Spectrum Plan for the Accommodation of Broadband Wireless Access Services

Maintenance History		
Date	**Change Details**	**Version**
23-03-06	First Draft	0.1
26-07-06	Second Draft. Modifications made as a result of comments and recommendations made during the first consultation stage.	0.2
15-11-06	Final Draft	0.3
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30-09-08	Revised Version – Plan updated: • Based on conclusion of competitive licensing process, which concluded in October 2007. • To include Frequency assignment plans for the 2.3 GHz, 2.5 GHz and 3.5 GHz bands based on the approved version of the Refarming Plan for BWA Services in the 2.3 GHz, 2.5 GHz and 3.5 GHz Bands.	2.0

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Executive Summary

In keeping with the Government of the Republic of Trinidad and Tobago's National Information and Communications Technology Strategy (***fastforward*** strategy), the Telecommunications Authority of Trinidad and Tobago has embarked on the liberalization of the telecommunications sector which will serve to facilitate telecommunications infrastructure growth essential for accessing information and the provision of communications services.

In the area of wireless technologies, this exercise began with the introduction of new Cellular Mobile Operators for the provision of public domestic mobile telecommunications network and services. In keeping with the National Spectrum Management Policy statement to make available radio frequency spectrum for fostering the delivery of emerging radiocommunications services within an enabling spectrum licensing framework, this document was prepared to address spectrum bands for Broadband Wireless Access (BWA) Technologies and the approach to be adopted by the Authority towards licensing of the spectrum that can be made available.

BWA technologies are currently deployed today to provide public telecommunications services such as broadband Internet access and voice telephony. Also, subscription broadcasting services can be offered using BWA technologies. These public telecommunications and broadcasting services which utilize BWA technologies can be termed BWA services.

This document seeks to firstly identify the various BWA technologies and their respective frequency bands of operation deployed globally and, in particular, by ITU-R Region 2 countries, taking into consideration the BWA technologies expressed by interested parties locally. Secondly, the results of an analysis of the current spectrum occupancy for the associated frequency bands in Trinidad and Tobago were summarized. Finally, the above information was used to propose frequency band plans for the provision of BWA services and indicate the appropriate licensing process for the assignment of spectrum to users.

Table 1 summarizes the proposed frequency band plans and the respective licensing approach for the provision of BWA services:

Table 1: Summary of BWA Technologies Operating Frequency Ranges and the Respective Licensing Approach for Trinidad and Tobago

BWA Technology	Frequency Range of Operation	Licensing Approach
Code Division Multiple Access (CDMA) 450	410 – 430 MHz 450 – 470 MHz	Due to the unavailability of sufficient spectrum within the frequency band plan ranges, a moratorium shall be placed on the licensing in those ranges of the 400 MHz band to new BWA spectrum users, until such time that the Authority deems it necessary to conduct a refarming exercise to make spectrum available in this band.
Multichannel Video Distribution and IP Services	698 – 746 MHz	The first competitive licensing process concluded in October 2007 that resulted in the assignment of three (3) spectrum blocks. Another competitive licensing process shall commence for the remaining available spectrum blocks in this band, at such time as determined by the Authority.
Worldwide Interoperability for Microwave Access (WiMAX)	2300 - 2360 MHz	The Authority has made sufficient spectrum available for the licensing of one (1) new BWA spectrum users at this time through a refarming exercise, which concluded in September 2008. A competitive licensing process shall commence for the remaining available spectrum blocks in this band, at such time as determined by the Authority.
Wireless Fidelity (WiFi)	2400 – 2483.5 MHz	BWA radiocommunication equipment will only be class licensed in this band, in conformance to the technical operating conditions and specifications. Also, a registration process will be employed to assist in the management of BWA radiocommunication systems used for the provision of public telecommunications and broadcasting services.

BWA Technology	Frequency Range of Operation	Licensing Approach
Worldwide Interoperability for Microwave Access (WiMAX)	2495 – 2690 MHz	The Authority has made sufficient spectrum available for the licensing of two (2) new BWA spectrum users at this time through a refarming exercise, which concluded in September 2008. A competitive licensing process shall commence for the remaining available spectrum blocks in this band, at such time as determined by the Authority.
Worldwide Interoperability for Microwave Access (WiMAX) Fixed Wireless Access Time Division Duplexing (TDD) and Frequency Division Duplexing (FDD) Systems	3400 – 3600 MHz 3600 – 3800 MHz	Pursuant to the refarming exercise conducted by the Authority, there is not sufficient spectrum available in this band for new BWA spectrum users at this time, due to the quantum of spectrum utilized by the incumbent BWA spectrum users. However, these incumbents have been given a maximum of one (1) year from the date of grant of their spectrum licences in order to surrender spectrum in excess of the spectrum cap for this band. Subsequent to this, a competitive licensing process competitive licensing process shall commence for the remaining available spectrum blocks in this band.
Wireless Fidelity (WiFi), HiperLAN, HiperMAN Worldwide Interoperability for Microwave Access (WiMAX)	5150 – 5250 MHz 5470 – 5725 MHz 5725 – 5850 MHz	BWA radiocommunication equipment will only be class licensed in this band, in conformance to the technical operating conditions and specifications. Also, a registration process will be employed to assist in the management of BWA radiocommunication systems used for the provision of public telecommunications and broadcasting services.
Multichannel Video Distribution and Data Services (MVDDS)	12.2 – 12.7 GHz	The first competitive licensing process concluded in October 2007 that resulted in the assignment of all twelve (12) spectrum blocks in this band. There is no spectrum available for licensing to new BWA spectrum users.
Local Multipoint Distribution Service (LMDS)	25.35 – 28.35 GHz	The first competitive licensing process concluded in October 2007 that resulted in no assignment of spectrum blocks in this band. Another competitive licensing process can commence for the assignment of spectrum blocks in this band to new BWA Spectrum users.

1 Background

The National Information and Communications Technology (NICT) Strategy (***fastforward*** strategy) of the Government of Republic of Trinidad and Tobago (GoRTT) is founded on the concept that information is critical to knowledge which in turn is crucial to the growth and development of the country. This Strategy provides the blueprint for a self-sustaining, knowledge-based society and will be a major contributor in the country's drive for a prominent position in the global information society, and providing Trinidad and Tobago with a giant stride towards developed country status.

The ***fastforward*** strategy describes many 'pathfinder' projects which will allow Trinidad and Tobago to realize this NICT vision. One such project is the development of a Broadband Strategy which will aid in achieving the national connectivity agenda, and accomplish the following:

- Provide all citizens with affordable Internet access;
- Focus on the development of skills for adults and children to ensure a sustainable solution and a vibrant future;
- Promote citizen trust, access, and interaction through good governance; and
- Maximize the potential within all citizens, and accelerate innovation, to develop a knowledge-based society.

GoRTT has also outlined the broad objective of its Broadband Strategy as the creation of a business environment that is conducive to the proliferation of market-led initiatives that are enabled through a robust regulatory regime, as well as by Government's direct or indirect participation, if required, to provide the necessary impetus for the roll out of broadband services in the country.

There are three (3) broad elements to GoRTT's proposed strategy:

1) Stimulating the provision of high speed access to the general public. This aspect of the proposed strategy aims at bringing about broadband connectivity throughout the country by a variety of means. GoRTT believes that the successful execution of this strategy demands a review of two (2) characteristics that currently limit a wider dispersion:
    a. the technical implementation of broadband to the home/customer premises; and
    b. the cost of provision, and associated retail rates.

2) Stimulating the provision of high speed connectivity and access by the public service. GoRTT is of the view that, in order to realize the goal of using e-government tools to increase performance and efficiency, Government and the Public Service need the foundation of connected high speed ICT infrastructure. Therefore, this element of the GoRTT's proposed strategy seeks to put this infrastructure in place.

3) Stimulating the provision of high speed connectivity and access to support the development/evolution of the local ICT sector. GoRTT is convinced that the ICT sector can become a pillar of the domestic economy. Indeed, in countries throughout the world, developed ICT sectors have formed essential elements in establishing and maintaining those countries' economic foundations. GoRTT believes that if Trinidad and Tobago were to duplicate this outcome, the necessary high speed, cost-effective connectivity must be provided. This element of the proposed strategy seeks to provide such connectivity.

In keeping with the ***fastforward*** initiatives and vision, the Telecommunications Authority of Trinidad and Tobago (hereafter called the Authority) has embarked on the liberalization of the telecommunications sector which will serve to facilitate

telecommunications infrastructure growth essential for accessing information and the provision of communications services.

In the area of wireless technologies, this exercise began with the introduction of new Cellular Mobile Operators for the provision of public domestic mobile telecommunications network and services. In the spirit of the more recent proposed broadband strategy of GoRTT, the Authority now look towards wireless access technologies to facilitate telecommunications infrastructure growth. This document addresses proposed spectrum bands for wireless access technologies and the approach proposed to be adopted by the Authority towards licensing of these bands.

In today's global society, the rapid evolution and deployment of wireless technologies, such as Cellular Mobile and Fixed Wireless Access, has contributed immensely to the growth in infrastructure as a more economical and feasible means of expanding public telecommunications networks and offering telecommunications and broadcasting services. This means of rapid roll-out of networks to facilitate access to telecommunications and broadcasting services is bringing countries closer to becoming knowledge-based societies.

Wireless access technologies have been instrumental in extending the reach of information and communication to persons who were not able to access a fixed line connection to public telecommunications networks and services. Wireless access technologies have been increasingly deployed as an alternative last mile solution to the traditional 'wired' local loop access networks. Wireless access technologies have evolved from offering 'narrowband' services only (i.e. Wireless Local Loop (WLL) services), such as voice telephony or dial-up internet access, to broadband services such as broadband Internet access and subscription television broadcasting services (e.g. wireless cable television). Today, Wireless Access technologies can be categorized as Fixed Wireless Access, Nomadic Wireless Access and Mobile Wireless Access, each category alluding to the level of mobility allowed by the wireless access technology. The commonality between them today is the ability to provide high capacity or broadband

connectivity, thus allowing services such as broadband Internet and subscription television broadcasting to be offered. Consequently, the term **Broadband Wireless Access (BWA) technologies** shall be used to address any wireless access technology in this document, with services utilizing these technologies referred to as **Broadband Wireless Access (BWA) services**.

The Authority commenced the process of expanding the use of BWA technologies with a request for information to parties interested in using such technologies to provide public telecommunications services, in the form of an Expressions of Interest (EOI) for such parties to indicate the public telecommunications services and frequency spectrum of preference. A total of forty-nine (49) parties responded by submitting EOIs. The information collated from this stage of the process was used to inform the development of version 1.0 of this spectrum plan. This version has now been revised in order to take account of the results of the auction that was conducted in October, 2007 and the results of the refarming exercise conducted in the 2.3 GHz, 2.5 GHz and 3.5 GHz bands.

2 Objectives

The objectives of this spectrum plan are to:

1. Identify the frequency ranges which will be allocated to the provision of BWA services, in accordance with the market and sector interests;
2. Indicate the licensing process to be implemented for the allocated frequency ranges, including any specific licensing conditions;
3. Specify the maximum technical operating conditions and specifications to be imposed on the licensed radiocommunication systems in the allocated frequency ranges.

3 Review Cycle

This document will be modified periodically to meet changing and unforeseen circumstances. The Authority will review and modify this spectrum plan as necessary and in consultation with stakeholders to ensure that the plan is guided by appropriate policy guidelines and objectives.

Questions or concerns regarding the maintenance of this spectrum plan may be directed to the Authority.

4 The Consultation Process

The Authority sought, in accordance with its "Procedures for Consultation in the Telecommunications Sector of Trinidad and Tobago" (http://www.tatt.org.tt/pfc-m.html), the views of industry stakeholders on the first draft of this document. The document has been revised with considerations to the comments and recommendations made in the second consultation phase (Refer to Annex I for the Decisions on Recommendations matrix (DOR)).

This document has been updated to reflect the results of the following activities conducted by the Authority:

- The first competitive licensing process for spectrum in the Lower 700 MHz, 12 GHz and 28 GHz bands, which concluded in October 2007.
- The refarming exercise conducted in the 2.3 GHz, 2.5 GHz and 3.5 GHz bands, as detailed in the approved version of the Refarming Plan for Broadband Wireless Access Services in the 2.3 GHz, 2.5 GHz and 3.5 GHz Bands.

5 Considerations for the Provision of BWA Services

In addition to the information received from interested parties for the EOI conducted initially, the Authority considered the following:

- The spectrum utilized by the available and prominent BWA technologies;
- The telecommunication and broadcasting services which can be offered using BWA technologies;
- The availability of spectrum in Trinidad and Tobago to accommodate BWA services; and
- The appropriate licensing process for the assignment of spectrum to users.

The following BWA technologies and their respective operating frequency ranges were identified from a review of current literature of technologies being considered and currently employed amongst ITU-R Region 2 countries on the subject, in addition to the information obtained from the EOI stage of the process. Table 2 summarises this study:

Table 2: Existing and Emerging BWA Technologies and Respective Operating Frequency Ranges Utilized Amongst ITU-R Region 2 Countries

BWA Technology	Operating Frequency Range
Code Division Multiple Access (CDMA) 450	410 – 430 MHz 450 – 470 MHz
Multichannel Video Distribution and IP Services	698 – 746 MHz
Code Division Multiple Access (CDMA) 2000 EVDO	824 – 896 MHz 1850 – 1990 MHz
Wideband Code Division Multiple Access High Speed Downlink Packet Access (WCDMA HSDPA)	824 – 960 MHz 1710 – 2025 MHz 2110-2200 MHz

BWA Technology	Operating Frequency Range
Worldwide Interoperability for Microwave Access (WiMAX)	2300 – 2360 MHz
Wireless Fidelity (WiFi)	2400 – 2483.5 MHz
Multipoint Multichannel Distribution Service (MMDS), Worldwide Interoperability for Microwave Access (WiMAX)	2150 – 2162 MHz 2495 – 2690 MHz
Worldwide Interoperability for Microwave Access (WiMAX)	3400 – 3600 MHz 3600 – 3800 MHz
Wireless Fidelity (WiFi)	5150 – 5250 MHz
Wireless Fidelity (WiFi), HiperLAN, HiperMAN	5470 – 5725 MHz
Wireless Fidelity (WiFi), Worldwide Interoperability for Microwave Access (WiMAX),	5725 – 5850 MHz
Multichannel Video Distribution and Data Services (MVDDS)	12.2 – 12.7 GHz
Local Multipoint Distribution Service (LMDS)	25.35 – 28.35 GHz

Subsequent to an analysis of:

- The frequency allocations and footnotes in the Trinidad and Tobago Frequency Allocation Table;
- The Authority's Frequency Assignment Register Records; and
- The 2004 Spectrum Audit conducted by the former Telecommunications Division, Ministry of Public Administration and Information;

the current spectrum occupancy in the Republic of Trinidad and Tobago was assessed for the operating frequency ranges of the various BWA technologies. The frequency ranges which can be considered for licensing were identified, as illustrated in Table 3 below.

Table 3: Assessment Summary of BWA Technologies Operating Frequency Ranges which can be considered for Licensing in the Republic of Trinidad and Tobago

BWA Technology	Frequency Range of Operation	Trinidad and Tobago Frequency Allocation Table	Current Spectrum Availability
Code Division Multiple Access (CDMA) 450	410 – 430 MHz 450 – 470 MHz	This frequency range 450 – 470 MHz is identified as one allocation in the TT FAT, 450 – 470 MHz. The radiocommunication services allocated to this band are Fixed Services and Mobile Services on a co-primary basis, which follows from the ITU Region 2 Table of Frequency Allocations. However, there are TT footnotes which sub-allocates various frequencies bands in this range for other radiocommunication services, such as telemetry and control (e.g. SCADA systems), medical radiocommunications systems, Radio Studio-to-Transmitter Links, Outside Broadcast stations, Family Radio Services and General Mobile Radio Services. As a result of these sub-allocations, there will not be sufficient spectrum in the frequency range 450 – 470 MHz for BWA services.	Verification of the operational status of licensees in the 410 – 430 MHz range is required. The current spectrum usage in the range 452.5 - 457.475 MHz and 462.5 - 467.475 MHz is at 73%. with existing assignments to users of conventional land mobile, SCADA and point-to-point radiocommunications systems. There is insufficient contiguous spectrum to accommodate the proposed frequency assignment plan for this frequency range.
Multichannel Video Distribution and IP Services	698 – 746 MHz	This frequency range 698 – 746 MHz is identified as a sub-allocation in the TT FAT, 614 – 806 MHz. The radiocommunication services allocated to this band are Broadcasting Services on a primary basis and Fixed and Mobile Services on a co-secondary basis, which follows from the ITU Region 2 Table of Frequency Allocations. Also, there is a TT footnote that sub-allocates 698 – 746 MHz for Fixed Services. As a result, the frequency range 698 – 746 MHz can be allocated to BWA services.	The 698 – 746 MHz frequency range is available for new spectrum users. The ranges 704 – 716 MHz and 740 – 746 MHz were assigned via an auction held in October, 2007.

BWA Technology	Frequency Range of Operation	Trinidad and Tobago Frequency Allocation Table	Current Spectrum Availability
Worldwide Interoperability for Microwave Access (WiMAX)	2300 – 2360 MHz	This frequency range 2300 – 2360 MHz is identified as one allocation in the TT FAT. This range is allocated to Fixed, Mobile and Radiolocation on a primary basis. Amateur service is allocated on a secondary basis in this range.	Pursuant to the refarming exercise which concluded in September 2008, 35 MHz of spectrum is available to new BWA spectrum users.
Wireless Fidelity (WiFi)	2400 – 2483.5 MHz	This frequency range 2400 – 2483.5 MHz is identified as two allocations in the TT FAT, 2400 - 2450 MHz and 2450 – 2483.5 MHz, which follows from the ITU Region 2 Table of Frequency Allocations. The radiocommunication services allocated to these bands are as follows: • The 2400 - 2450 MHz Band is allocated to Fixed, Mobile and Radiolocation Services on a co-primary basis and Amateur Services on a secondary basis; • The 2450 – 2483.5 MHz Band is allocated to Fixed Services, Mobile Services and Radiolocation Services on a co-primary basis. Also, an ITU footnote (S5.150) in these two (2) bands notes that Industrial, Scientific and Medical (ISM) applications and radiocommunication services operating within these bands shall accept harmful interference which may be caused by these applications.	Within the range 2400 – 2483.5 MHz there are an estimated three (3) existing users, operating fixed point-to-point radiocommunication systems. Due to the nature of operation of the BWA technologies employed in this frequency range, this spectrum can be made available to new users, under specific operating conditions.
Multipoint Multichannel Distribution Service (MMDS), Worldwide Interoperability for Microwave Access	2495 – 2690 MHz	This frequency range 2495 - 2690 MHz is identified as one allocation in the TT FAT. The only radiocommunication service allocated to this band is Fixed Service, which is a subset of the recommended radiocommunication services from the ITU Region 2 Table of Frequency Allocations.	Pursuant to the refarming exercise which concluded in September 2008, 100 MHz of spectrum is available to new BWA spectrum users.

BWA Technology	Frequency Range of Operation	Trinidad and Tobago Frequency Allocation Table	Current Spectrum Availability
(WiMAX)		As a result, the frequency range 2495 - 2690 MHz can be allocated to BWA services.	
Worldwide Interoperability for Microwave Access (WiMAX) Fixed Wireless Access Time Division Duplexing (TDD) and Frequency Division Duplexing (FDD) Systems	3400 – 3800 MHz	This frequency range 3400 - 3800 MHz is identified as three (3) allocations in the TT FAT, 3400 – 3500 MHz, 3500 – 3700 MHz and 3700 – 4200 MHz, which follows from the ITU Region 2 Table of Frequency Allocations. The radiocommunication services allocated to these bands are as follows: • The 3400 - 3500 MHz Band is allocated to Fixed and Fixed Satellite Services on a co-primary basis and Amateur Services on a secondary basis; • The 3500 - 3700 MHz Band is allocated to Fixed and Fixed-Satellite Services on a co-primary basis; • The 3700 - 4200 MHz Band is allocated to Fixed and Fixed-Satellite Services on a co-primary basis. Due to the Fixed Service allocation in these bands, the frequency range 3400 – 3800 MHz can be allocated to BWA services.	The current spectrum usage in the 3400 - 3600 MHz range is currently at 100%, based on the quantum of spectrum utilized by incumbent BWA spectrum users. Pursuant to the Refarming Plan, it is expected that a estimated 100 MHz will become available in one (1) year subsequent to the licensing of these incumbent spectrum users.
Wireless Fidelity (WiFi)	5150 – 5250 MHz	This frequency range 5150 - 5250 MHz is identified as one allocation in the TT FAT. The radiocommunication services allocated to this band are Aeronautical Radionavigation, Mobile and Fixed Satellite Services on a co-primary basis, which follows from the ITU Region 2 Table of	The recommended Licensing approach can be implemented immediately.

BWA Technology	Frequency Range of Operation	Trinidad and Tobago Frequency Allocation Table	Current Spectrum Availability
		Frequency Allocations. Also, the TT footnotes permits the use of WLANs indoor applications, subject to specific operating specifications. As a result, the frequency range 5150 - 5250 MHz can be allocated to BWA services using spread spectrum methods only.	
Wireless Fidelity (WiFi), HiperLAN, HiperMAN	5470 – 5725 MHz	This frequency range 5470 - 5725 MHz is identified as two (2) allocations in the TT FAT, 5470 – 5650 MHz and 5650 – 5725 MHz, which follows from the ITU Region 2 Table of Frequency Allocations. The radiocommunication services allocated to these bands are as follows: • The 5470 - 5650 MHz Band is allocated to Maritime Radionavigation and Mobile Services on a co-primary basis and Amateur Services on a secondary basis; • The 5650 – 5725 MHz Band is allocated to Radiolocation Services on a primary basis and Amateur Services on a secondary basis. Also, the TT footnote TT29 permits the use of WLAN applications, subject to specific operating specifications. As a result, the frequency range 5470 - 5725 MHz can be allocated to BWA services using spread spectrum methods only.	The recommended Licensing approach can be implemented immediately.
Wireless Fidelity (WiFi), Worldwide Interoperability for Microwave Access (WiMAX)	5725 – 5850 MHz	This frequency range 5725 - 5850 MHz is identified as one allocation in the TT FAT, which follows from the ITU Region 2 Table of Frequency Allocations. The radiocommunication services allocated to this band are Radiolocation Services on	The recommended Licensing approach can be implemented immediately.

BWA Technology	Frequency Range of Operation	Trinidad and Tobago Frequency Allocation Table	Current Spectrum Availability
		a primary basis and Amateur Services on a secondary basis. Also, an ITU footnote (S5.150) in this band notes that Industrial, Scientific and Medical (ISM) applications and radiocommunication services operating within these bands shall accept harmful interference which may be caused by these applications. However, the BWA technologies in this frequency range use spread spectrum methods, which are able to co-exist with the primary service in this range, subject to specific operating specifications. Due to the type of BWA technology employed in this band and the ITU footnote S5.150, the frequency range 5725 – 5850 MHz can be allocated to BWA services.	
Multichannel Video Distribution and Data Services (MVDDS)	12.2 – 12.7 GHz	This frequency range 12.2 – 12.7 GHz is identified outside the range of the TT FAT. However, the TT FAT references the ITU Region 2 Table of Frequency Allocation for the allocation of spectrum outside its range. The ITU Region 2 Table of Frequency Allocation allocates this range to Fixed, Mobile (except aeronautical mobile), Broadcasting and Broadcasting Satellite services on a co-primary basis. As a result, the frequency range 12.2 – 12.7 GHz can be allocated to BWA services using spread spectrum methods only.	MVDDS radiocommunications systems can operate on a co-primary basis to Broadcasting Satellite services provided that the specified interference protection criteria and procedure are followed. This entire frequency range was assigned via an auction in October, 2007.
Local Multipoint Distribution Service (LMDS)	25.35 – 28.35 GHz	This frequency range 25.35 – 28.35 GHz is identified outside the range of the TT FAT. However, the TT FAT references the ITU Region 2 Table of Frequency Allocation for the allocation of	The recommended Licensing approach can be implemented immediately.

BWA Technology	Frequency Range of Operation	Trinidad and Tobago Frequency Allocation Table	Current Spectrum Availability
		spectrum outside its range. This frequency range extends across three (3) bands in the ITU Region 2 Table of Frequency Allocation. The radiocommunication services allocated to these bands are as follows: • The 25.5 - 27 GHz Band is allocated to Earth Exploration Satellite, Fixed, Inter Satellite and Mobile Services on a co-primary basis and Standard Frequency and Time Signal-Satellite Service on a secondary basis; • The 27 – 27.5 GHz Band is allocated to Fixed, Fixed Satellite, Inter Satellite and Mobile Services on a primary basis; • The 27.5 – 28.5 GHz Band is allocated to Fixed, Fixed Satellite and Mobile Services on a primary basis. Due to the allocation to Fixed Services in these three (3) frequency bands, The frequency range 25.35 – 28.35 GHz can be allocated to BWA services.	

6 Frequency Assignment Principles

The following principles apply to the frequency assignment plans developed for the provision of BWA services in Trinidad and Tobago:

1. The frequency assignment plan shall be developed based on the prominent assignment plan utilized for BWA services in the particular frequency band.

2. Although the spectrum plan may identify the prominent BWA technology deployed in a particular band, BWA technologies not identified in this plan may be deployed, subject to the conformance to the stated frequency assignment plan and technical conditions and specifications.

3. A frequency assignment plan developed for Frequency Division Duplexing (FDD) operation may also be used for Time Division Duplexing (TDD) operation, in accordance with the technical conditions and specifications.

4. Frequency assignments shall be made in accordance with the selected licensing process, as established by the Authority.

5. Unless otherwise stated, the frequency spectrum blocks or frequency channels in a frequency assignment plan incorporates any necessary guard bands. Any necessary guard bands for entities authorized to use adjacent blocks or channels will be determined at such time when the licensees, and accordingly the respective technologies to be deployed, have been determined.

6. A Spectrum Cap shall be instituted in each band in order to limit the quantum of spectrum assigned to an individual spectrum user. The Spectrum Cap is the maximum quantum of spectrum that will be assigned to one (1) Licensee in a specified frequency band.

7 Proposed Frequency Band Plans for BWA Services

The various frequency bands allocated for the provision of BWA Services can be further sub-divided in frequency channel or block assignments, predicated on the type(s) of technologies which can be employed using the allocated spectrum. These frequency band plans are aimed at maximizing the efficient use of the allocated spectrum, especially for spectrum that is individually licensed.

The following sub-sections illustrate, for the various frequency ranges under consideration, the frequency band plan including rationale, the recommended licensing process and conditions, and the technical operating conditions and specifications for the radiocommunication systems operating in the stated frequency band.

NOTE: The actual availability of frequency spectrum for BWA services will be determined subject to a spectrum audit prior to the implementation of the respective licensing process for the designated frequency bands.

7.1 400 MHz Band: 410 – 430 MHz & 450 – 470 MHz

Frequency Assignment Plan

7.1.1 CDMA 450 is the prominent technology used in the provision of BWA services in the 400 MHz Band. Primarily, high speed Internet access services can be provided as a public telecommunications service using this technology.

7.1.2 CDMA 450 utilizes a family of frequency band plans globally, ranging from 410 – 490 MHz. The most commonly implemented band plan ranges from 450 –470 MHz, also known as sub-class band A. In addition, this technology has been piloted in the 410 – 430 MHz range, or sub-class band D, in Croatia, Slovenia and Brazil as a CITEL project, in collaboration with the local regulator ANATEL. CITEL's final recommendation was to consider the use of CDMA 450 at 410 – 430 MHz and 450 – 470 MHz where possible by its members.

7.1.3 In view of the above, the sub-class A and sub-class D assignment plans shall be adopted for the operation of radiocommunication systems that employ the CDMA 450 Technology. The table below identifies the adopted frequency assignment plans:

Table 4: Frequency Assignment Plan for BWA Radiocommunication Systems in the 400 MHz Band

Subclass	Subscriber CPE Transmit Frequency / MHz	Base Station Transmit Frequency / MHz
A	452.5 - 457.475	462.5 - 467.475
D	411.675 - 415.850	421.675 - 425.850

Recommended Licensing Process and Conditions

7.1.4 The licensing of spectrum in the 400 MHz band for the provision of BWA services is preferred for public telecommunication and broadcasting services, on a national basis.

7.1.5 Due to the unavailability of sufficient spectrum within the frequency band plan ranges, a moratorium shall be placed on the licensing in those ranges of the 400 MHz band to new BWA spectrum users, until such time that the Authority deems it necessary to conduct a refarming exercise to make spectrum available in this band..

Technical Operating Conditions and Specifications

7.1.6 The technical operating conditions and specifications for radiocommunication systems operating in the 400 MHz band shall be indicated when the licensing moratorium has ended.

7.2 700 MHz Band: 698 MHz – 746 MHz (Lower 700 MHz Band) & 746 MHz – 806 MHz (Upper 700 MHz Band)

Frequency Assignment Plan

7.2.1 The Television Broadcasting Sector of Trinidad and Tobago is developing in the same manner as our ITU Region 2 neighbours in North America. The band plans and standards previously adopted in Trinidad and Tobago originate from North America, as well as the equipment used in deploying broadcasting stations. One of the major evolutions in Television Broadcasting in North America was the reallocation of television channels 52 – 69, i.e. 698 – 806 MHz to Fixed and Mobile services in addition to the current Broadcasting Services allocation.

7.2.2 The propagation characteristics of the spectrum in this band and the allowable power limits make it conducive to business models that are built on serving consumers over a large area. As such, radiocommunication systems operating in this band can achieve similar coverage areas comparable to typical UHF television broadcasters.

7.2.3 In the USA, channels 52 – 59, i.e. 698 – 746 MHz have been reallocated to commercial Fixed and Mobile Services to support the development of new services, such as broadband Internet access and subscription broadcasting services. This frequency range was titled the Lower 700 MHz band.

7.2.4 The remaining channels 60 – 69, i.e. 746 – 806 MHz have been allocated to public health and safety services, Fixed and Mobile Services. This frequency range was titled the Upper 700 MHz band. Channels 63, 64, 68 and 69 have been allocated to public health and safety, and the remaining channels 60 –62, 65 – 67 have been allocated for Fixed and Mobile Services.

7.2.5 The technologies arising out of this spectrum reallocation utilize the same 6 MHz television channel bandwidth to deliver compressed television channels and IP services such as broadband Internet and VOIP voice telephony. The Federal Communications Commission (FCC), which manages commercial frequency spectrum in the USA, has implemented a frequency band plan that offers three (3) 6 MHz paired channels and two (2) 6 MHz contiguous and unpaired channels. This channel arrangement is aimed at allowing both subscription broadcasting services and other BWA services. Currently in the USA, spectrum in this band has been allocated to two service providers, in accordance with the proposed assignment plan, for mobile broadcasting services (e.g. Qualcomm's MediaFlo (Block D: FLO); Hiwire (Block pair C:DVB-H))

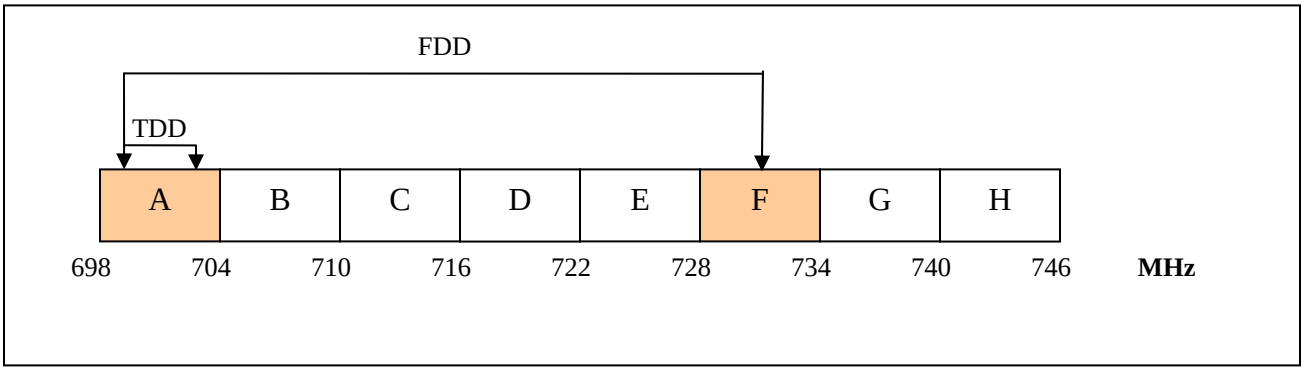
7.2.6 In Canada, only channels 63, 64, 68 and 69 have been allocated to public health and safety services, due to the high occupancy of licensees on the television UHF channels 52 – 59, while the remainder of channels from 60 – 67 have been allocated for Fixed and Mobile services. It is envisaged that the advancements in Digital Television broadcasting will reduce the number of 'free-to-air' television broadcasting channels, thus allowing further reallocation of the television UHF channels to other radiocommunication services.

7.2.7 The Authority has not completed its assessment of the quantum of spectrum in the Upper 700 MHz Band that should be allocated towards public health and safety services in Trinidad and Tobago. Therefore, at this time, only the Lower 700 MHz band shall be considered for assignment to new spectrum users.

7.2.8 It is anticipated that equipment will be available commercially in the near future, in conformance with the FCC Lower 700 MHz band frequency assignment plan. Also, the FCC band plan provides for both broadcast and bi-directional radiocommunication systems.

7.2.9 In view of the aforementioned, the FCC frequency assignment plan shall be adopted to allow for the deployment of BWA radiocommunication systems in this band. Also, considering that BWA radiocommunications systems can be deployed to operate in a FDD or TDD mode, the FCC plan shall be modified to allow flexibility for either FDD or TDD mode of operation. The modified frequency assignment plan is illustrated in Figure 1.

Figure 1: Frequency Assignment Plan for Subscription Broadcasting and Other BWA Services in the Lower 700 MHz Band



7.2.10 The frequency range is divided in frequency blocks of 6 MHz each. This arrangement allows the assignment of blocks to facilitate FDD mode of operation, utilizing a frequency duplex spacing of 30 MHz (e.g. – Block A paired with Block F. TDD mode of operation may be assigned in any 6 MHz block (e.g. Block A).

Recommended Licensing Process and Conditions

7.2.11 The licensing of spectrum in the Lower 700 MHz band for the provision of BWA services is preferred for public telecommunication and broadcasting services, on a national basis.

7.2.12 The first competitive licensing process concluded in October 2007 that resulted in the assignment of three (3) spectrum blocks. Frequency assignment to new spectrum users shall be via a competitive licensing process.

7.2.13 The allocated spectrum in the Lower 700 MHz band shall be licensed in accordance with the proposed frequency assignment plan (Figure 1).

7.2.14 The Spectrum Cap for the Lower 700 MHz band shall be 24 MHz (i.e. equivalent to four (4) spectrum blocks of 6 MHz each).

Technical Operating Conditions and Specifications

7.2.15 All spectrum users shall not exceed the maximum technical operating conditions and specifications identified in the following table, in order to operate BWA radiocommunication equipment in the Lower 700 MHz band.

Table 5: Maximum Technical Operating Specifications, Lower 700 MHz band, BWA Services

Parameter	Maximum Value	Comments
Maximum Effective Radiated Power (E.R.P.)	Base Station – 30dBW Fixed and Mobile Station – 14.8 dBW Portable(handheld) Station – 4.8 dBW	
Modulation scheme	Digital	Any digital modulation technique e.g. BPSK, QPSK
Standardization	FCC, Industry Canada, ETSI	

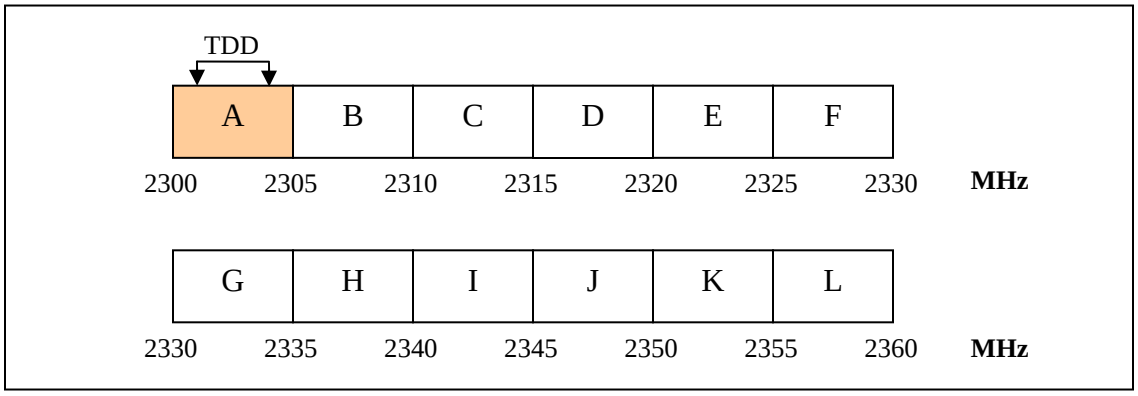
7.2.16 Notwithstanding the parameters identified in Table 5 above, amended or additional technical operating conditions may be instituted and identified in the respective schedule of the licence document for the specific radiocommunications system deployed.

7.3 2.3 GHz Band: 2300 MHz – 2360 MHz

7.3.1 In accordance with the frequency assignment principles of the Spectrum Plan, the frequency assignment plan for these bands shall be based on the prominent assignment plan utilized for BWA services in these bands.

7.3.2 The frequency assignment plan that shall be adopted for BWA radiocommunications systems in the 2.3 GHz band is illustrated in Figure 2 below.

Figure 2: Frequency Assignment Plan for BWA Radiocommunications Systems in the 2.3 GHz Band



7.3.3 The frequency range is divided into twelve (12) spectrum blocks of 5 MHz each. Considering that the total quantum of spectrum in this band is 60 MHz, there is not sufficient Tx/Rx (duplex) spacing to accommodate FDD duplex mode of operation. Also, the typical allocation of spectrum for WiMAX in this band is in TDD duplex mode. Therefore, the duplex mode of operation of WiMAX in the 2.3 GHz band shall be limited to TDD.

Recommended Licensing Process and Conditions

7.3.4 The licensing of spectrum in the 2.3 GHz band for the provision of BWA services is preferred for public telecommunication and broadcasting services, on a national basis.

7.3.5 The Authority has made sufficient spectrum available for the licensing of one (1) new BWA spectrum users at this time through a refarming exercise, which concluded in September 2008. The spectrum available for assignment to new spectrum users in this band ranges from 2330 – 2360 MHz. Frequency assignment to new spectrum users shall be via a competitive licensing process.

7.3.6 The allocated spectrum in the 2.3 GHz band shall be licensed in accordance with the proposed frequency assignment plan (Figure 2).

7.3.7 The Spectrum Cap for the 2.3 GHz band shall be 30 MHz (i.e. six (6) spectrum blocks).

7.3.8 The Licensee who is assigned spectrum blocks in 2.3 GHz, 2.5 GHz and 3.5 GHz bands shall not exceed a total Spectrum Cap of 50 MHz

Technical Operating Conditions and Specifications

7.3.9 All spectrum users shall not exceed the maximum technical operating conditions and specifications identified in the following table, in order to operate BWA radiocommunications equipment in the 2.3 GHz band.

Table 6: Maximum Technical Operating Specifications, 2.3 GHz band, BWA Services

Parameter	Maximum Value	Comments
Maximum RF Output Power of Transmitter	Base Station – 13 dBW Fixed and Mobile Station – -3 dBW Portable(handheld) Station – -3 dBW	
Antenna Gain	Base Station – 18 dBi Fixed and Mobile Station – 6 dBi Portable(handheld) Station – 0 dBi	For every dBi gain above maximum value, RF Output Power of transmitter shall be reduced by 1 dBW.
Modulation scheme	Digital	Any digital modulation technique e.g. BPSK, QPSK
Spectrum Block Edge Spectral Density Mask Limits[1] (Channel Bandwidth equal to 5 MHz)	At Block Edge – -36 dBW/MHz 1 MHz Block Edge Offset – -77 dBW/MHz 1.75 MHz Block Edge Offset – -89 dBW/MHz	
Standardization	FCC, Industry Canada, ETSI	

7.3.10 Notwithstanding the parameters identified in Table 6 above, amended or additional technical operating conditions may be instituted and identified in the respective schedule of the licence document for the specific radiocommunications system deployed.

[1] Source: Electronic Communications Committee (ECC) within the European Conference of Postal and Telecommunications Administrations (CEPT), ECC Recommendations (04)05.

7.4 2.4 GHz Band: 2400 MHz – 2483.5 MHz

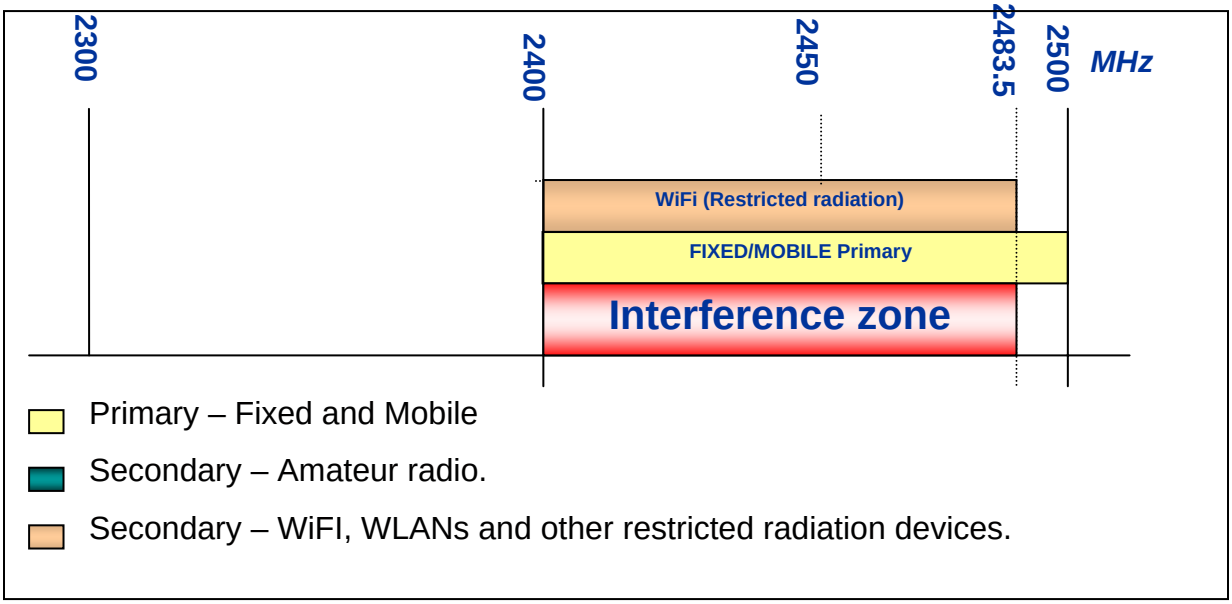
Frequency Assignment Plan

7.4.1 WiFi technology, as prescribed by the IEEE 802.11b and IEEE 802.11g specifications, is the prominent BWA technology employed in the 2.4 GHz band. This technology is utilized to provide both private and public telecommunications services. High speed Internet service is the primary BWA service offered.

7.4.2 The frequency assignment plan for the use of this technology in the 2.4 GHz band has become a de facto standard due to the proliferation of commercially available and mass market equipment, supported by the initiatives to apply light-handed regulation and exemptions, by regulatory authorities of countries around the world.

7.4.3 In view of the above, the de facto frequency assignment plan shall be adopted for BWA radiocommunication systems in this band. The following figure illustrates the adopted plan.

Figure 3: Frequency Assignment Plan for BWA Radiocommunication Systems in the 2.4 GHz Band



7.4.4 The typical assignment plan for BWA technologies in this frequency range will be adopted. Therefore, the assignment plan for BWA services in the 2.4 GHz Band extends from 2400 MHz – 2483.5 MHz.

Recommended Licensing Process and Conditions

7.4.5 BWA radiocommunication systems using the 2.4 GHz band can be used for both private or public telecommunications networks and services or broadcasting services.

7.4.6 BWA radiocommunications systems using the 2.4 GHz band shall only be class licensed, via a class licensing regime, under the condition that the BWA radiocommunication systems operate in accordance with the technical operating conditions and specifications identified in this Spectrum Plan, and any other term or condition stated in the class licensing regime.

7.4.7 The Authority shall institute a registration process to assist in the management of BWA radiocommunication systems used for the provision of public telecommunications and broadcasting service, in order to maintain a minimum quality of service.

7.4.8 Existing spectrum users in the 2.4 GHz band shall claim no protection from harmful interference from BWA radiocommunication systems allowed to operate in this band.

7.4.9 There shall be no further spectrum and station licensing for new spectrum users in the 2.4 GHz band.

Technical Operating Conditions and Specifications

7.4.10 All spectrum users shall not exceed the maximum technical operating conditions and specifications identified in the following table, in order to operate BWA radiocommunication equipment in the 2.4 GHz band.

Table 7: Technical Operating Specifications, 2.4 GHz band, BWA Services

Parameter	Maximum Value	Comments
Maximum Effective Radiated Power ERP (i.e. RF Output of Transmitter)	30 dBm	For frequency hopping systems employing less than 75 hopping channels ERP shall be no greater than 20.97 dBm
Antenna Gain	6 dBi	For every dB gain above 6 dBi, ERP of RF transmitter shall be reduced by 1 dBm.
Modulation scheme	Digital	Any digital modulation technique e.g. BPSK, QPSK
Multiple Access technique	Frequency Hopping Spread Spectrum (FHSS) Direct Sequence Spread Spectrum (DSSS)	Any other multiple access technology that can co-exist with FHSS and DSSS systems can be employed.
Minimum Channel Bandwidth	FHSS (20dB) – 25kHz DSSS (6dB) – 500kHz	FHSS shall use at least 15 well-defined, non-overlapping channels separated by the channel bandwidth. The dwell time per channel shall not exceed 0.4s within a period of 0.4n, where n is the number of channels employed
Frequency Range	2.4 – 2.4835 GHz	This frequency range can be used for either indoor or outdoor operation.

Parameter	Maximum Value	Comments
Narrowband Transmitter spurious emission limits	**Operating** 30MHz – 1GHz = -36dBm 1GHz to 12.75GHz = -30dBm **Standby** 30MHz – 1GHz = -57dBm 1GHz to 12.75GHz = -47dBm	
Narrowband Receiver spurious emission limits	30MHz – 1GHz = -57dBm 1GHz to 12.75GHz = -47dBm	
Wideband Transmitter spurious emission limits	**Operating** 30MHz – 1GHz = -86dBm/Hz 1GHz to 12.75GHz = -80dBm/Hz **Standby** 30MHz – 1GHz = -107dBm/Hz 1GHz to 12.75GHz = -97dBm/Hz	
Wideband Receiver spurious emission limits	30MHz – 1GHz = -107dBm/Hz 1GHz to 12.75GHz = -97dBm/Hz	
Maximum Spectral Power density	FHSS – 100mW/100kHz DSSS – 10mW/1MHz	
Standardization	FCC, Industry Canada, ETSI	

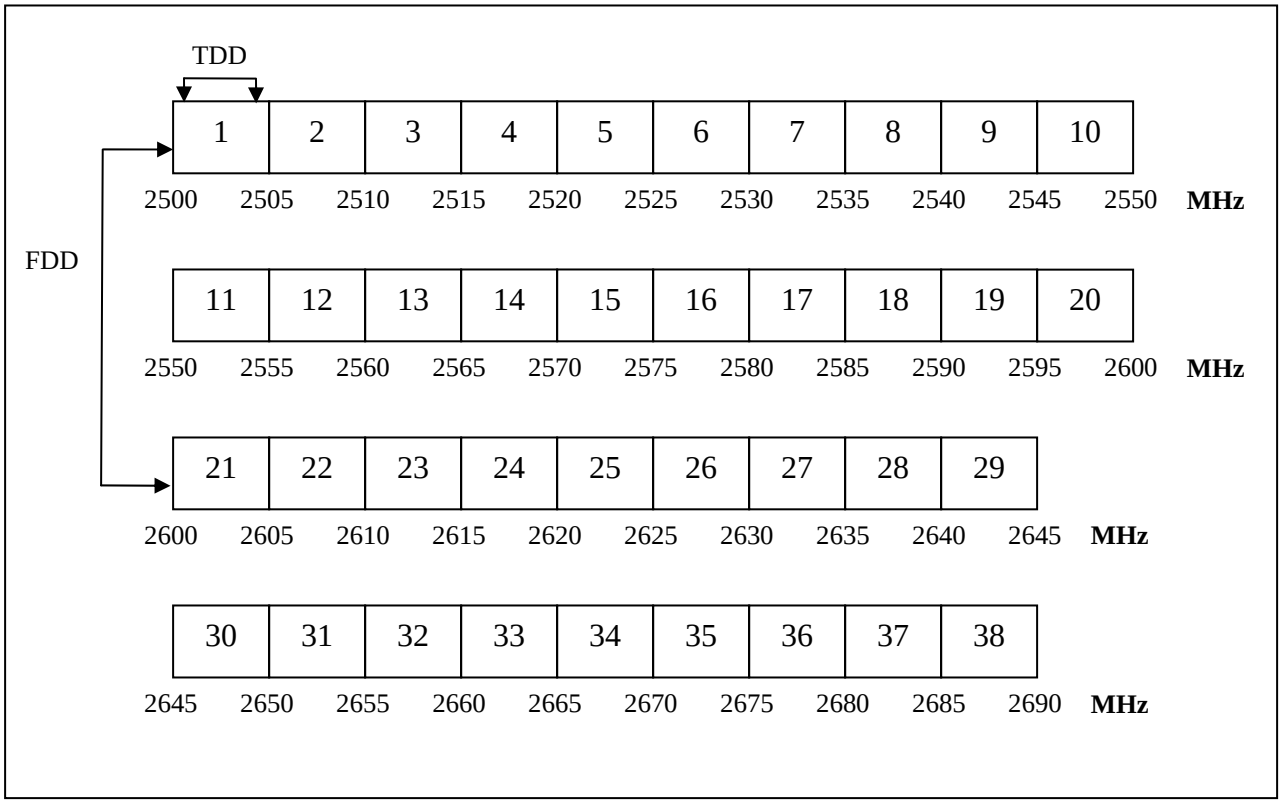
7.5 2.5 GHz Band: 2495 MHz – 2690 MHz

Frequency Assignment Plan

7.5.1 In accordance with the frequency assignment principles of the Spectrum Plan, the frequency assignment plan for these bands shall be based on the prominent assignment plan utilized for BWA services in these bands.

7.5.2 The frequency assignment plan that shall be adopted for BWA radiocommunications systems in the 2.5 GHz band is illustrated in Figure 4 below.

Figure 4: Frequency Assignment Plan for BWA Radiocommunications Systems in the 2.5 GHz Band



7.5.3 The frequency range is divided in thirty-eight (38) spectrum blocks of 5 MHz each (i.e. blocks 1, 2, 3 to 38).

7.5.4 This assignment plan allows the assignment of blocks to facilitate both FDD and TDD duplex mode of operation within this band. The accommodation of a FDD duplex mode will facilitate the incumbent spectrum users as the standard duplex mode of operation for the prominent BWA technologies in this band is TDD. It is anticipated that the incumbent spectrum users in this band will also upgrade to BWA systems that employ a TDD duplex mode of operation.

7.5.5 FDD operation will maintain a duplex spacing (i.e. Tx/Rx spacing) of 100 MHz (e.g. Block 1 paired with Block 21).

7.5.6 Considering that the minimum spectrum block is 5 MHz, a guard band of one (1) spectrum block (i.e. 5 MHz) shall be established by the Authority between adjacent spectrum blocks, which duplex modes of operation are FDD-to-TDD or TDD-to-FDD. This guard band shall be identified before the licence of spectrum in this band to a spectrum user wishing to employ a TDD duplex mode.

7.5.7 The Authority shall not establish a guard band between adjacent spectrum blocks, which duplex modes of operation are FDD to FDD or TDD to TDD. The licensees of such spectrum blocks will be required to operate in a manner that does not cause harmful interference to adjacent spectrum users.

Recommended Licensing Process and Conditions

7.5.8 The licensing of spectrum in the 2.5 GHz band for the provision of BWA services is preferred for public telecommunication and broadcasting services, on a national basis.

7.5.9 The Authority has made sufficient spectrum available for the licensing of two (2) new BWA spectrum users at this time through a refarming exercise, which concluded in September 2008. The spectrum available for assignment to new

spectrum users in this band ranges from 2500 – 2550 MHz and 2600 – 2650 MHz. Frequency assignment to new spectrum users shall be via a competitive licensing process.

7.5.10 The allocated spectrum in the 2.5 GHz band shall be licensed in accordance with the proposed frequency assignment plan (Figure 4).

7.5.11 The Spectrum Cap for the 2.5 GHz band shall be 50 MHz (i.e. equivalent to ten (10) spectrum blocks or five (5) paired spectrum blocks of 5 MHz each).

7.5.12 The Licensee who is assigned spectrum blocks in 2.3 GHz, 2.5 GHz and 3.5 GHz bands shall not exceed a total Spectrum Cap of 50 MHz.

Technical Operating Conditions and Specifications

7.3.11 All spectrum users shall not exceed the maximum technical operating conditions and specifications identified in the following table, in order to operate BWA radiocommunications equipment in the 2.5 GHz band.

Table 8: Maximum Technical Operating Specifications, 2.5 GHz band, BWA Services

Parameter	Maximum Value	Comments
Maximum RF Output Power of Transmitter	Base Station – 13 dBW Fixed and Mobile Station – -3 dBW Portable(handheld) Station – -3 dBW	
Antenna Gain	Base Station – 18 dBi Fixed and Mobile Station – 6 dBi Portable(handheld) Station – 0 dBi	For every dBi gain above maximum value, RF Output Power of transmitter shall be reduced by 1 dBW.
Modulation scheme	Digital	Any digital modulation technique e.g. BPSK, QPSK

Parameter	Maximum Value	Comments
Spectrum Block Edge Spectral Density Mask Limits[2] (Channel Bandwidth equal to 5 MHz)	At Block Edge – -36 dBW/MHz 1 MHz Block Edge Offset – -77 dBW/MHz 1.75 MHz Block Edge Offset – -89 dBW/MHz	
Standardization	FCC, Industry Canada, ETSI	

7.5.13 Notwithstanding the parameters identified in Table 8 above, amended or additional technical operating conditions may be instituted and identified in the respective schedule of the licence document for the specific radiocommunications system deployed.

[2] Source: Electronic Communications Committee (ECC) within the European Conference of Postal and Telecommunications Administrations (CEPT), ECC Recommendations (04)05.

7.6 3.5 GHz Band: 3.4 GHz – 3.8 GHz

Frequency Assignment Plan

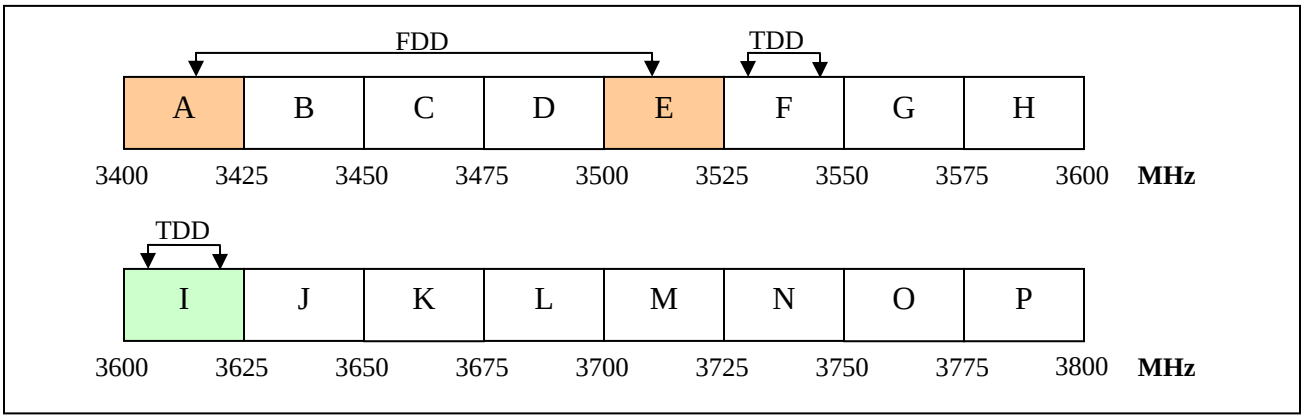
7.6.1 The frequency range 3300 – 3400 MHz is allocated on a primary basis to the Radiolocation Service and on a secondary basis to the Amateur Service, in accordance with the Trinidad and Tobago Frequency Allocation Table. Further to this, the ITU-R Region 2 Table of Frequency Allocation allocates this frequency range to Fixed Service on a secondary basis as well. BWA radiocommunications equipment is categorized under Fixed Service. Consequently the provision of BWA services shall not claim protection from harmful interference from radiocommunications equipment in the Radiolocation Service. Considering this, the frequency range 3300 – 3400 MHz will not be considered for the provision of BWA services.

7.6.2 Consideration shall be given to Fixed Satellite Service which currently exist on a co-primary basis with Fixed Service in the frequency range 3400 – 3800 MHz, in accordance with the Trinidad and Tobago Frequency Allocation Table, as follows:

- 3400 – 3700 MHz – The Fixed Service shall remain as primary but the Fixed Satellite Service shall operate on a secondary basis. This implies that BWA services shall be protected from harmful interference from radiocommunications equipment in the Fixed Satellite Service.
- 3700 – 3800 MHz – The Fixed Satellite Service shall remain as primary but the Fixed Service shall operate on a secondary basis. This implies that BWA services shall not be protected from harmful interference caused by radiocommunications equipment in the Fixed Satellite Service.

7.6.3 The frequency assignment plan that shall be adopted for BWA radiocommunications systems in the 3.5 GHz band is illustrated in Figure 3 below.

Figure 5: Frequency Assignment Plan for BWA Radiocommunications Systems in the 3.5 GHz Band



7.6.4 The frequency range 3400 – 3600 MHz is divided in eight (8) spectrum blocks of 25 MHz each. This spectrum block size was chosen in order to accommodate the typical channel bandwidths in this band, namely 3.5 MHz, 5 MHz of 7 MHz. This arrangement allows the assignment of blocks to facilitate both TDD and FDD duplex mode of operation within this band.

7.6.5 FDD operation in the frequency range 3400 – 3600 MHz shall maintain a duplex spacing (i.e. Tx/Rx spacing) of 100 MHz (e.g. – Block A paired with Block E).

7.6.6 Considering that the minimum spectrum block is 25 MHz, the Authority shall not establish a guard band between adjacent spectrum blocks, which duplex modes of operation are FDD-to-FDD, TDD-to-TDD, FDD-to-TDD or TDD-to-FDD. The licensees of such spectrum blocks will be required to operate in a manner that does not cause harmful interference to adjacent spectrum users, via the establishment of any necessary in-band guard bands or adjacent spectrum user coordination.

7.6.7 The frequency range 3600 – 3800 MHz is divided in eight (8) spectrum blocks of 25 MHz each. Considering part 7.5.3 (b), the provision of public BWA services shall be restricted to the frequency range 3600 – 3700 MHz.

7.6.8 New and existing spectrum users shall be encouraged to operate in a TDD or FDD duplex mode for the provision of public BWA services, within the frequency range 3600 – 3700 MHz. FDD operation in this frequency range shall maintain a duplex spacing (i.e. Tx/Rx spacing) of less or equal to 50 MHz (e.g. – Block I paired with Block K).

7.6.9 Consideration shall be given to existing spectrum users who currently operate in a FDD duplex mode in the frequency range 3600 – 3800 MHz, subject to the conditions in part 7.5.3.

Recommended Licensing Process and Conditions

7.6.10 The licensing of spectrum in the 3.5 GHz band for the provision of BWA services is preferred for public telecommunication and broadcasting services, on a national basis.

7.6.11 Pursuant to the refarming exercise conducted by the Authority, there is not sufficient spectrum available in this band for new BWA spectrum users at this time, due to the quantum of spectrum utilized by the incumbent BWA spectrum users. However, these incumbents have been given a maximum of one (1) year from the date of grant of their spectrum licences in order to surrender spectrum in excess of the spectrum cap for this band. Subsequent to this, a competitive licensing process can commence for the spectrum made available in this band.

7.6.12 The Spectrum Cap for the 3.5 GHz band shall be 50 MHz (i.e. equivalent to two (2) paired spectrum blocks of 25 MHz each).

7.6.13 The Licensee who is assigned spectrum blocks in 2.3 GHz, 2.5 GHz and 3.5 GHz bands shall not exceed a total Spectrum Cap of 50 MHz.

Technical Operating Conditions and Specifications

7.3.14 All spectrum users shall not exceed the maximum technical operating conditions and specifications identified in the following table, in order to operate BWA radiocommunications equipment in the 3.5 GHz band.

Table 9: Maximum Technical Operating Specifications, 3.5 GHz band, BWA Services

Parameter	Maximum Value	Comments
Maximum RF Output Power of Transmitter	Base Station – 13 dBW Fixed and Mobile Station – -3 dBW Portable(handheld) Station – -3 dBW	
Antenna Gain	Base Station – 18 dBi Fixed and Mobile Station – 6 dBi Portable(handheld) Station – 0 dBi	For every dBi gain above maximum value, RF Output Power of transmitter shall be reduced by 1 dBW.
Modulation scheme	Digital	Any digital modulation technique e.g. BPSK, QPSK
Spectrum Block Edge Spectral Density Mask Limits[3] (Channel Bandwidth equal to 5 MHz)	At Block Edge – -36 dBW/MHz 1 MHz Block Edge Offset – -77 dBW/MHz 1.75 MHz Block Edge Offset – -89 dBW/MHz	
Standardization	FCC, Industry Canada, ETSI	

Notwithstanding the parameters identified in Table 9 above, amended or additional technical operating conditions may be instituted and identified in the respective schedule of the licence document for the specific radiocommunications system deployed.

[3] Source: Electronic Communications Committee (ECC) within the European Conference of Postal and Telecommunications Administrations (CEPT), ECC Recommendations (04)05.

7.7 5 GHz Band: 5150 MHz – 5850 MHz

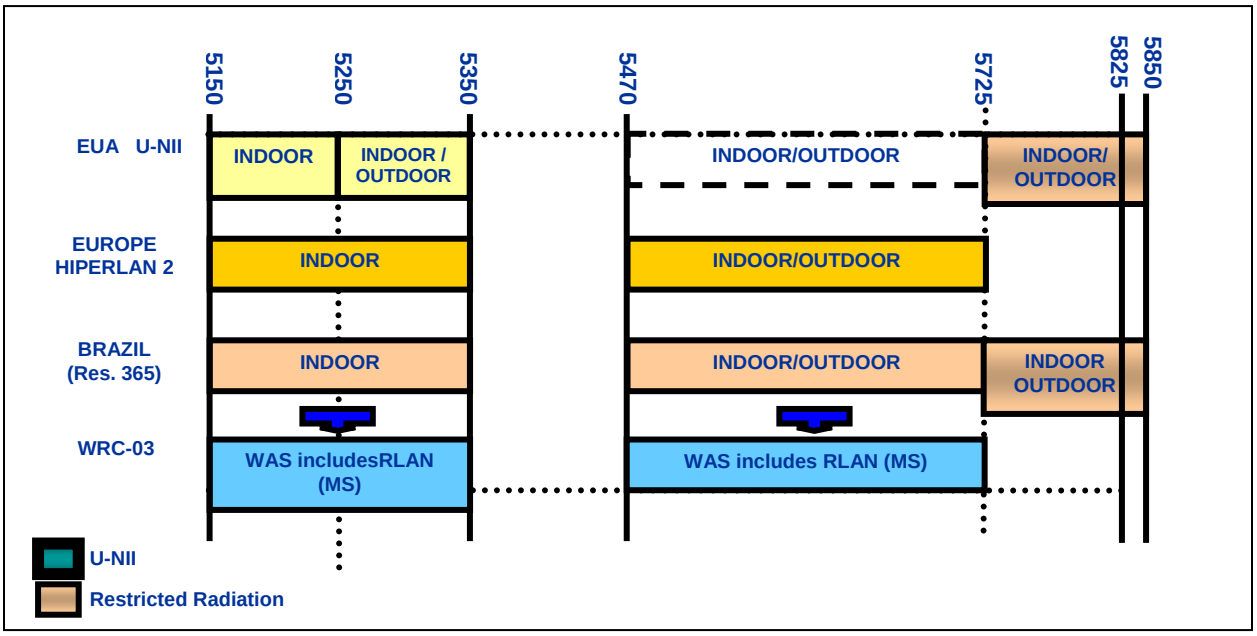
Frequency Assignment Plan

7.7.1 Similarly to the 2.4 GHz band, spread spectrum technologies such as WiFi and HiperLan are the prominent BWA technologies employed in the 5 GHz band. The emerging technologies in this band are WiMAX and the European version HiperMAN, as prescribed by the ETSI specification. These technologies are utilized to provide both private and public telecommunications services. High speed Internet services are the primary BWA services offered.

7.7.2 Similarly to the 2.4 GHz band again, the frequency assignment plan for the use of these technologies in the 5 GHz band has become a de facto standard due to the proliferation of commercially available and mass market equipment, supported by the initiatives to apply light-handed regulation and exemptions, by regulatory authorities of countries around the world.

7.7.3 In view of the above, the de facto frequency assignment plan shall be adopted for BWA radiocommunication systems in this band. The following figure illustrates this frequency assignment plan.

Figure 6: Frequency Assignment Plan for BWA Radiocommunication Systems in the 5 GHz Band



7.7.4 The defacto assignment plan for BWA technologies in this frequency range will be adopted. Therefore, the Band Plan for BWA services in the 5 GHz Band comprises the following frequency bands

- 5150 – 5250 MHz;
- 5250 – 5350 MHz;
- 5470 – 5725 MHz;
- 5725 – 5850 MHz.

Recommended Licensing Process and Conditions

7.7.5 BWA radiocommunication systems using the 5 GHz band can be used for both private or public telecommunications networks and services or broadcasting services.

7.4.11 BWA radiocommunications systems using the 5 GHz band shall only be class licensed, via a class licensing regime, under the condition that the BWA radiocommunication systems operate in accordance with the technical operating conditions and specifications identified in this Spectrum Plan, and any other term or condition stated in the class licensing regime.

7.7.6 The Authority shall institute a registration process to assist in the management of BWA radiocommunication systems used for the provision of public telecommunications and broadcasting service, in order to maintain a minimum quality of service.

7.7.7 Existing spectrum users in the 5 GHz band shall claim no protection from harmful interference from BWA radiocommunication systems allowed to operate in this band.

7.7.8 There shall be no further spectrum and station licensing for new spectrum users in the 2.4 GHz band.

Technical Operating Conditions and Specifications

7.7.9 All spectrum users shall not exceed the maximum technical operating conditions and specifications identified in the following table, in order to operate BWA radiocommunication equipment in the 5 GHz band.

Table 10: Technical Operating Specifications, 5 GHz band, BWA Services

Parameter	Maximum Value	Comments
Maximum Effective Radiated Power ERP (i.e. RF Output of Transmitter)	5150 – 5250 MHz – 23 dBm 5250 – 5350 MHz – 23 dBm 5470 – 5725 MHz – 30 dBm 5725 – 5850 MHz – 30 dBm	For frequency hopping systems employing less than 75 hopping channels ERP shall be no greater than 20.97 dBm.
Antenna Gain	5150 – 5250 MHz – 4 dBi 5250 – 5350 MHz – 4 dBi 5470 – 5725 MHz – 6 dBi 5725 – 5850 MHz – 6 dBi	For every dB gain above 6 dBi, ERP of RF transmitter shall be reduced by 1 dBm.
Modulation scheme	Digital	Any digital modulation technique e.g. BPSK, QPSK
Multiple Access technique (WiFi and WiMAX Technology)	Frequency Hopping Spread Spectrum (FHSS) Direct Sequence Spread Spectrum (DSSS) Orthogonal Frequency Division Multiplexing (OFDM)	Any other multiple access technology that can co-exist with FHSS, DSSS and OFDM systems can be employed.
Minimum Channel Bandwidth (WiFi and WiMAX Technology)	FHSS (20dB) – 25kHz DSSS (6dB) – 500kHz OFDM (20dB) – 1.25 MHz	FHSS shall use at least 75 well-defined, non-overlapping channels separated by channel bandwidth. The dwell time per channel shall not exceed 0.4s within a period of 30s
Operating Frequency Range (WiFi and WiMAX Technology)	5150 – 5250 MHz 5250 – 5350 MHz 5470 – 5725 MHz 5725 – 5850 MHz	Frequency ranges 5150 – 5250 MHz and 5250 – 5350 MHz shall be for indoor use only. Frequency ranges 5470 – 5725 MHz and 5725 – 5850 MHz can be used for wither indoor or outdoor operation.

Parameter	Maximum Value	Comments
Narrowband Transmitter mask (WiFi technology)	**Un-modulated** F_{tx} +/- 3 to 14MHz = -49dBm **Modulated** F_{tx} +/- 3 to 8MHz = -32dBm F_{tx} +/- 2 to 14MHz = -35dBm	
Transmitter Spectral Mask (WiMAX technology)	**20 MHz Channelization:** F_{tx} +/- 9.5 MHz = 0dBm F_{tx} +/- 10.9 MHz = -25dBm F_{tx} +/- 19.5MHz = -32dBm F_{tx} +/- 29.5MHz = -50dBm **10 MHz Channelization:** F_{tx} +/- 4.75 MHz = 0dBm F_{tx} +/- 5.45 MHz = -25dBm F_{tx} +/- 9.75MHz = -32dBm F_{tx} +/- 14.75MHz = -50dBm	
Transmitter spurious emission limits (WiFi Technology)	**Operating** 25MHz – 1GHz = -69dBm 1GHz to 40GHz = -63dBm **Standby** 25MHz – 1GHz = -90dBm 1GHz to 40GHz = -80dBm	
Receiver spurious emission limits (WiFi Technology)	25MHz – 1GHz = -90dBm 1GHz to 40GHz = -80dBm	
Maximum Spectral Power density (WiFi Technology)	FHSS – 1W/100kHz DSSS – 10mW/3kHz	
Standardization	FCC ETSI	

7.8 12 GHz Band: 12.2 GHz – 12.7 GHz

Frequency Assignment Plan

7.8.1 MVDDS is the prominent technology used in the provision of BWA services in the 12 GHz band. This technology provides the adequate data rate and capacity to offer subscription television broadcasting services and one-way broadband Internet access services.

7.8.2 This technology emanated from the USA and was commercialized in May 2002 (FCC Public Notice DA 02-1258) via an auction of the allocated spectrum by FCC. This auction concluded in January 2004. Each spectrum licence permitted the use of the 500MHz block of spectrum to a single spectrum user within a specified geographic service area.

7.8.3 One important condition for use of this spectrum for a terrestrial radiocommunication system such as MVDDS is the limitation to the technical operating specification to allow sharing/ co-existence with Broadcasting Satellite Service (BSS) systems. The FCC based the MVDDS to DBS sharing criterion on the Non-Geostationary Orbit Fixed Satellite Service (NGSO FSS) systems and Geostationary Orbit (GSO) BSS systems sharing specifications as recommended by the ITU-R. Equivalent Power Flux Density (EFPD) limits have been calculated for NGSO FSS and GSO BSS sharing, which have been used to allow GSO BSS and MVDDS spectrum sharing. This approach to sharing implies that there will be an area around a MVDDS transmitting site, called a mitigation zone, within which the MVDDS Operator will be responsible for avoiding or correcting harmful interference caused by its operation to a DBS subscriber in that area. This sharing criterion provides for the co-existence of MVDDS Operators and DBS Operators such as Direct TV and Echostar

7.8.4 In Trinidad and Tobago, Direct TV operates a BSS system in this frequency range providing subscription television broadcasting services (i.e. Cable TV).

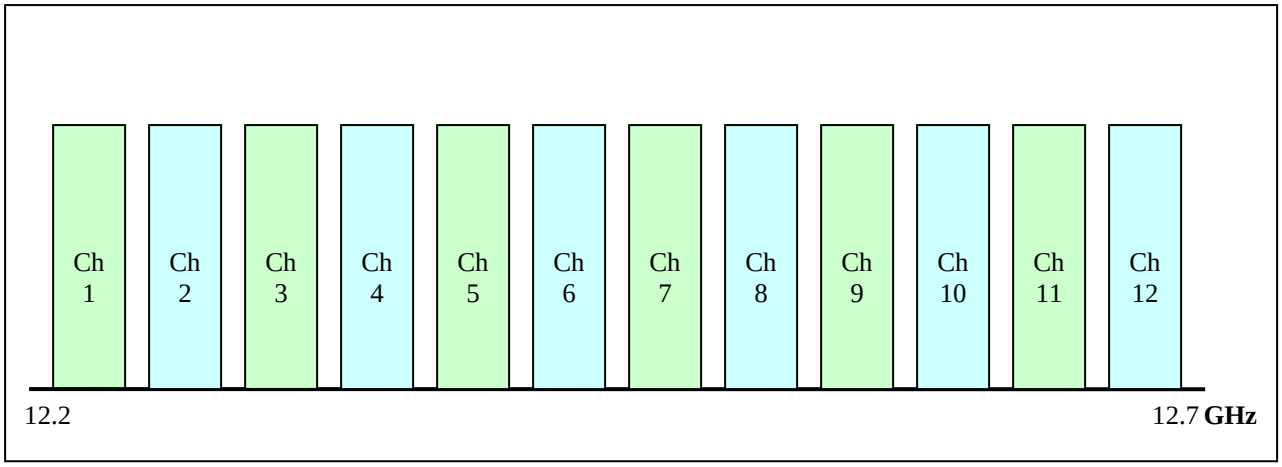
7.8.5 Notwithstanding the above licensing approach implemented by the FCC, it may not be technically or commercially practical to have more than one geographic service area. Consequently, it would not be prudent to allocate a significant quantum of spectrum to a single spectrum user. A better approach would be to offer the 500 MHz block of spectrum in a form that will allow the market to determine the number of spectrum users.

7.8.6 Considering the abovementioned discussion, the frequency assignment plan which shall be adopted for BWA radiocommunication systems in the 12 GHz band is shown in Table 9 and illustrated in Figure 7 :

Table 11: Frequency Assignment Plan for BWA Radiocommunication Systems in the 12 GHz band

Channel No#	Transmit Carrier Frequency / MHz	Channel Bandwidth /MHz
1	12,236	36
2	12,274	36
3	12,312	36
4	12,351	36
5	12,389	36
6	12,428	36
7	12,466	36
8	12,504	36
9	12,543	36
10	12,581	36
11	12,619	36
12	12,658	36

Figure 7: Frequency Assignment Plan for BWA Radiocommunication Systems in the 12 GHz Band



7.8.7 The channels identified in the adopted frequency band plan shall be vertically polarized. Notwithstanding this, spectrum users assigned to contiguous channels may choose to interleave horizontally polarization channel(s) between their assigned channels, once feasible.

Recommended Licensing Process and Conditions

7.8.8 The licensing of spectrum in the 12 GHz band for the provision of BWA services is preferred for public telecommunication and broadcasting services, on a national basis.

7.8.9 The first competitive licensing process concluded in October 2007 that resulted in the assignment of all twelve (12) spectrum blocks in this band. There is no spectrum available for licensing to new BWA spectrum users.

7.8.10 Spectrum users assigned in the 12 GHz band for the provision of BWA services using MVDDS technology shall operate on a non-harmful interference co-primary basis to Broadcasting Satellite services, i.e. Digital Broadcasting Services (DBS).

7.8.11 The Spectrum Cap for the 12 GHz band shall be 500 MHz (i.e. all twelve (12) spectrum blocks of 36 MHz each)

Technical Operating Conditions and Specifications

7.8.12 All spectrum users shall not exceed the maximum technical operating condition and specifications identified in the table below, in order to operate BWA radiocommunication equipment in the 12 GHz band.

Table 12: Technical Operating Specifications, 12 GHz band, BWA Services

Parameter	Maximum Value	Comments
Maximum Effective Isotropically Radiated Power (E.I.R.P.)	14 dBm per 24 MHz	
Polarization	Vertical	Notwithstanding this, spectrum users assigned contiguous channels may choose to interleave horizontally polarization channel(s) between their assigned channels, once feasible
Modulation scheme	Digital	Any digital modulation technique e.g. BPSK, QPSK
Standardization	FCC ETSI	

7.8.13 Notwithstanding the parameters identified in Table 12, amended or additional technical operating conditions may be instituted and identified in respective schedule of the licence document for the specific radiocommunications system deployed.

7.8.14 The frequency range 12.2 – 12.7 GHz is shared on a co-primary basis between terrestrial and broadcasting satellite services, therefore, coordination of radiocommunication system for BWA services and broadcasting satellite services will be required in accordance with the ITU-R Radio Regulations and Recommendations.

7.8.15 MVDDS fixed stations shall exist on a co-primary basis with direct broadcast satellite service in the frequency range 12.2 – 12.7 GHz. The necessary interference protection criteria shall be determined once a co-primary accommodation exists.

7.9 28 GHz Band: 25.35 GHz – 28.35 GHz

Frequency Assignment Plan

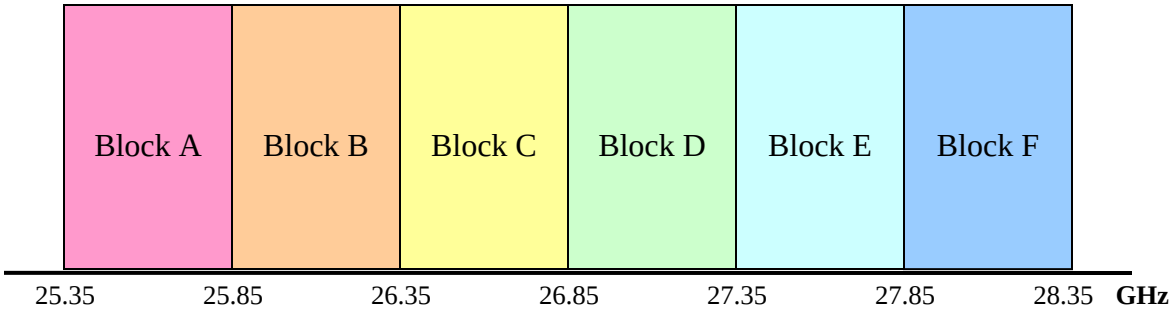
7.9.1 LMDS is the prominent technology used in the provision of BWA services in the 28 GHz band. This BWA technology can be used to offer voice telephony, broadband Internet and subscription television broadcasting services.

7.9.2 The typical bands of operation in ITU Region 1 and 2 are:

- United States of America:- 27.5 – 28.35 GHz, 29.1 – 29.35 GHz and 31.075 – 31.225 GHz;
- Canada:- 25.35 – 28.35 GHz, 24.25 – 25.25 GHz and 38.6 – 40 GHz;
- United Kingdom:- 28.05 – 29.45 GHz and 40.5 – 43.5 GHz;
- Ireland:- 24.5 – 26.5 GHz.

7.9.3 Due to the availability of spectrum in the frequency bands above 20 GHz in Trinidad and Tobago, the frequency range 25.35 GHz – 28.35 GHz can be allocated to LMDS. The following frequency assignment plan shall be adopted for BWA radiocommunication systems in the 28 GHz band.

Figure 8: Frequency Assignment Plan for BWA Radiocommunication Systems in the 28 GHz Band



7.9.4 The frequency range is divided in frequency blocks of 500MHz each, thus allowing for an estimated 100 channels per block, as identified below:

Block A:	25.35 - 25.85 GHz
Block B:	25.85 - 26.35 GHz
Block C:	26.35 - 26.85 GHz
Block D:	26.85 - 27.35 GHz
Block E:	27.35 - 27.85 GHz
Block F:	27.85 - 28.35 GHz

7.9.5 The typical assignment plan for BWA technologies in this frequency range will be adopted. Therefore, the Band Plan for BWA services in the 28 GHz Band extends from 25.35 GHz - 28.35 GHz.

Recommended Licensing Process and Conditions

7.9.6 The licensing of spectrum in the 28 GHz band for the provision of BWA services is preferred for public telecommunication and broadcasting services, on a national basis.

7.9.7 The first competitive licensing process concluded in October 2007 that resulted in no assignment of spectrum blocks in this band. Another competitive licensing

process can commence for the assignment of spectrum blocks in this band to new BWA Spectrum users.

7.9.8 The allocated spectrum in the 28 GHz band shall be licensed as six (6) 500MHz frequency blocks (i.e. blocks A, B, C, D, E and F).

Technical Operating Conditions and Specifications

7.9.9 All spectrum users shall not exceed the maximum technical operating condition and specifications identified in the table below, in order to operate radiocommunication equipment in the 28 GHz band.

Table 13: Technical Operating Specifications, 28 GHz band, BWA Services

Parameter	Maximum Value	Comments
Maximum Effective Isotropic Radiated Power (E.I.R.P.) Density	Base Station: +55 dBW per carrier frequency Subscriber (CPE) Station: +30 dBW/MHz	
Minimum Height of Intentional Radiator (Antenna) above ground	30 metres	
Modulation scheme	Digital	Any digital modulation technique e.g. BPSK, QPSK
Standardization	FCC, Industry Canada, ETSI	

7.9.10 Notwithstanding the parameters identified in Table 13, amended or additional technical operating conditions may be instituted and identified in respective

schedule of the licence document for the specific radiocommunications system deployed.

7.9.11 The frequency range 25.35 GHz - 28.35 GHz is shared on a co-primary basis between terrestrial and satellite services, therefore, coordination of radiocommunication system for BWA services and satellite services will be required in accordance with the ITU-R Radio Regulations and Recommendations.

ANNEX 1 Decisions on Recommendations Matrix

The following summarises the comments and recommendations received from stakeholders on the first draft of this document (dated 26th July 2006), and the decisions made by TATT as incorporated in this revised document (dated 11th August 2006).

Document Sub-Section	Submission Made By: Stakeholder Category[4]	Comments Received	Recommendations Made	TATT's Decisions
General				
	TSTT	The document focuses on the actual allocation plans, but ignores broader policy issues that must be addressed for the market to work efficiently. In most countries, review of the spectrum plan is coupled with a broader review of the general policies that govern spectrum usage. In this regard, TSTT highlights some of the broader issues that the Authority should consider in its spectrum plan for BWA services: Operators must have the flexibility to use spectrum in the most cost effective way. There is great uncertainty around the current viability of most emerging BWA technologies and how they will evolve over time. Any spectrum policy should therefore provide operators with the flexibility to use existing spectrum for any application/or technology based on market needs and least costs considerations – spectrum policies must be neutral and should not be tied to any one particular application.		The proposed spectrum management policy is intended to deal with the general or broad spectrum usage policies. However, the Authority will consider addressing relevant technical principles with respect to spectrum usage for BWA services.

[4] Regional regulatory or Governmental agencies, Existing service and/ or network provider and affiliates, Potential service and/ or network providers and affiliates, Service/ Network Provider Associations/ Clubs/ Groups, General Public

Document Sub-Section	Submission Made By: Stakeholder Category[4]	Comments Received	Recommendations Made	TATT's Decisions
		This includes the pairing of spectrum. For mobile services, the practices have been to pair two licenses of equal size, one for upstream (mobile to base station) and one for downstream (base station to mobile) communications. Broadband services differ from traditional mobile telephony services in that they often involve a high volume of downstream traffic – the result of consumers/users downloading large music and video files, as well as graphics-rich content – and a lower volume of upstream traffic. Given this paradigm, it may make sense to leave to the providers themselves the pairing of spectrum combinations that is used for broadband networks carrying large volumes of data traffic in addition to or instead of circuit switched voice service.		
	TSTT	Development of secondary markets for spectrum trading and sharing is essential to encourage optimal market efficiency. Secondary markets will be useful to encourage efficient/greater usage of allocated spectrum among all operators. Operators with excess or unused spectrum should have the flexibility/option – but not the obligation - to trade some this underutilized spectrum. Any rules or policies that inhibit trading of spectrum among existing carriers should be discontinued.		This matter is adequately addressed in the proposed spectrum management policy.
	TSTT	An important factor in relation to licensing BWA providers is ensuring they are subject to the same obligations as traditional forms of operators, such as fixed wired and mobile operators. The Authority should clarify that these providers will also be subjected to Universal Service Obligations, as well as provide	TSTT recommends that the Authority starts to develop and publish rules in relation to award of spectrum for BWA services, to ensure issues such as eligibility	This information will be forthcoming when the Authority announces the licensing process for the award of spectrum for BWA services.

Document Sub-Section	Submission Made By: Stakeholder Category[4]	Comments Received	Recommendations Made	TATT's Decisions
		emergency access to the extent they provide public telephone services. In addition, the Authority needs to establish clear rules governing spectrum-pricing policies, as well as eligibility restrictions, if any. Around the world, a few challenges have arisen in relation to bidding rules for WiMAX spectrum, and as such, the Authority needs to establish and publish these as soon as possible to ensure similar challenges are avoided in Trinidad and Tobago.	and obligations are clearly understood.	Noted.
	Digicel	As the Authority knows, one of the key planks of Trinidad and Tobago's national connectivity agenda which forms a part of the Government's National Information and Communication Technology (ICT) Strategy is to *"accelerate innovation, to develop a knowledge based society".* One of the key chapters in the strategy report developed as a part of the Government's *fastforward* agenda is entitled *Accelerating Social and Economic Development Through the Use of ICT.* It is in the light of this great emphasis on accelerating progress and moving forward more quickly on ICT than other countries in order to catch up with more developed nations that Digicel is very surprised to see suggestions from the Authority that it intends to place moratoriums on further development within many frequency bands. We do not believe that was the intent or		Noted.

Document Sub-Section	Submission Made By: Stakeholder Category[4]	Comments Received	Recommendations Made	TATT's Decisions
		desire of government policy. It would mean of course that the country would riot be going *fastforward* in terms of the development of broadband. The Authority appears to be suggesting that potential investors should wait until mid to late 2007 when a more detailed plan of some description has been established. However, we do not believe that developing such a plan could justify holding up investment for such a long period of time, and are skeptical that further planning will make a great deal of difference in terms of deciding what has to be done. We think that the outcome will be to unnecessarily hold up the government's *fastforward* agenda for the country. Digicel feels therefore that the Authority must move forward now on the basis of the information that is currently available. The Authority's policy document already establishes broadly what services can be offered in what bands. The Authority will never arrive at a completely watertight and perfect strategy because telecommunications services are evolving rapidly. By the time the Authority had devised what it terms a plan in 2007 technology could have moved on again and the plan could already be partly out of date. This is simply part of a never ending and accelerating cycle. Much in telecommunications technological development is uncertain and may become more so, and cannot be laid out in a predictable step by step sequence at a very detailed level for development for the future. The driver of development in broadband area will be entrepreneurs willing to take the risk of investing in particular technologies in spite of an uncertain		

Document Sub-Section	Submission Made By: Stakeholder Category[4]	Comments Received	Recommendations Made	TATT's Decisions
		future. They are best placed to establish what customers want and are prepared to pay for and therefore which technologies to invest in. We feel that this should be one of the greatest determinants in terms of what the Authority permits and takes action on in respect of spectrum usage. We believe that the most effective approach to develop the use of broadband in Trinidad and Tobago at this time, and an approach which is consistent with the *fastforward* agenda, would be to establish the level of interest from market participants in particular bands, prioritise work on those areas and then to move forward with all the resources at the Authority's disposal. If the Authority feels that it does not have a sufficient number of staff versed in this area to do the work required then it could for example hire additional staff or consultants if necessary. The alternative, which involves following the Authority's suggested approach of first developing a more detailed overall plan for all spectrum will mean that the Authority is likely to spend time working on spectrum areas in which interest is relatively minor, and will hold up investment in areas where companies are already prepared to invest whilst the Authority doing this and while the Authority's plan is finalized. As a final point in this overview section we refer the Authority to its Spectrum Management policy. As the Authority knows one of the objectives is:		

Document Sub-Section	Submission Made By: Stakeholder Category[4]	Comments Received	Recommendations Made	TATT's Decisions
		• *recovering the cost incurred in the management of spectrum and to realize an adequate economic benefit to the country for the use of spectrum resources* We feel that this objective can more readily be achieved by the approach Digicel has advocated. Competition is ready and waiting to drive broadband forward in Trinidad and Tobago. Digicel is looking to invest substantially in this area in the immediate future. Other Digicel companies have already rolled out WiMAX networks in Jamaica and in the Cayman Islands. We hope that the Authority will enable investors to move forward rapidly in this area in Trinidad and Tobago also. This can be done if those prepared to invest the most in developing the use of the spectrum are given early access to it.		Noted.
Section 5				
Table 3	**TSTT**	TSTT in its previous comments asked for the Authority to identify those parties that are currently operating in the 3.5GHz band. TSTT notes that the Authority has not identified who. TSTT is aware of only two providers operating in the 3.4 - 3.6GHz band, and has been advised that the band 3.6 – 3.7GHz is presently unoccupied. TSTT has also confirmed that the Ministry of National Security is not occupying this band at this time. TSTT refers the Authority to its Mobile Spectrum Plan where it	TSTT recommends that the Authority idenitfy which users are occupying the 3.4 – 3.8GHz band, and which portions of the band each user is occupying. In the event the 3.6 – 3.7GHz band is indeed unoccupied, TSTT strongly recommends that the Authority desist from placing a	The Authority shall identify how much of this band is currently utilized. Noted.

Document Sub-Section	Submission Made By: Stakeholder Category[4]	Comments Received	Recommendations Made	TATT's Decisions
		outlined TSTT's present and future spectrum assignment for mobile services. TSTT calls on the Authority to adopt a similar approach in relation to spectrum for BWA. TSTT reminds the Authority of its statutory obligation under the Act to make available upon request, the terms of a licence, which includes the frequency bands assigned under that licence. TSTT cannot understand what purpose the Authority is serving by not identifying or disclosing whether any party is occupying the 3.6 – 3.7GHz band, as requested by TSTT. If this band is indeed unavailable, the Authority should license this spectrum immediately in support of Government's objectives, rather than refusing to let parties have access to this spectrum. How does the Authority expect the industry to ***fastforward*** broadband takeup, if the Authority itself hoards available and desirable broadband spectrum? Furthermore, what is the Authority's preoccupation with moratoriums, particularly if spectrum for broadband is available?	moratorium on available spectrum, and proceed immediately to license this spectrum for the delivery of BWA services.	
	TSTT	There have been recent developments in relation to WiMAX, proposing that the 2.3 – 2.4GHz and 3.3 – 3.4GHz bands can also be used for WiMAX services. For example, see page 8 of www.**intel**.com/netcomms/technologies/**wimax**/313900.pdf, where Intel is the primary WiMAX CPE vendor. Note that all proposed bands are TDD in nature.	TSTT recommends that the 2.3 – 2.4GHz and the 3.3 – 3.4GHz bands also be allocated for BWA.	Noted. The Authority shall consider this request within the ITU-R Radio Regulations Table of Frequency Allocations.
Section 6				

Document Sub-Section	Submission Made By: Stakeholder Category[4]	Comments Received	Recommendations Made	TATT's Decisions
6.2.3 The remaining channels 60 – 69 (746 – 806MHz) have been allocated to public health and safety Fixed and Mobile Services.	**TSTT**	This is incorrect. TSTT draws to the Authority's attention that only channels 63, 64 (764-776MHz) paired with channels 68 and 69 (794 – 806MHz) have been allocated for public health and safety (see http://wireless.fcc.gov/publicsafety/700MHz/ and attached upper 700MHz FCC spectrum plan, which clearly outlines the public safety spectrum). The remaining channels (60, 61, 62, 65, 66 and 67) have been allocated for BWA and AWS. It is important that the allocation is correctly identified to ensure that only the spectrum that equipment will be manufactured in for public safety will be allocated for public safety.	TSTT recommends that this statement be corrected as to what spectrum has been allocated in the US for public safety, so that only the spectrum necessary for public safety in T&T, and no more, will be allocated for those purposes here. The remaining spectrum (channels 60 – 62, 65 – 67) can then correspondingly be allocated for BWA. This statement should read: "Channels 63, 64, 68 and 69 have been allocated to public health and safety, and the remaining channels 60 –62, 65 – 67 have been allocated for fixed and mobile services under the Upper 700MHz plan"	Noted. The appropriate revision shall be made to the text. However, the Authority shall consider the allocation of the upper 700 MHz band for commercial services.
6.2.5 In Canada, only channels 60 – 69 have been allocated to public health and safety Fixed and Mobile Services, due to the high occupancy of licensees on	**TSTT**	This is similarly incorrect. TSTT submitted in its Expression of Interest the October 2004 Spectrum Utilization Policy (SP-746MHz pages 4 - 11, attached for ease of reference) of Industry Canada in relation to the 746 – 806MHz band. This policy also speaks to only allocating channels 63, 64, 68 and 69 for public	TSTT recommends that this statement be corrected as to what spectrum has been allocated in the US for public safety, so that only the spectrum necessary for public	Noted. The appropriate revision shall be made to the text. However, the Authority shall consider the allocation of the upper 700 MHz band for commercial services.

Document Sub-Section	Submission Made By: Stakeholder Category[4]	Comments Received	Recommendations Made	TATT's Decisions
the television UHF channels 52 – 59. It is envisaged that the advancements in Digital Television broadcasting will reduce the number of 'free-to-air' television broadcasting channels, thus allowing further reallocation of the television UHF channels to other radiocommunication services.		health and safety.	safety in T&T, and no more, will be allocated for those purposes here. The remaining spectrum (channels 60 – 62, 65 – 67) can then correspondingly be allocated for BWA. This statement should read: "In Canada, only channels 63, 64, 68 and 69 have been allocated to public health and safety Fixed and Mobile Services, due to the high occupancy of licensees on the television UHF channels 52 – 59, while the remainder of channels from 60 – 67 have been allocated for Mobile services on a primary basis"	
6.2.7 and Table 5	**TSTT**	As these technologies in the 700MHz are now emerging, and are not widespread or globally harmonized, it is far too early to tie operators to using a particular FDD approach and channel assignment. Operators would need the flexibility to use this spectrum in the most cost effective way to meet market demand, and may not be able to conform to the strict channeling plans being defined by the Authority, where commercial equipment may not even be available, particularly where Time Division	TSTT recommends that the spectrum in the 700MHz band simply be channelized into 6MHz spectrum blocks, without specifying uplink and downlink at this time.	Noted. The Authority shall explicitly include that the option of TDD assignment of spectrum, but wishes to maintain the FDD option of assignment.

Document Sub-Section	Submission Made By: Stakeholder Category[4]	Comments Received	Recommendations Made	TATT's Decisions
		Duplex (TDD) equipment is becoming very commonplace for broadband services so that operators can configure their upload requirements.		
6.3.8 There shall be a moratorium on spectrum and station licensing of new spectrum users in this band and existing users shall claim no protection from harmful interference from BWA radiocommunication systems operating in this band.	**TSTT**	Why would a moratorium be placed on spectrum and station licensing, if the Authority intends to class license this band?	TSTT recommends that the Authority simply proceed to class-license this band, as WiFi devices have already proliferated the environment.	This section has been revisited to offer more clarity.
6.4.4 The band 2150 – 2162MHz shall also be made available for users in this band as an uplink path from customer terminal equipment to service provider base stations	**TSTT**	TSTT strongly opposes this recommendation. 3G spectrum for mobile services has been allocated and assigned globally. 3G spectrum allocations include the 2110 – 2170MHz band allocated by Region 1 and Region 3 countries for the Universal Mobile Telecommunications Services (UMTS) downlink, and the 2110 – 2155MHz band allocated by Region 2 for Advanced Wireless Services (AWS) downlink. These are globally harmonized bands for 3G services, and the Authority can expect that each of the existing three mobile operators, as well as any prospective mobile operator in the future, would require access to this band at some stage to provide 3G services, either using UMTS or AWS technology. The allocation of this band for an uplink path would compromise such an allocation for 3G services in the future, particularly as it places an uplink band	TSTT believes the proposal for the inclusion of an uplink band 2150 – 2162MHz should be removed. This would adversely compromise harmonization of Trinidad and Tobago's 3G spectrum with the entire world, and is unnecessary as a wide cross-section of BWA systems operate in TDD mode.	Noted. The Authority shall re-consider this allocation, along with the need to cater for other technologies than WiMAX in this band and the need for allocation of additional spectrum for public domestic mobile telecommunications services.

Document Sub-Section	Submission Made By: Stakeholder Category[4]	Comments Received	Recommendations Made	TATT's Decisions
		within the 3G-downlink spectrum. In contrast, this uplink allocation is anything but universal. Surely, this uplink is not being used in North America, Europe or Australia, as these countries have allocated this spectrum for 3G services as described above. Hence, this allocation for uplink bandwidth is either an allocation for obsolete technology, or has only been adopted in a small niche of jurisdictions, which surely a globally harmonized allocation for 3G services outweigh. Furthermore, examining the trends in relation to contemporary BWA systems, particularly WiMAX, TDD equipment is becoming more prevalent, as it allows the operator to adjust its uplink capacity based upon demand, whereas FDD allocations represent a static assignment. Hence, an uplink band is far from necessary as far as BWA is concerned. It must be added that the bands being identified by the WiMAX Forum (http://www.wimaxforum.org/news/downloads/ WiMAX_Forum_Regulatory_Whitepaper_v08092004.pdf) for BWA or Intel (www.**intel**.com/netcomms/technologies/**wimax**/313900.pdf) does not include this sub-band allocation.		

Document Sub-Section	Submission Made By: Stakeholder Category[4]	Comments Received	Recommendations Made	TATT's Decisions
6.5.7 The Authority expects to develop a plan to address the licensing within the proposed frequency band plans in the next twelve (12) months, due to the unavailability of sufficient spectrum within the frequency band plan ranges. The Authority anticipates that during this period, consultation will be held with existing and new users to investigate spectrum availability, ensure that there is efficient use and develop any necessary refarming/ migration plans. Until then, a moratorium shall be placed on the licensing in those ranges of the 3.5 GHz band to new spectrum users.	**TSTT**	This consultation can be held immediately and prior to release of the third version of this Plan, given the urgency expressed by the Government to have Broadband rolled out to the population of Trinidad and Tobago. Why should the Spectrum Plan be finalized and then the consultation held? Why can a consultation not be held during the month of August to determine the occupancy of the various bands, particularly the WiMAX bands, so that the revised version would reflect the outcome of the consultation? This consultation would take no more than a single day session. This would be far more effective and productive for all of the key stakeholders, and may eliminate the need for placing a moratorium on any bands unnecessarily.	TSTT recommends that a consultation session be held during the month of August and prior to release of the finalized version of the Spectrum Plan for BWA, so that spectrum that can be made available immediately can in fact be included in the finalized plan.	Noted.
6.6.8 There shall be a moratorium on spectrum and station licensing of new spectrum users in this band and existing users shall claim no protection from harmful interference from BWA	**TSTT**	Why would a moratorium be placed on spectrum and station licensing, if the Authority intends to class license this band?	TSTT recommends that the Authority simply proceed to class-license this band, as 5.8GHz networks and devices have already proliferated the environment.	This section has been revisited to offer more clarity.

Document Sub-Section	Submission Made By: Stakeholder Category[4]	Comments Received	Recommendations Made	TATT's Decisions
radiocommunication systems operating in this band.				
	Digicel	There is no mention of the 2.3Ghz band, which has been assigned to Wireless Communication Service ("WCS") in the USA and is used extensively in ASIA for wireless broadband services predominately WiMAX. The characteristics of 2.3Ghz with its, propagation and in building coverage makes it ideal for wireless broadband services. The FCC has allocated the following ranges: 2305-2320 MHz and 2345-2360 MHz. It should be noted that many of the prominent mobile WiMAX providers are developing base stations and CPE for this band and it is on the roadmap of profiles to be certified by the WiMAX forum. Intel's announced Rosedale 2 chipset will support the 2.3-2.5Ghz band for both 802.16d (fixed) and 802.16e (mobile). Therefore Digicel proposes that the Authority adds this frequency to its proposed frequency band plans for BWA.		Noted. The Authority shall consider this request within the ITU-R Radio Regulations Table of Frequency Allocations.
Section 6.4	**Digicel**	We feel that interest in the 2.5 to 2.6 GHz band is likely to be considerable and that the Authority should therefore focus immediately on the efficient allocation and usage of spectrum in this area. No moratorium should be countenanced that being the case.		Noted.
Section 6.4.2	**Digicel**	802.16e (Mobile WiMax) was ratified in December 2005. Release-1 Mobile WiMAX profiles will cover 5, 7, 8.75, and 10 MHz channel bandwidths for licensed worldwide spectrum allocations in the 2.3 GHz, 2.5 GHz, and 3.5 GHz frequency bands. As such Digicel propose the frequency bands in both 2.3		Noted. This will be considered when spectrum can be made available.

Document Sub-Section	Submission Made By: Stakeholder Category[4]	Comments Received	Recommendations Made	TATT's Decisions
		and 2.5 are adjusted to the 5 and 7Mhz channel bandwidths for optimum spectrum efficiency. Based on TATT current allocation of 194MHz of spectrum it can be divided up into 29*5Mhz and 7*7Mhz channels.		
Section 6.5	**Digicel**	We can also envisage that there is likely to be considerable interest in the 3.4 to 3.8 GHz band and that the Authority should also start work immediately on efficient allocation and usage of spectrum in this band if that is the case, and that a moratorium would therefore not be sensible.		The moratorium shall be in place only until spectrum can be made available, then the moratorium shall end, this spectrum plan shall be modified and the licensing of new spectrum users can commence.