Guidelines at Section 5.7.3 The Authority will not at this time allow the trading of spectrum but will continue to monitor relevant development in the regulatory arena.		TSTT draws to TATT its previous submission which states: “Sections 37(1)(d) and 37(2) of the Act permit a licensee to assign its licence to another party with the approval of the Authority, where such approval shall not be unreasonably withheld. However, the policy statement seems to read that the Authority will not permit assignment (trading) of licences at this time, which seems in contravention with the Act.” TSTT recommended in its previous submission that TATT brings “its policy in conformance with the Act, permit the assignment of licences to third parties, and define by what criteria it would refuse its approval of such assignment.” In its DOR appended to its Draft Spectrum Management Policy dated September 27, 2005 TATT stated that it will clarify what is meant by Spectrum Trading in the policy and explicitly stated that assignment will be permitted pursuant to the Act. However	TSTT reiterates its previous comments that the Authority brings its policy, in conformance with the Act, permit the assignment of licences to third parties, and define by what criteria it would refuse its approval of such assignment.	The policy as it pertains to assignment of licences is unchanged. The intention of this section is to deal with Secondary Trading and the section has been amended accordingly. See above.

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		the said statement reappeared in this 2 nd Draft.		