



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

Table of Contents

MAINTENANCE HISTORY	II
TABLE OF CONTENTS	III
EXECUTIVE SUMMARY	1
1 BACKGROUND	4
2 OBJECTIVES	7
3 REVIEW CYCLE.....	8
4 THE CONSULTATION PROCESS	8
5 CONSIDERATIONS FOR THE PROVISION OF BWA SERVICES	9
6 PROPOSED FREQUENCY BAND PLANS FOR BWA SERVICES.....	17
6.1 400 MHz BAND: 410 – 430 MHz & 450 – 470 MHz.....	18
6.2 700 MHz BAND: 698 MHz – 746 MHz.....	20
6.3 2.4 GHz BAND: 2400 MHz – 2483.5 MHz	24
6.4 2.5 GHz BAND: 2495 MHz – 2690 MHz	28
6.5 3.5 GHz BAND: 3.4 GHz – 3.8 GHz.....	30
6.6 5 GHz BAND: 5150 MHz – 5850 MHz	32
6.7 12 GHz BAND: 12.2 GHz – 12.7 GHz.....	37
6.8 28 GHz BAND: 25.35 GHz – 28.35 GHz.....	41
ANNEX 1 DECISIONS ON RECOMMENDATIONS MATRIX	44

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	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. Until then, a moratorium shall be placed on the licensing in those ranges of the 400 MHz band to new spectrum users.
Multichannel Video Distribution and IP Services	698 – 746 MHz	A competitive licensing process will commence immediately after this spectrum plan and the associated licensing procedures are approved.
Wireless Fidelity (WiFi)	2400 – 2483.5 MHz	Radiocommunication equipment will be class licensed in this band. This will include a registration process to assist in the management of BWA radiocommunication systems used for the provision of public telecommunications and broadcasting services.
Multipoint Multichannel Distribution Service (MMDS), Worldwide Interoperability for Microwave Access (WiMAX)	2495 – 2690 MHz	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. Until then, a moratorium shall be placed on the licensing in those ranges of the 2.5 GHz band to new spectrum users.

BWA Technology	Frequency Range of Operation	Licensing Approach
Worldwide Interoperability for Microwave Access (WiMAX) Fixed Wireless Access Time Division Duplexing (TDD) and Frequency Division Duplexing (FDD) Systems	3400 – 3800 MHz	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. Until then, a moratorium shall be placed on the licensing in those ranges of the 3.5 GHz band to new spectrum users.
Wireless Fidelity (WiFi), HiperLAN, HiperMAN Worldwide Interoperability for Microwave Access (WiMAX)	5150 – 5250 MHz 5470 – 5725 MHz 5725 – 5850 MHz	Radiocommunication equipment will be class licensed in this band. This will include a registration process 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	A competitive licensing process will commence immediately after this spectrum plan and the associated licensing procedures are approved.
Local Multipoint Distribution Service (LMDS)	25.35 – 28.35 GHz	A competitive licensing process will commence immediately after this spectrum plan and the associated licensing procedures are approved.

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 this spectrum plan.

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 first consultation phase (Refer to Annex I for the Decisions on Recommendations matrix (DOR)).

The second consultation phase will take place over a period to be prescribed by the Authority.

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 assigning spectrum to users.

The following BWA technologies and their respective operating frequency ranges were identified from a review of current literature of technologies 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: BWA Technologies Deployed Globally 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
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 – 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 Occupancy
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 spectrum occupancy in the 450 – 470 MHz range is high due to existing users of conventional land mobile, SCADA and point-to-point radiocommunications systems.
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.

BWA Technology	Frequency Range of Operation	Trinidad and Tobago Frequency Allocation Table	Current Spectrum Occupancy
Wireless Fidelity (WiFi)	2400 – 2483.5 MHz	<p>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:</p> <ul style="list-style-type: none"> • 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. <p>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.</p>	<p>Within the range 2400 – 2483.5 MHz there are an estimated three (3) existing users, operating fixed point-to-point radiocommunication systems.</p> <p>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.</p>
Multipoint Multichannel Distribution Service (MMDS), Worldwide Interoperability for Microwave Access (WiMAX)	2495 – 2690 MHz	<p>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. As a result, the frequency range 2495 - 2690 MHz can be allocated to BWA services.</p>	<p>The spectrum occupancy in the 2495 - 2690 MHz range is high due to existing users of BWA radiocommunication systems. Spectrum cannot be made available to new users at this time.</p>

BWA Technology	Frequency Range of Operation	Trinidad and Tobago Frequency Allocation Table	Current Spectrum Occupancy
<p>Worldwide Interoperability for Microwave Access (WiMAX) Fixed Wireless Access Time Division Duplexing (TDD) and Frequency Division Duplexing (FDD) Systems</p>	<p>3400 – 3800 MHz</p>	<p>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:</p> <ul style="list-style-type: none"> • 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. <p>Due to the Fixed Service allocation in these bands, the frequency range 3400 – 3800 MHz can be allocated to BWA services.</p>	<p>The spectrum occupancy in the 3400 - 3800 MHz range is high due to existing users of BWA radiocommunication systems. Spectrum cannot be made available to new users at this time</p>
<p>Wireless Fidelity (WiFi)</p>	<p>5150 – 5250 MHz</p>	<p>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</p>	<p>The recommended Licensing approach can be implemented immediately.</p>

BWA Technology	Frequency Range of Operation	Trinidad and Tobago Frequency Allocation Table	Current Spectrum Occupancy
		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	<p>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:</p> <ul style="list-style-type: none"> • 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. <p>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.</p>	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 Occupancy
		<p>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.</p>	
<p>Multichannel Video Distribution and Data Services (MVDDS)</p>	<p>12.2 – 12.7 GHz</p>	<p>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.</p>	<p>The recommended Licensing approach can be implemented immediately.</p>
<p>Local Multipoint Distribution Service (LMDS)</p>	<p>25.35 – 28.35 GHz</p>	<p>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</p>	<p>The recommended Licensing approach can be implemented immediately.</p>

BWA Technology	Frequency Range of Operation	Trinidad and Tobago Frequency Allocation Table	Current Spectrum Occupancy
		<p>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:</p> <ul style="list-style-type: none"> • 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. <p>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.</p>	

6 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.

6.1 400 MHz Band: 410 – 430 MHz & 450 – 470 MHz

Frequency Band Plan

- 6.1.1 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.
- 6.1.2 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 CITELE project, in collaboration with the local regulator ANATEL. CITELE’s final recommendation was to consider the use of CDMA 450 at 410 – 430 MHz and 450 – 470 MHz where possible by its members.
- 6.1.3 In view of the above, the sub-class A and sub-class D band plans shall be adopted for the operation of radiocommunication systems that employ the CDMA 450 Technology. The table below identifies the adopted frequency band plans:

Table 4: Frequency Band Plan, BWA Services, 400MHz 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

- 6.1.2 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.
- 6.1.3 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 400 MHz band to new spectrum users.

Technical Operating Conditions and Specifications

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

6.2 700 MHz Band: 698 MHz – 746 MHz

Frequency Band Plan

- 6.2.1 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.
- 6.2.2 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.
- 6.2.3 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. The remaining channels 60 – 69, i.e. 746 – 806 MHz have been allocated to public health and safety Fixed and Mobile Services.
- 6.2.4 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

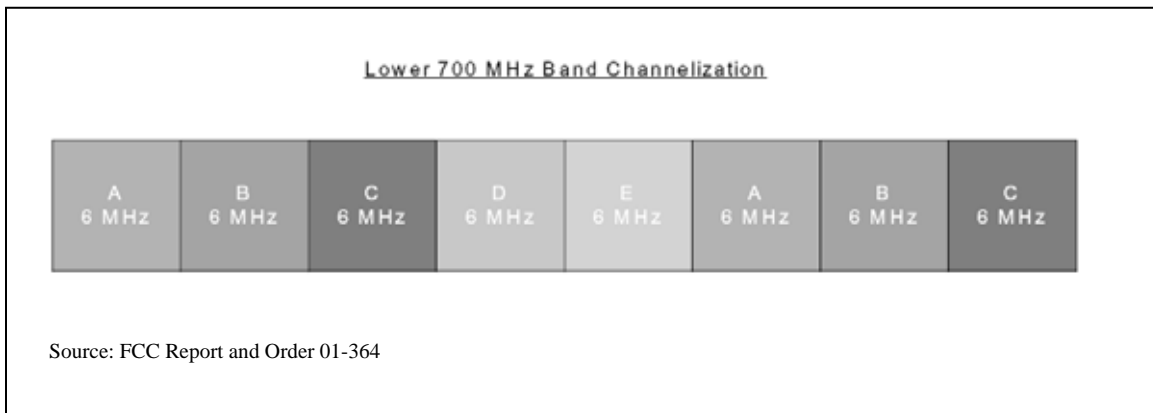
services and other BWA services. Currently in the USA, spectrum in this band has been allocated to two service providers, in accordance with the proposed assignment plan, for mobile broadcasting services (e.g. Qualcomm's MediaFlo (Block D: FLO); Hiwire (Block pair C:DVB-H))

- 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 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.
- 6.2.6 It is anticipated that equipment will be available commercially in the near future, in conformance with the FCC band plan. Also, the FCC band plan provides for both broadcast and bi-directional radiocommunication systems.
- 6.2.7 In view of the aforementioned, the FCC frequency band plan shall be adopted to allow for the deployment of BWA radiocommunication systems in this band. The adopted band plan is identified in Table 5 and illustrated in Figure 1.

Table 5: Frequency Band Plan, BWA Services, 700MHz Band

Block	Subscriber CPE Transmit Frequency / MHz	Base Station Transmit Frequency / MHz
A	698 – 704	728 – 734
B	704 – 710	734 – 740
C	710 – 716	740 – 746
D		716 – 722
E		722 – 728

Figure 1: UHF Frequency Band Plan for Subscription Broadcasting and BWA Services



Recommended Licensing Process and Conditions

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

6.2.9 Frequency assignment to new spectrum users shall be via a competitive licensing process.

6.2.10 The allocated spectrum in the 700 MHz band shall be licensed as three (3) 6MHz duplex frequency blocks (i.e. blocks A, B and C) and two (2) 6MHz frequency blocks (i.e. blocks D and E).

Technical Operating Conditions and Specifications

6.2.11 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 700 MHz band.

Table 6: Maximum Technical Operating Specifications, 700 MHz band, BWA Services

Parameter	Maximum Value	Comments
Maximum Effective Radiated Power (E.R.P.)	Fixed Station – 1kW Mobile Station – 30 W Portable(handheld) Station – 3W	
Modulation scheme	Digital	Any digital modulation technique e.g. BPSK, QPSK
Standardization	FCC	

6.2.12 Notwithstanding the parameters identified in Table 6, 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.

6.3 2.4 GHz Band: 2400 MHz – 2483.5 MHz

Frequency Band Plan

6.3.1 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.

6.3.2 The frequency band 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.

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

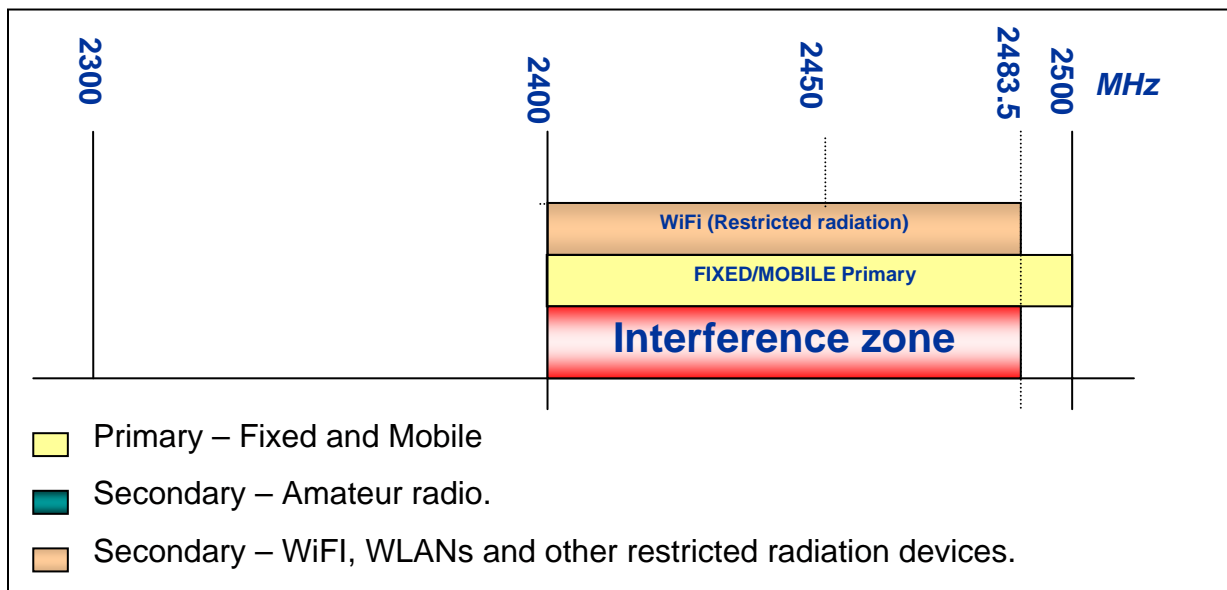


Figure 2: 2.4 GHz Frequency Band Plan for BWA Services

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

Recommended Licensing Process and Conditions

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

6.3.6 The spectrum allocated in the 2.4 GHz band shall be shared amongst spectrum users, via a class licensing regime.

6.3.7 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.

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.

Technical Operating Conditions and Specifications

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

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

Parameter	Maximum Value	Comments
Peak Output power of Intentional Radiator	200mW	
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 can be employed other than FHSS and DSSS, provided that they can co-exist.
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	
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	

Parameter	Maximum Value	Comments
Wideband Transmitter spurious emission limits	<p>Operating 30MHz – 1GHz = -86dBm/Hz 1GHz to 12.75GHz = -80dBm/Hz</p> <p>Standby 30MHz – 1GHz = -107dBm/Hz 1GHz to 12.75GHz = -97dBm/Hz</p>	
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	

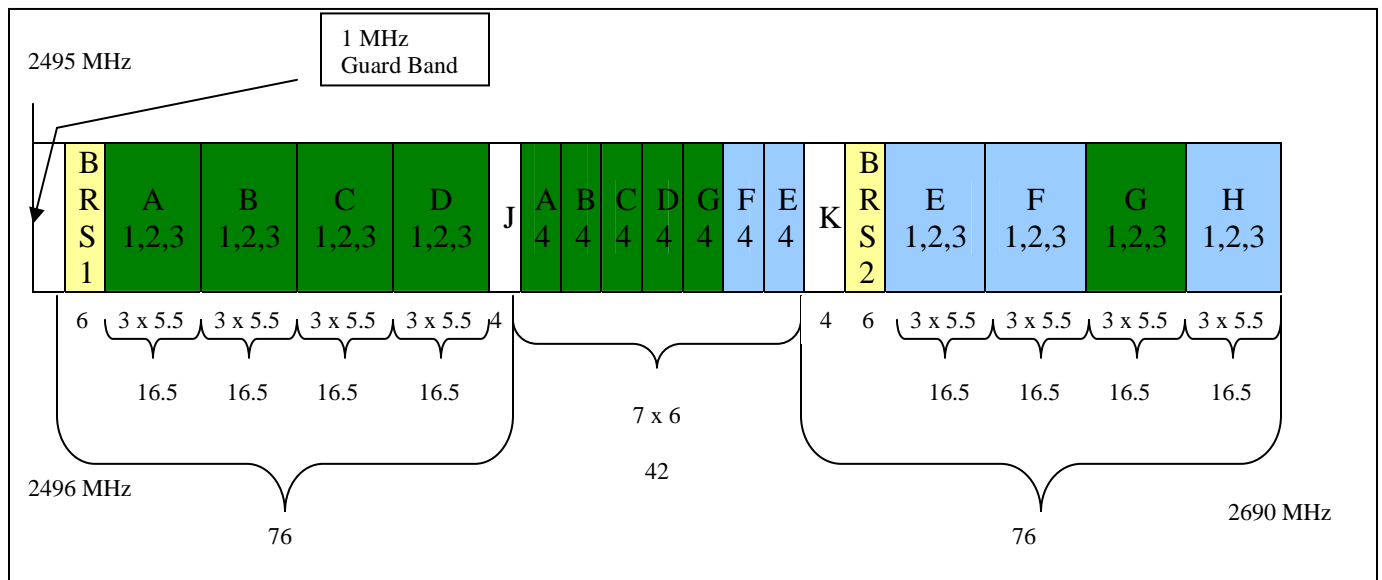
6.4 2.5 GHz Band: 2495 MHz – 2690 MHz

Frequency Band Plan

6.4.1 MMDS is the prominent technology used in the provision of BWA services in the 2.5 GHz Band. Emerging technologies in this band are WiMAX, as prescribed by the IEEE 802.16e specification, and specifications under the IMT-2000 family of air interface specifications. High speed Internet access services are primarily provided using these technologies, for both private and public uses. MMDS and WiMAX can also be used to provide private WAN networks.

6.4.2 This frequency band plan based on the MMDS technology shall be adopted for BWA radiocommunication systems in the 2.5 GHz band. The figure below illustrates the adopted band plan.

Figure 3: 2.5 GHz Frequency Band Plan for BWA Services



6.4.3 The typical Band Plan for BWA technologies in this frequency range will be adopted. Therefore, the Band Plan for BWA services in the 2.5 GHz Band ranges from 2495 MHz – 2690 MHz.

6.4.4 The band 2150 – 2162 MHz shall also be made available for users in this band as an uplink path from customer terminal equipment to service provider base stations.

Recommended Licensing Process and Conditions

6.4.5 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.

6.4.6 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 2.5 GHz band to new spectrum users.

Technical Operating Conditions and Specifications

6.4.7 The technical operating conditions and specifications for radiocommunication systems operating in the 2.5 GHz band shall be indicated when the licensing moratorium has ended.

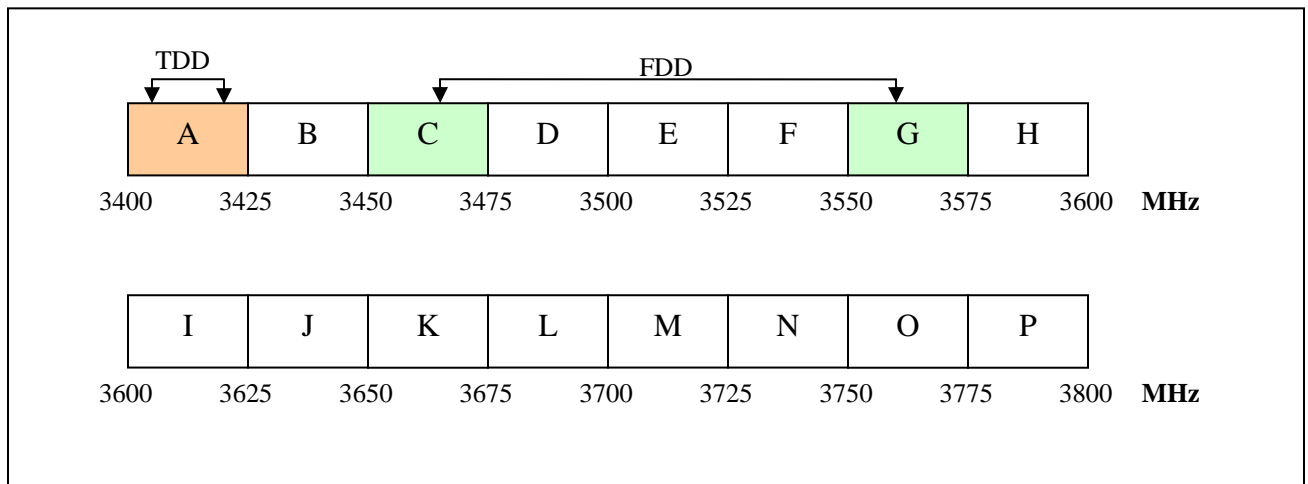
6.5 3.5 GHz Band: 3.4 GHz – 3.8 GHz

Frequency Band Plan

6.5.1 The BWA technologies which traditionally occupied the 3.5 GHz band were fixed wireless access TDD and FDD radiocommunications systems. However, WiMAX, as prescribed by the IEEE 802.16e specification, has grown to be the popular technology to be employed in this band henceforth.

6.5.2 The frequency band plan based on the use of WiMAX technology shall be adopted for BWA radiocommunication systems in the 3.5 GHz band. The typical frequency band plan for the assignment of spectrum in the frequency range 3.4 – 3.8 GHz is illustrated in Figure 4 below.

Figure 4: 3.5 GHz Frequency Band Plan for BWA Services



6.5.3 The frequency range is divided in frequency blocks of 25MHz each. This arrangement allows the assignment of blocks to facilitate Frequency Division Duplex (FDD) radiocommunications systems, utilizing a frequency duplex spacing of 100 MHz (e.g. – Block C paired with Block G. Time Division Duplex

(TDD) systems or IEEE 802.16 (WiMAX) systems may operate in any 25 MHz block (e.g. Block A).

6.5.4 The typical Band Plan for BWA technologies in this frequency range will be adopted. Therefore, the Band Plan for BWA services in the 3.5 GHz Band extends from 3400 MHz – 3800 MHz.

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

- 3400 – 3700 MHz – Fixed and Mobile Services shall remain as co-primary but Fixed Satellite Services shall operate on a secondary basis. This implies that Fixed and Mobile radiocommunication services shall be given preference to operate over Fixed Satellite Services.
- 3700 – 3800 MHz – Fixed Satellite Services shall remain as primary but Fixed and Mobile Services shall operate on a secondary basis. This implies the Fixed Satellite radiocommunication services shall be given preference to operate over Fixed and Mobile Services.

Recommended Licensing Process and Conditions

6.5.6 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.

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.

Technical Operating Conditions and Specifications

6.5.8 The technical operating conditions and specifications for radiocommunication systems operating in the 3.5 GHz band shall be indicated when the licensing moratorium has ended.

6.6 5 GHz Band: 5150 MHz – 5850 MHz

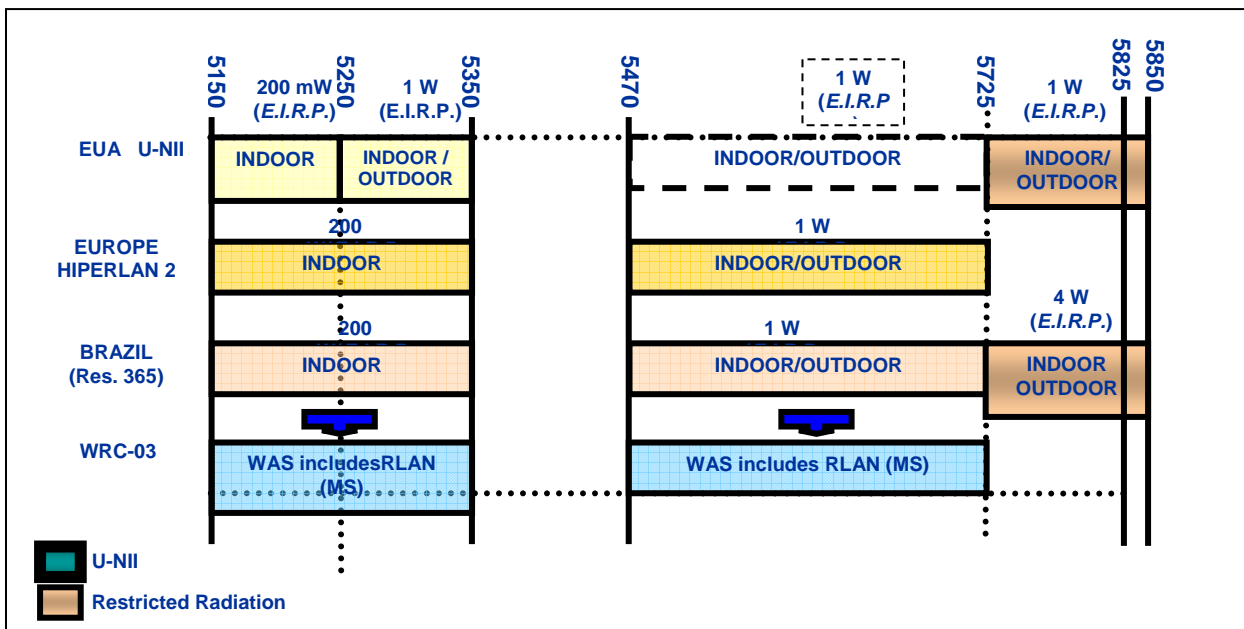
Frequency Band Plan

6.6.1 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.

6.6.2 Similarly to the 2.4 GHz band again, the frequency band 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.

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

Figure 5: 5 GHz Frequency Band Plan



6.6.4 The typical Band 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

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

6.6.6 The spectrum allocated in the 5 GHz band shall be shared amongst spectrum users, via a class licensing regime.

6.6.7 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.

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 radiocommunication systems operating in this band.

Technical Operating Conditions and Specifications

6.6.9 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 8: Technical Operating Specifications, 5 GHz band, BWA Services

Parameter	Maximum Value	Comments
Peak Output power of Intentional Radiator	5150 – 5250 MHz – 200 mW 5250 – 5350 MHz – 200 mW 5470 – 5725 MHz – 1 W 5725 – 5850 MHz – 1 W	
Modulation scheme	Digital	Any digital modulation technique e.g. BPSK, QPSK

Parameter	Maximum Value	Comments
Multiple Access technique (WiFi and WiMAX Technology)	Frequency Hopping Spread Spectrum (FHSS) Direct Sequence Spread Spectrum (DSSS) Orthogonal Frequency Division Multiplexing (OFDM)	
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	
Narrowband Transmitter mask (WiFi technology)	Un-modulated $F_{tx} \pm 3$ to 14MHz = -49dBm Modulated $F_{tx} \pm 3$ to 8MHz = -32dBm $F_{tx} \pm 2$ to 14MHz = -35dBm	
Transmitter Spectral Mask (WiMAX technology)	20 MHz Channelization: $F_{tx} \pm 9.5$ MHz = 0dBm $F_{tx} \pm 10.9$ MHz = -25dBm $F_{tx} \pm 19.5$ MHz = -32dBm $F_{tx} \pm 29.5$ MHz = -50dBm 10 MHz Channelization: $F_{tx} \pm 4.75$ MHz = 0dBm $F_{tx} \pm 5.45$ MHz = -25dBm $F_{tx} \pm 9.75$ MHz = -32dBm $F_{tx} \pm 14.75$ MHz = -50dBm	

Parameter	Maximum Value	Comments
Transmitter spurious emission limits (WiFi Technology)	<p>Operating 25MHz – 1GHz = -69dBm 1GHz to 40GHz = -63dBm</p> <p>Standby 25MHz – 1GHz = -90dBm 1GHz to 40GHz = -80dBm</p>	
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	

6.7 12 GHz Band: 12.2 GHz – 12.7 GHz

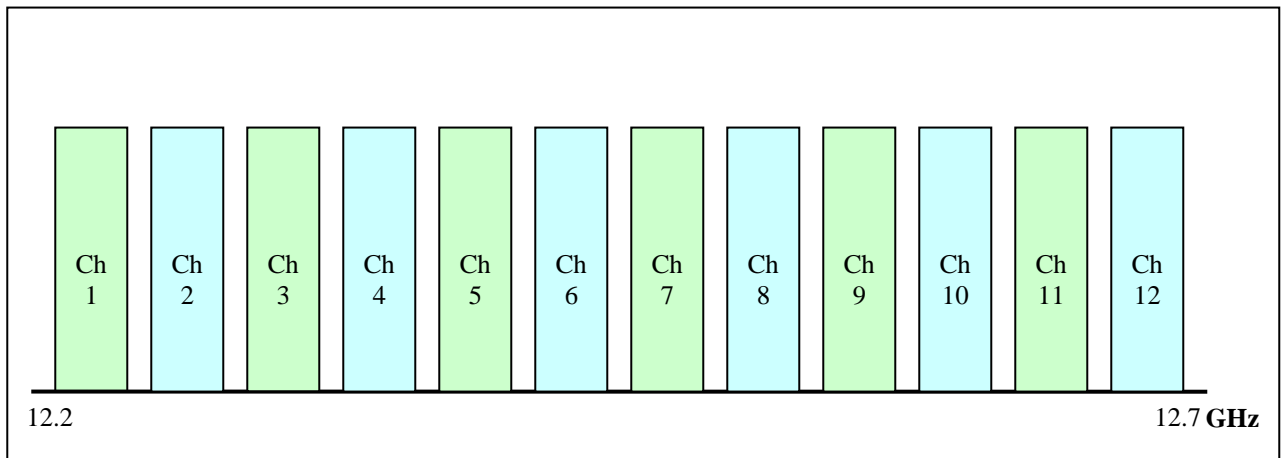
Frequency Band Plan

- 6.7.1 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.
- 6.7.2 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.
- 6.7.3 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.
- 6.7.4 Considering the abovementioned discussion, the frequency band plan which shall be adopted for BWA radiocommunication systems in the 12 GHz band is shown in Table 9 and illustrated in Figure 6 :

Table 9: Frequency Band 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 6: Frequency Band Plan for BWA Radiocommunication Systems in the 12 GHz band



6.7.5 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

6.7.6 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.

6.7.7 Assignment to a spectrum user shall be via a competitive licensing process.

6.7.8 The allocated spectrum in the 12 GHz band shall be licensed on a per channel basis, however, a spectrum user can be assigned more than one(1) channel.

Technical Operating Conditions and Specifications

6.7.9 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 10: Technical Operating Specifications, 12 GHz band, BWA Services

Parameter	Maximum Value	Comments
Maximum Effective Isotropically Radiated Power (E.I.R.P.)	-16dBW per 36 MHz	
Polarization	Vertical	Notwithstanding this, spectrum users assigned contiguous channels may choose to interleave horizontally polarization channel(s) between their assigned channels, once feasible

Parameter	Maximum Value	Comments
Modulation scheme	Digital	Any digital modulation technique e.g. BPSK, QPSK
Standardization	FCC ETSI	

6.7.10 Notwithstanding the parameters identified in Table 10, amended or additional technical operating conditions may be instituted and identified in respective schedule of the licence document for the specific radiocommunications system deployed.

6.7.11 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.

6.7.12 MVDDS fixed stations shall exist on a co-primary basis with non-geostationary satellite orbit fixed satellite services and 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.

6.8 28 GHz Band: 25.35 GHz – 28.35 GHz

Frequency Band Plan

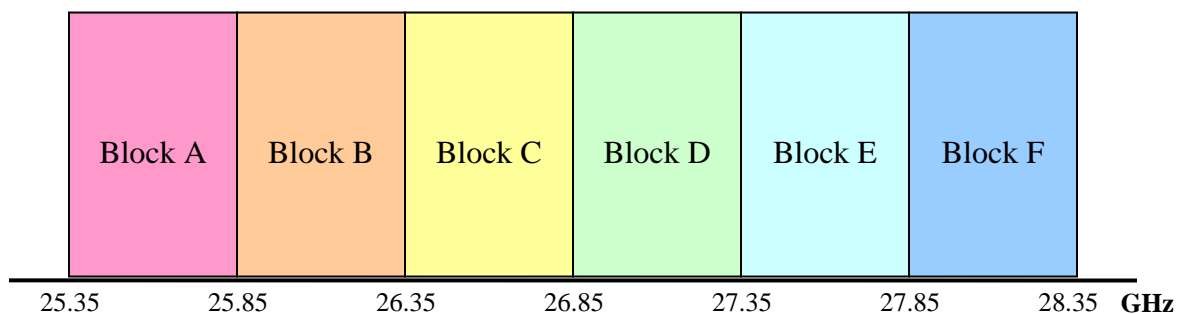
6.8.1 LMDS is the prominent technology used in the provision of BWA services in the 28 GHz band. This BWA technology can be used to offer voice telephony, broadband Internet and subscription television broadcasting services.

6.8.2 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.

6.8.3 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 band plan shall be adopted for BWA radiocommunication systems in the 28 GHz band.

Figure 7: 28 GHz Typical Band Plan



6.8.4 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

6.8.5 The typical Band 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

6.8.6 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.

6.8.7 Assignment to a spectrum user shall be via a competitive licensing process.

6.8.8 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

6.8.9 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 11: Technical Operating Specifications, 28 GHz band, BWA Services

Parameter	Maximum Value	Comments
Maximum Effective Isotropically 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 ETSI	

6.8.10 Notwithstanding the parameters identified in Table 11, amended or additional technical operating conditions may be instituted and identified in respective schedule of the licence document for the specific radiocommunications system deployed.

6.8.11 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 March 23rd 2006), and the decisions made by TATT as incorporated in this revised document (dated July 26th 2006).

Document Sub-Section	Submission Made By: Stakeholder Category¹	Comments Received	Recommendations Made	TATT's Decisions
General				
	Ministry of Public Administration and Information	There should be a presentation of the BWA spectrum issues to be discussed, with specific questions posed to stakeholders.		The Authority shall consider this for BWA spectrum issues that cannot be adequately addressed via the consultation phase.
Section 1				
Background	Ministry of Public Administration and Information	<ul style="list-style-type: none"> • Mention should be made that Gov't has produced a strategy to fast-track the deployment of broadband and that this spectrum plan is one part of achieving that strategy. • There should be a discussion of alternate broadband access technologies, with emphasis on the reasons for adopting wireless methods. It should also be clearly stated that this approach will be executed now while 		Agreed.

¹ 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 Category¹	Comments Received	Recommendations Made	TATT's Decisions
		alternative approaches are being discussed and finalized.		
Section 5				
Section 5 (Considerations for the Provision of BWA Services)	TSTT	The Strategic Planning of spectrum use is a key regulatory instrument which must be developed and deployed for the resolution of the two main challenges of spectrum management i.e. availability and access for use. There are distinct advantages for Trinidad & Tobago in adopting measures to harmonize the international use of the radio spectrum.	The Authority should clearly state its position on harmonization as the strategies proposed have adhered to and departed from the “global communications approach.” In the event that TATT is supportive of the international harmonization measures, then the Authority should clearly provide that rationale when it departs from its overall strategy.	This plan reflects the strategic statements made in the proposed Spectrum Management Policy. For clarity, a statement to this effect shall be included in this section.
Section 6				
Section 6.1 (400 MHz Band)	TSTT	1. The allocation of non-standard and uncommon band such as the 410 – 430 MHz band for 400 MHz BWA would not be appropriate. Operators in Trinidad and Tobago would have to procure customized and non-standard requirement for both their base stations and subscriber devices. As a consequence, subscribers would be unable to travel and procure these devices. This is in essence removing the advantages of standardized and commercially available off-the-shelf	1. TSTT recommend that a moratorium be placed on the 450 MHz particularly the 452.5 – 457.5 MHz paired with the 462.5 – 467.5 MHz spectrum.	Noted. Please refer to the Section 6.1 in the revised Spectrum Plan in response to your comment and recommendation.

Document Sub-Section	Submission Made By: Stakeholder Category¹	Comments Received	Recommendations Made	TATT's Decisions
		<p>equipment from the providers in Trinidad & Tobago.</p> <p>2. Telecommunications Services of Trinidad & Tobago Limited is cognizant of the potential conflict in spectrum of FRS/GMRS use at 450 MHz. However, as low-end use should not deter the economic benefits of wireless broadband services being rolled out nationwide. The FRS/GMRS radios also operate in the guard bands of the CDMA spectrum allocation as the CDMA 450 BTS carriers actually operate from 463.375 MHz – 467.065 while the GMRS carriers transmit up to 462.725 MHz or start from 467.55 MHz. Therefore, interference should be minimal.</p>	<p>2. It is recommended that the proceeds from the licensing process for the 450 MHz should be used to fund the relocation of existing users.</p> <p>3. TSTT recommends that in addition to placing a moratorium, the Authority should establish a timeline for relocating users and making the spectrum available in two (2) years for BWA.</p>	<p>Noted.</p> <p>Agreed.</p>
Section 6.2 (700 MHz Band)	TSTT	TSTT fully agrees with the allocation of the 700 MHz band for Broadband Wireless Access. However, TSTT believes that the Authority should not necessarily specify whether the spectrum should be paired (bi-directional) or not. In keeping with the principle of a spectrum license, the operator should have the flexibility, particularly where the technology in this band is still nascent and the operator should be able to use the band for the most efficient and commercially viable purpose. However, the present band plan simply adopted the United States Band Plans even though the US has not auctioned bands A,	TSTT therefore recommends that the 698 – 746 MHz band be allocated in eight, 6 MHz blocks with full freedom of use allocated to the licensee. Thus enabling the provision of asymmetric broadband services, multi-channel video distribution and mobile video services in the Trinidad and Tobago market.	Noted. Please refer to the Section 6.2 in the revised Spectrum Plan in response to your comment and recommendation.

Document Sub-Section	Submission Made By: Stakeholder Category¹	Comments Received	Recommendations Made	TATT's Decisions
		B and E, and there have been no deployment of technological solutions for bands A, B, C and E.		
Section 6.3 (2.4 GHz Band)	TSTT	TSTT endorses both the adoption of class licensing of the 2.4 GHz band and the proposed maximum power output levels for equipment used in this band.	TSTT recommends that in relation to access schemes that flexibility be allowed for new access schemes for example Orthogonal Frequencies Division Modulation (OFDM).	Any other multiple access technology can be employed other than FHSS and DSSS, provided that they can co-exist.
Section 6.3 (2.4 GHz Band)	Open Telecom Limited	We are concerned with the issuing of Class Licence for this band	We recommend that if this band is being used to offer Public Services that it require a Concession to ensure Public experiences are properly regulated by TATT.	It is proposed that the equipment in this band is class licensed because the Radiocommunication equipment is a low interference potential device and it is a mass market product. However, in the event that this equipment is used to provide public telecommunication services or broadcasting services, a Concession will be required.
Section 6.4 (2.5 GHz Band)	TSTT	TSTT agrees with the allocation of the band for Broadband Wireless Access. However, the redistribution of existing users should be incorporated in the spectrum plan. TSTT notes that there are existing users in this band. However, the Spectrum Plan is silent on the	TSTT recommends that if the current users in this band include Public Health and Safety organizations and/or National Security, that these operators be identified for use in the Public Health and Safety bands identified in the 380 – 400 MHz or the upper 700 MHz band as	Noted. Please refer to the Section 6.4 in the revised Spectrum Plan in response to your comment and recommendation.

Document Sub-Section	Submission Made By: Stakeholder Category¹	Comments Received	Recommendations Made	TATT's Decisions
		Authority's approach in addressing the current users.	proposed by the Federal Communications Commission.	
Section 6.4 (2.5 GHz Band)	Open Telecom Limited	How long is the proposed moratorium going to be? What considerations will be given to existing operators? Any proposals for these bands will adversely affect present and future planned investments.	Give preference to existing operators. Investigate the use of other bands to offers BWA services (i.e. 700MHz)	Noted. Please refer to Section 6.4 of the revised Spectrum Plan in response to your comment and recommendation.
Section 6.4 (2.5 GHz Band)	Trini Diffusion Management Service Limited	Missing: 2150 MHz – 2162 MHz These frequencies are presently recognized around the world as frequencies assigned to wireless operators to provide wireless internet service to customers. These frequencies are used for the return path from customers back to the internet provider. DOCSIS modems are readily available. A Frequency Band Plan as shown in the document enclosed herewith would be preferred for digital TV transmission, 2500 – 2686 MHz divided into Thirty-one (31) 6 MHz Bandwidth Channels. Transmitters used for Digital MMDS Services today are already designed to Transmit Audio/Video over a 6MHz Bandwidth starting as 2500 MHz.		Noted. The Authority shall modify the document accordingly. Noted.

Document Sub-Section	Submission Made By: Stakeholder Category¹	Comments Received	Recommendations Made	TATT's Decisions
Section 6.5 (3.5 GHz Band)	Open Telecom Limited	How long is the proposed moratorium going to be? What considerations will be given to existing operators? Any proposals for these bands will adversely affect present and future planned investments.	Give preference to existing operators. Investigate the use of other bands to offers BWA services (i.e. 700MHz)	Comments and recommendation noted. Please refer to Section 6.5 of the revised Spectrum Plan in response to your comment and recommendation.
Section 6.5 (3.5 GHz Band)	TSTT	TSTT is aware that the 3.6 – 3.7 GHz band is presently available based upon the outcome of its spectrum scans. As the Authority is aware, the World Trade Organization (WTO) Reference Paper on Telecommunications stipulates that frequency bands publicly available should be published. The Telecommunications Act 2001 also requires the Authority to make licenses available for the public upon request. The precedent was also established when during the mobile spectrum auction process: the bands used by TSTT for mobile services were published. TSTT strongly advises the Authority to refrain from allocation of the 3.7 – 3.8 GHz band for Broadband Wireless Access as there are numerous C-Band and VSAT users. In addition, TSTT's Earth Station also operates in this band.	TSTT recommends that the Authority identify and publish the current users of the 3.4 – 3.8 GHz (National Security exempted) and thereby indicate whether the 3.6 – 3.7 GHz band is available. TSTT recommends that the Authority immediately implement a licensing process for the 3.6 – 3.7 GHz band to enable the licensing of additional Broadband Wireless Access providers, particularly with the emergence of WiMax technology.	Noted. Please refer to the Section 6.5 in the revised Spectrum Plan in response to your comment and recommendation. Noted. Please refer to the Section 6.5 in the revised Spectrum Plan in response to your comment and recommendation. Noted. Please refer to the Section 6.5 in the revised Spectrum Plan in response to your comment and recommendation.

Document Sub-Section	Submission Made By: Stakeholder Category¹	Comments Received	Recommendations Made	TATT's Decisions
Section 6.5 (3.5 GHz Band)	Trini Diffusion Management Service Limited	Discussions will be held with the Licensees in this Band with a view to implement a more efficient use of the band. The recommended Licensing approach can be implemented at a later date.	We would rather have 3800 – 4200 MHz than 3400 – 3800 MHz.	The Authority shall investigate the availability of equipment and co-existence feasibility of the associated technologies, considering that this band is the Space-Earth allocation for Fixed Satellite Services.
Section 6.6 (5 GHz Band)	TSTT	TSTT endorses the class licensing approach to the 5 GHz band with the exception of 5.47 – 5.725 GHz band to facilitate the deployment of licensed WiMax services in this band.	TSTT recommends that the power levels of equipment in band 5.47 – 5.725 GHz be increased to accommodate 10 W.	The Authority disagrees with TSTT's recommendation as such high power levels may harmfully interfere with the other radiocommunication services that share this band.
Section 6.6 (5 GHz Band)	Open Telecom Limited	We are concerned with the issuing of Class Licence for this band.	We recommend that if this band is being used to offer Public Services that it require a Concession to ensure Public experiences are properly regulated by TATT.	It is proposed that this band is class licensed because the Radiocommunication equipment is a low interference potential device and it is a mass market product. However, in the event that this equipment is used to provide public telecommunication services or broadcasting services, a Concession will be required.
Section 6.7 (12 GHz Band)	TSTT	TSTT has no objection to the proposed allocation of this band.	TSTT recommends that this band be divided to create two bands as the current allocation represents a significant amount of our national resource for a single operator.	Noted. Please refer to Section 6.7 in the revised Spectrum Plan in response to your comment and recommendation.

Document Sub-Section	Submission Made By: Stakeholder Category¹	Comments Received	Recommendations Made	TATT's Decisions
		TSTT is concerned that his band is at a high frequency and hence would be affected by matters as rainfall, foliage and indoor coverage thereby making the band possibly somewhat unattractive.		Noted.
Section 6.7 (12 GHz Band)	Trini Diffusion Management Service Limited	The recommended Licensing approach can be implemented immediately	We would rather have 10.7 – 11.2 GHz or 11.2 – 11.7 than 12.2 – 12.7 GHz	The frequency band 10.7 – 11.7 GHz is currently allocated to Fixed Point-to-Point Radiocommunication systems. There are existing spectrum users in this band.
Section 6.8 (28 GHz Band)	TSTT	TSTT has no objection to the proposed allocation of this band. TSTT is concerned that his band is at a high frequency and hence would be affected by matters as rainfall, foliage and indoor coverage thereby making the band possibly somewhat unattractive.	TSTT recommends that this band be divided to create two bands as the current allocation represents a significant amount of our national resource for a single operator.	As indicated in the Spectrum Plan, the 28GHz band has been divided in six (6) blocks for possible assignment to up to six (6) users.
	Ministry of Public Administration and Information	TATT may consider including rollout obligations and reserving rights to re-allocate the spectrum pending non-fulfillment of the obligations. However, the process of competitive bidding is time consuming and increases the cost of the spectrum. TATT may consider some alternate approach for allocation of the spectrum in the 700MHz, 12GHz and 28GHz bands and linking the same with the		Agreed. Rollout obligations are an integral part of all concessionaires' obligations, as identified in their Concession document. When demand is greater than supply, as is the case for most of the spectrum in question, a competitive process has to be employed to fairly and transparently

Document Sub-Section	Submission Made By: Stakeholder Category¹	Comments Received	Recommendations Made	TATT's Decisions
		rollout obligations.		assign the spectrum resource. The competitive process employed can either be an auction, beauty contest, or a hybrid. A competitive process does not increase the cost of spectrum but rather achieve the market price for spectrum. Also, any process will consume time if it is to be done fairly and transparently, especially if it is done in an environment for the first time. An alternate approach to a competitive process is lottery or a combination of a pre-qualification and then a lottery. The Authority shall consider the advantages of this alternative and whether it will still achieve the objectives of the process.
	Ministry of Public Administration and Information	There should be a discussion of the assignment approaches adopted in other jurisdictions.		Agreed. Please refer to the revised BWA Plan for the Authority's response.
	Ministry of Public Administration and Information	There should be an identification of the current status of the relevant frequency bands in T&T that have been identified for BWA.		Agreed. Please refer to the revised BWA Plan for the Authority's response.
	Ministry of Public Administration and Information	What are the expected timeframes for the moratoria placed on the 400MHz, 2.5GHz, and 3.5GHz bands?		Please refer to the revised BWA Plan for the Authority's response.