



Spectrum Plan for the Accommodation of Public Mobile Telecommunications Services

Maintenance History		
Date	Change Details	Version
01-08-04	Approved Version	1.0
30-09-08	Revised Version – Plan updated: <ul style="list-style-type: none"> • Based on conclusion of the competitive licensing process for the introduction of new public mobile telecommunications service concessionaires, which concluded in June 2005. 	2.0
06-11-12	Consultative document including the 700 MHz frequency allocation for cellular mobile radiocommunications service.	2.1
06-02-13	Revised Consultative document based on comments received from first round of consultation.	2.2
24-04-13	Revised Consultative document based on comments received from second round of consultation.	2.3
26-06-13	Revised Version – Plan Updated: <ul style="list-style-type: none"> • Based on consultation to include 700 MHz spectrum for the provision of public mobile telecommunications services. 	3.0

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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, 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, the Authority considered spectrum bands for Broadband Wireless Access (BWA) Technologies and licensed spectrum users accordingly.

In light of the development of new cellular mobile technologies, such as Long Term Evolution (LTE) and the identification of frequency bands for International Mobile Telecommunications (IMT) by the International Telecommunications Union, Radiocommunications Bureau (ITU-R), there are new opportunities for cellular mobile operators to deploy 3G and 4G networks and capitalize on the services that can be offered, namely mobile broadband.

This document seeks to firstly identify the optimal frequency bands of operation deployed globally and, in particular, by ITU-R Region 2 countries, taking into consideration the cellular mobile technologies deployed today. Secondly, it summarizes the results of an analysis of the current spectrum occupancy for the associated frequency bands in Trinidad and Tobago. Finally, it utilizes the above information to propose frequency band plans for the provision of public mobile telecommunications services and indicates the appropriate licensing process for the assignment of spectrum to cellular mobile operators.

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

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

Frequency Range of Operation	Available Cellular Mobile Technologies	Licensing Approach
<p>700 MHz Band : 698 – 806 MHz (i.e. 704 -716 MHz ; 734 – 758 MHz and 776 – 788 MHz)</p>	<p align="center">LTE</p>	<p>A competitive process shall be used to assign spectrum in this band.</p> <p>48 MHz of spectrum is available in the 700 MHz band for the provision of public mobile telecommunications service.</p> <p>The minimum assignment shall be 12 MHz (i.e. 2x6 MHz or one (1) spectrum package).</p> <p>The Spectrum Cap for the 700 MHz band shall be 24 MHz (i.e. 2x12 MHz) for the available spectrum.</p> <p>There shall also be a limitation to the combinations of spectrum packages for assignments of 24 MHz. The two (2) spectrum packages are limited to Package 1a with 1b or Package 2a with 2b.</p>
<p>850 MHz Band: 824 – 896 MHz (i.e. 824 – 849 MHz and 869 – 894 MHz)</p>	<p align="center">GSM, CDMA, GPRS, EDGE CDMA 2000 EvDO, UMTS, HSPA(+), LTE</p>	<p>A competitive process shall be used to assign available spectrum in this band.</p> <p>12 MHz is currently available in this band for assignment for the provision of public mobile telecommunications services.</p> <p>The minimum assignment shall be 10 MHz, i.e. 2 x 5 MHz. Additionally, the minimum assignment shall be accompanied by a quantum of spectrum for guard bands (no less than 2 x 1 MHz).</p> <p>The Spectrum Cap for the 850 MHz band shall be 10 MHz, i.e. 2 x 5 MHz. Additionally, each 2 x 5 MHz assignment shall be accompanied by a quantum of spectrum for guard bands (not to exceed 2 x 2.5 MHz).</p>

Frequency Range of Operation	Available Cellular Mobile Technologies	Licensing Approach
<p>1900 MHz Band: 1880 – 1990 MHz (i.e. 1880 – 1930 MHz and 1950 – 1990 MHz)</p>	<p>GSM, CDMA, GPRS, EDGE CDMA 2000 EvDO, UMTS, HSPA(+), LTE</p>	<p>A competitive process shall be used to assign available spectrum in this band.</p> <p>40 MHz is currently available in this band for assignment for the provision of public mobile telecommunications services.</p> <p>The minimum assignment shall be 10 MHz (i.e. 2 x 5 MHz).</p> <p>The Spectrum Cap for the 1900 MHz band shall be 40 MHz for the available spectrum.</p>

1 Introduction

In keeping with the Government of the Republic of Trinidad and Tobago's National Information and Communications Technology 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, the Authority considered spectrum bands for Broadband Wireless Access (BWA) Technologies and licensed spectrum users accordingly.

The Telecommunications Authority of Trinidad and Tobago (hereinafter called "the Authority") conducted an authorisation process (from September 2004 to June 2005) to introduce two (2) new entrants into the public mobile telecommunications market. Out of this process, Digicel (Trinidad and Tobago) Limited and LaqTel Limited were authorized to provide public mobile telecommunications services, in addition to the incumbent. Unfortunately, the spectrum that was licensed to LaqTel Limited was reclaimed and its concession revoked, as it was not able to launch service in the allotted timeframe. This reclaimed spectrum is now available for a new entrant, via an authorisation process determined by the Authority. Digicel (Trinidad and Tobago) Limited continues to compete against TSTT in this marketplace to-date.

The Authority carried out a competitive process in 2008 in order to introduce a third mobile operator into the market. However, there were no successful applicants from that process and, consequently, there was no assignment of spectrum. The mobile sector currently comprises two (2) cellular mobile operators, the Telecommunications Services of Trinidad and Tobago (TSTT) and Digicel (Trinidad and Tobago) Limited. The cellular mobile technologies employed in this sector to-date are GSM, GPRS, EDGE, CDMA 2000 EvDO, HSPA and HSPA+.

In light of the development of new cellular mobile technologies, such as Long Term Evolution (LTE) and the identification of frequency band for International Mobile Telecommunications (IMT) by the International Telecommunications Union, Radiocommunications Bureau (ITU-R), there are new opportunities for cellular mobile operators to deploy 3G and 4G networks and capitalize on the services, that can be offered, namely mobile broadband.

This document seeks to firstly identify the optimal frequency bands of operation deployed globally and, in particular, by ITU-R Region 2 countries, taking into consideration the cellular mobile technologies deployed today. Secondly, it summarizes the results of an analysis of the current spectrum occupancy for the associated frequency bands in Trinidad and Tobago. Finally, it utilizes the above information to propose frequency band plans for the provision of public mobile telecommunications services and indicate the appropriate licensing process for the assignment of spectrum to users.

This document is a subset of the National Spectrum Plan¹ and should be considered as part of the entire National Spectrum Plan. The National Spectrum Plan provides a framework to regulate the efficient use of spectrum, in an orderly manner, in accordance with the Authority's mandate.

¹ The Authority's National Spectrum Plan is available on the Website at <http://www.tatt.org.tt>
Telecommunications Authority of Trinidad and Tobago
June 2013

2 Objectives

The objectives of this spectrum plan are to:

1. Identify the frequency ranges which will be allocated to the provision of public mobile telecommunications services, in accordance with the market and sector interests;
2. Indicate the suitable 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 radiocommunications systems in the allocated frequency ranges.

3 Review Cycle

This document will be modified periodically to meet changing technological service requirements. 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 should be directed to the Authority at technical@tatt.org.tt.

4 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 in order to make an additional frequency allocation for the provision of public domestic mobile telecommunications networks and services.

The document was 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 period of the first round of consultation, which was originally set as four (4) weeks, was extended to a total of six (6) weeks, based on requests made by the existing cellular mobile operators.

The consultative document was further revised with considerations to the comments and recommendations made in the second consultation phase (Refer to Annex II for the Decisions on Recommendations matrix (DOR)). The period of the second round of consultation, which was originally set as four (4) weeks, was also extended to a total of six (6) weeks, based on requests made by the existing cellular mobile operators.

5 Other Relevant Documents

In addition to the National Spectrum Plan, other relevant policies, plans and regulations prepared by the Authority that should be read in addition to the Spectrum Plan for the accommodation of public mobile telecommunications services include the following:²

- Framework for the Authorization of Telecommunications Networks and Services and Broadcasting Services in Trinidad and Tobago;
- Spectrum Management Framework;
- Draft Radio Spectrum Regulations;
- National Spectrum Management Plan;
- Trinidad and Tobago Frequency Allocation Table (9 kHz – 1000 GHz);
- Fee Methodology; and
- Telecommunications (Fees) Regulations.

² All available on the Authority's Website at <http://www.tatt.org.tt>
Telecommunications Authority of Trinidad and Tobago
June 2013

6 Considerations for the Accommodation of Public Mobile Telecommunications Services

6.1 Global Environment

Public mobile technologies have evolved greatly with a new generation of technology released approximately every decade. The technological evolution is shadowed by a synonymous evolution in spectrum use. **Figure 1** shows the evolution of cellular mobile technologies, depicting the frequencies and channel bandwidth used by these technologies.

Fourth generation (4G) technologies are the latest evolution in the cellular mobile technology. In markets where 4G networks are deployed, they operate in parallel to earlier generation technologies, in many cases, in parallel to both 2nd generation (2G) and 3rd generation (3G) technologies. Therefore planning must consider spectrum allocation for all current generations of technologies.

The International Telecommunications Union (ITU) has defined spectrum for International Mobile Telecommunications (IMT) for the provision of public mobile telecommunications networks and services such as traditional mobile telephony and, more recently, mobile data services, including mobile broadband. The table below lists the various frequency bands identified for IMT.

Table 2 : Frequency Band Identified for IMT

Band (MHz)	Radio Regulations footnotes identifying the band for IMT
450–470	5.286AA
698–960	5.313A, 5.317A
1 710–2 025	5.384A, 5.388
2 110–2 200	5.388
2 300–2 400	5.384A
2 500–2 690	5.384A
3 400–3 600	5.430A, 5.432A, 5.432B, 5.433A

Source: ITU-R, IMT-Advanced standards for mobile broadband communications

Figure 1 and Table 3 below summarise the spectrum allocations for 2G, 3G and 4G networks deployed in the International Telecommunications Union, Radiocommunications Bureau (ITU-R) Region 2 territories.

Figure 1: Illustration of Frequency Allocations for 2G, 3G and 4G cellular Mobile Networks

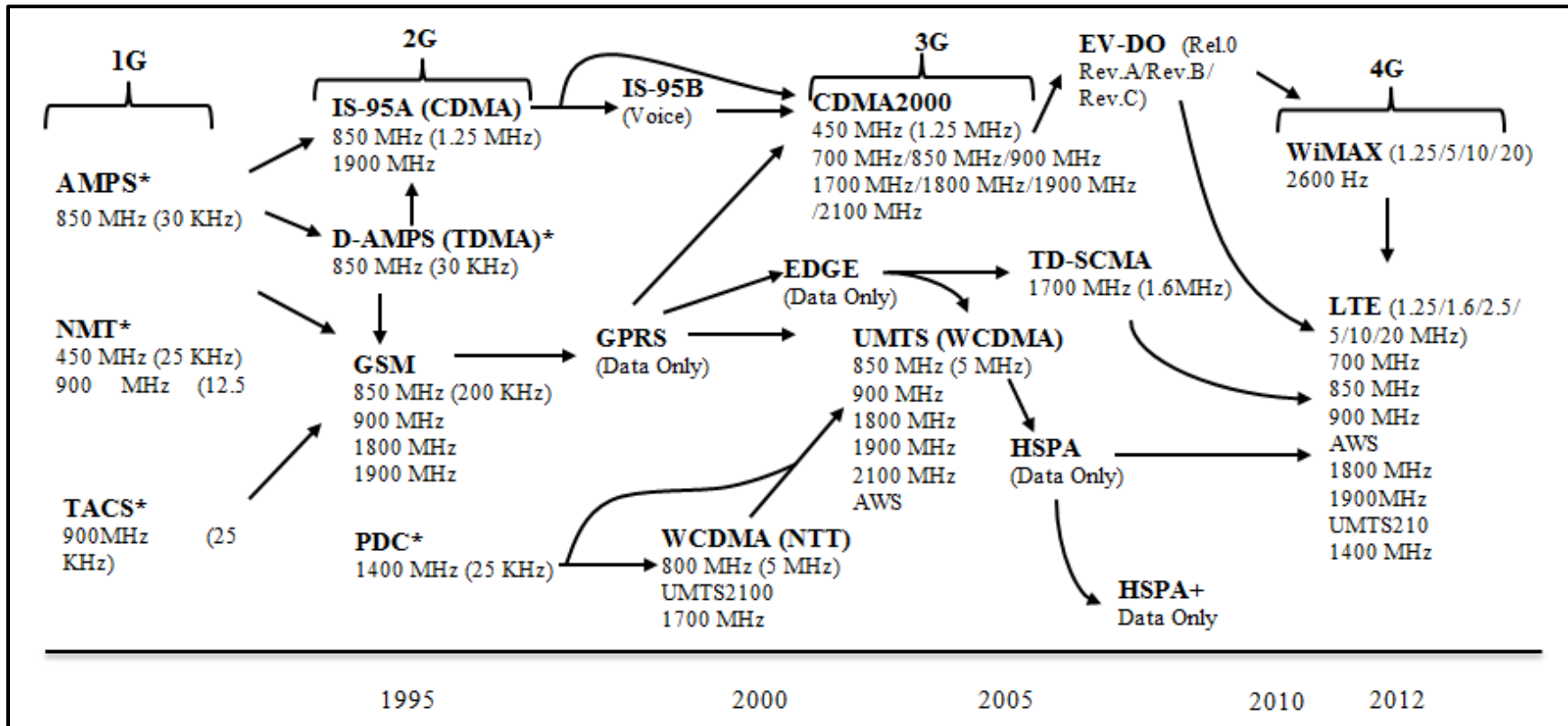


Table 3: Frequency Allocations for 2G, 3G and 4G cellular Mobile Networks

Generation	Available Technologies	Frequency	Remarks
2G	Global System for Mobile Communications (GSM) General Packet Radio Service (GPRS) Enhanced Data Rates for GSM Evolution (EDGE)	<ul style="list-style-type: none"> • 850MHz (824 – 849/869 – 894MHz). • 1900MHz (1850 – 1910/1930 – 1990MHz). 	GSM Networks are actively used for voice services throughout the region, in conjunction with its data enhancements GPRS and EGDE, and with other more recent generations of data services.
	IS-95 (CDMA)	<ul style="list-style-type: none"> • 850MHz (824 – 849/869 – 894MHz) • 1900MHz (1850 – 1910/1930 – 1990MHz) 	IS-95 Networks are in the process of being decommissioned. They are constrained by offering limited data services, as no data enhancements were released for this generation of CDMA network.
3G (IMT-2000)	Universal Mobile Telecommunications Service (UMTS) High Speed Packet Access (HSPA)	<ul style="list-style-type: none"> • 850 MHz (824 – 849/869 – 894MHz). • 1900 MHz (1850 – 1910/1930 – 1990MHz). • 1710-1755 MHz /2110-2155 MHz. 	UMTS Networks are currently deployed throughout the region for voice and data services. These networks were given a significant boost in data service when the HSPA data enhancement upgrades were released.
	CDMA2000 1xRTT 1xEV-DO	<ul style="list-style-type: none"> • 850 MHz (824 – 849/869 – 894MHz) 	CDMA2000 networks are deployed throughout Region 2, offering voice and data services. The 1xRTT air interface is used for the voice services and the EV-DO for mobile and wireless broadband data services.
	CDMA 1xRTT 1xEV-DO	<ul style="list-style-type: none"> • 1900 MHz (1850 – 1910/1930 – 1990MHz) 	Region 2, offering voice and data services. The 1xRTT air interface is used for the voice services and the EV-DO for mobile and wireless broadband data services.

Generation	Available Technologies	Frequency	Remarks
4G (IMT-Advanced)	Long Term Evolution (LTE)	<ul style="list-style-type: none"> • 700 MHz (698-746 MHz/746-806 MHz). • 817-824/862-869 MHz • 1900 MHz. • 2500 - 2690 MHz. • 2110-2155 MHz. 	<p>LTE networks are being rapidly deployed worldwide.</p> <p>At this point there are no global harmonized frequencies.</p> <p>Networks based on the 700 MHz brings increased economies of scale due to reduced infrastructure cost, need for less base stations, brought about by the better propagations properties of signals in this band.</p> <p>Reports on the LTE ecosystem show, that 30% of user devices support the 700 MHz band.³</p>
	Worldwide Interoperability for Microwave Access (WiMAX)	<ul style="list-style-type: none"> • 2500 - 2690 	<p>WiMAX technology has seen limited deployment as a cellular mobile technology. Mostly deployed for broadband wireless access (BWA) services.</p>
	Evolved High Speed Packet Access (HSPA+)		<p>HSPA+ is a mainstream mobile technology, implemented via a software update to existing HSPA networks. This technology is further boosted by a rapidly growing device ecosystem.</p> <p>Because of the ease of deployment (software upgrade) many operators opt to use this technology as their entry 4G service, while deploying their LTE network.</p>

³ Extract from the Global Mobile Suppliers Association report, entitled, “Status of LTE Ecosystem Report, GSA, July 3rd, 2012”
Telecommunications Authority of Trinidad and Tobago
June 2013

Considering the better propagation characteristics and the development in the ecosystem of end-user devices and network equipment for LTE networks deployed on the 700 MHz band, this band will be considered complementary to the 850 MHz and 1900 MHz bands currently being deployed for the provision of public mobile telecommunications services and in fact, may be the preferred band for the provision of high speed data services, at this time.

6.2 Further Considerations

Pursuant to the above, in order to comprehensively allocate and plan the use of the 700 MHz, 850 MHz and 1900 MHz frequency bands for the accommodation of public mobile telecommunications services, the following information was considered by the Authority:

1. The frequency bands allocated to the Mobile service, in accordance with the International Telecommunications Union, Radiocommunications Bureau (ITU-R) Region 2 Table of Frequency Allocations and the Trinidad and Tobago Frequency Allocation Table (TTFAT);
2. The spectrum used by public mobile telecommunications services presently licensed in Trinidad and Tobago;
3. The availability of spectrum in Trinidad and Tobago to accommodate public mobile telecommunications services; and
4. The appropriate licensing method for the assignment of spectrum to users.

Information discussed and collated relating to the abovementioned considerations have been summarised and illustrated in Table 4 below:

Table 4: Frequency Allocations for 2G, 3G and 4G cellular Mobile Networks

ITU-R Recommended Frequency Range of Operation	Trinidad and Tobago Frequency Allocation Table (TTFAT)	Current Spectrum Availability and Appropriate Licensing Method
<p><u>700 MHz Band:</u> (698-806 MHz)</p>	<p>The frequency range 698-806 MHz is allocated in the TTFAT to mobile and broadcasting services on a co-primary basis and also to fixed services on a secondary basis.</p>	<p>108 MHz Spectrum in the 700 MHz band is currently allocated to BWA and PHS services.</p> <p>24 MHz in the Lower 700 MHz band has been re-classified for the provision of public mobile telecommunications services, i.e. Blocks B, C, G and H.</p> <p>24 MHz in the Upper 700 MHz band has also been re-classified for the provision of public mobile telecommunications services.</p> <p>36 MHz of the Upper 700 MHz band has been reserved for the provision of PHS services.</p> <p>48 MHz of spectrum is available in the 700 MHz band for the provision of public mobile telecommunications services.</p>
<p><u>850 MHz Band:</u> (824 – 849/869 – 894 MHz)</p>	<p>The frequency ranges 824 – 849/869 – 894 MHz spans two frequency allocations in the TTFAT: 806-890 MHz and 890-902 MHz Mobile service is co-primary in both ranges.</p>	<p>The 850 MHz band is currently allocated to public mobile telecommunications services, with the two (2) existing operators currently assigned spectrum in this band.</p> <p>12 MHz is currently available in this band for assignment for the provision of public mobile telecommunications services.</p>

ITU-R Recommended Frequency Range of Operation	Trinidad and Tobago Frequency Allocation Table (TTFAT)	Current Spectrum Availability and Appropriate Licensing Method
<u>1900 MHz Band:</u> (1850 – 1910/1930 – 1990 MHz)	The frequency ranges 1850-1910/1930-1990 MHz spans four (4) frequency allocations in the TTFAT: 1710-1930 MHz, 1930-1970 MHz, 1970-1980 MHz and 1980-2010 MHz Mobile service is co-primary on all the ranges.	The 1900 MHz band is currently allocated to public mobile services, with the two (2) existing operators currently assigned spectrum in this band. 40 MHz is currently available in this band for assignment for the provision of public mobile telecommunications services.

Based on the Authority's re-farming exercise, 48 MHz of spectrum in the 700 MHz band is now available for allocation and assignment for the provision of public mobile telecommunications services, as shown in Table 4. Consequently, the Authority will be considering the inclusion of spectrum in the 700 MHz band within the family of frequency bands allocated for the provision of public mobile telecommunications services.

The Authority will also be conducting a due diligence monitoring exercise to verify that the proposed 700 MHz spectrum is free from harmful interference. Furthermore, the Authority is also aware of the possibility of harmful interference with neighbouring countries. The International Telecommunications Union's (ITU) Radio Regulations articulates the procedures for which countries can conduct frequency notification, coordination and treatment of harmful interference across borders. The Authority will be guided by these procedures in the event that there are any potential harmful interference issues. As part of the implementation process, the Authority will issue the necessary notification to the ITU in order to effect any necessary coordination process with neighbouring countries.

In its continuing effort to make additional spectrum available for public mobile telecommunications services and recognizing the value of feedback from the Industry, the Authority will seek to establish a Technical Working Committee comprising relevant stakeholders to assess the other available candidate bands for public mobile telecommunications services and to make such recommendations to the Authority, and the Authority shall accept those recommendations, as appropriate.

The completion of the TSTT's migration of its cellular mobile operations from the 1800 MHz to 1900 MHz band has provided an opportunity for this planning activity to commence with the assessment of the 1710-1755 MHz and 2110-2155 MHz bands, more commonly known as the Advanced Wireless Services (AWS) bands. The Authority aims, with the co-operation of the relevant stakeholders, to make spectrum available in the AWS bands for public mobile telecommunications services within the next two (2) years.

It is also the Authority's intention that the other candidate IMT bands shall be considered for the provision of public mobile telecommunications services as spectrum is made available and as demand emerges.

7 Frequency Assignment Principles

The following principles apply to the frequency assignment plans developed for the accommodation of public mobile telecommunications services in Trinidad and Tobago:

1. The adopted frequency assignment plan for a specified band shall follow the relevant ITU-R recommendation, if applicable, and take into consideration the predominant frequency assignment plan utilized by public mobile services in the particular frequency band.
2. All frequency assignment plans shall have a reference channel bandwidth which serves as the minimum channel bandwidth assignment. Frequency channels that require larger bandwidths can be achieved by concatenating multiple consecutive frequency channels of the reference channel bandwidth.
3. The frequency assignment plans are limited to Frequency Division Duplexing (FDD). Frequency assignment plans for Time Division Duplexing (TDD) operation will not be permitted.
4. Frequency assignments shall be made in accordance with the selected licensing process, as established by the Authority.
5. 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 can be assigned to an individual Licensee in a specified frequency band.

7. A Licensee shall utilize its spectrum assignment in a manner that does not cause harmful interference to another Licensee who has an adjacent spectrum assignment. The use of in-band guard bands can be employed to mitigate against harmful interference between adjacent channel Licensees.

8 Proposed Frequency Assignment Plans for Public Mobile Telecommunications Services

The various frequency bands allocated for the accommodation of public mobile telecommunications services can be further sub-divided in frequency channel assignments, predicated on the type(s) of technologies which can be employed using the allocated spectrum. These frequency assignment plans are aimed at maximizing the efficient use of the allocated spectrum.

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

NOTE: The actual availability of frequency channels for public mobile telecommunications services will be determined subject to a spectrum audit prior to the implementation of the respective licensing process for the designated frequency channel.

8.1 700 MHz Band: 698 MHz – 746 MHz (Lower 700 MHz Band) & 746 MHz – 806 MHz (Upper 700 MHz Band)

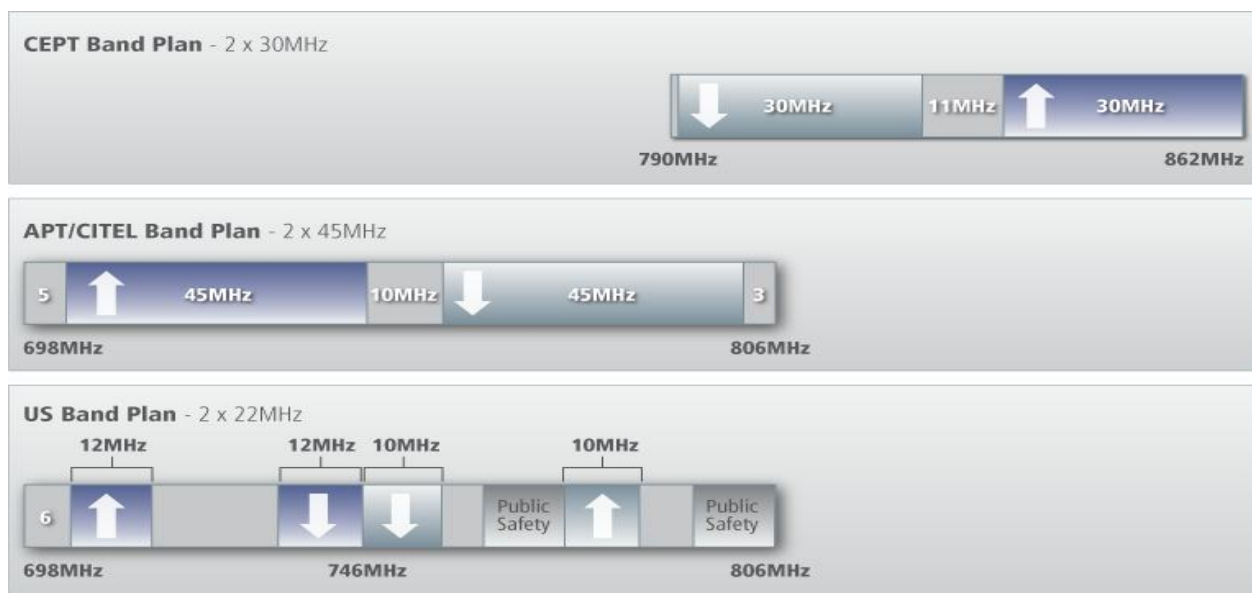
Frequency Assignment Plan

- 8.1.1 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.
- 8.1.2 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, radiocommunications systems operating in this band can achieve similar coverage areas comparable to typical UHF television broadcasters.
- 8.1.3 In the US and Canada, channels 52-59, titled the Lower 700 MHz band, have been reallocated to commercial Mobile Services to support the development of new fourth generation (4G) cellular mobile services. The Upper 700 MHz band, channels 60-69 have been allocated to both commercial Fixed and Mobile Services and to Public Health & Safety (PHS) Services.
- 8.1.4 In the US, 763-775 MHz and 793-805 MHz have been allocated to PHS services. While in Canada, 763-776 MHz and 793-806 MHz have been allocated to PHS services, which incorporate the 2 MHz guard band B-block allocation of the US band plan as well.
- 8.1.5 The only cellular mobile technology to-date deployed in the 700 MHz band is Long Term Evolution (LTE), which is a fourth (4th) Generation cellular mobile technology and part

of the International Mobile Telecommunications (IMT) suite of specifications for 4G mobile technologies.

8.1.6 The use of the 700 MHz band for LTE has taken three (3) main forms globally, by way of three (3) competing frequency assignment (channel) plans. The diagram below illustrates the channelization of the 700 MHz band by the European Conference of Postal and Telecommunications Administrations (CEPT) in its 800 MHz band plan, by the Asian-Pacific Telecommunity (APT) in its 700 & 800 MHz band plan and the US in its 700 MHz band plan.

Figure 2: 700/800 MHz Band Plans



Source: GSMA

8.1.7 It should be noted that network equipment and mobile handsets are already available in accordance with the US Band Plan. It is anticipated that harmonization with the US Band Plan, would promote economies of scale by allowing access to a large eco-system of low cost network and end-user equipment. Additionally, conformance to the US Band Plan would facilitate data roaming on the LTE networks in North America, and vice versa, as

the handsets would operate on the same frequencies as the US and Canada's cellular mobile operators. Consequently, the Authority proposes to adopt the US Band Plan.

8.1.8 The entire lower 700 MHz band was previously assigned to BWA services, licensed to two (2) operators. However, with the decision to make available spectrum in the 700 MHz band to accommodate public mobile telecommunications services, arrangements were made for the release of 24 MHz from one (1) BWA operator (i.e. the frequency ranges 704 – 716 MHz and 734 – 746 MHz) as it was a primary range for the LTE cellular mobile technology, in accordance with the US Band Plan.

8.1.9 The Authority also assessed the spectrum assigned to the other BWA operator (i.e. frequency ranges 698 – 704 MHz and 716 – 734 MHz) and noted that these ranges were not suitable for re-allocation to accommodate public mobile telecommunications services for the following reasons:

- i. The 698 – 704 MHz and 728 – 734 MHz ranges, identified as the “paired A Block” in the US Band Plan does not have an eco-system for low cost network and end-user equipment. Reasons associated with this are concerns relating to possible harmful interference with Broadcasters in spectrum immediately below 698 MHz (i.e. TV channel 51) in the USA and the lack of interoperability of equipment amongst the other LTE 700 MHz network in the USA as well. Also, there is little indication that the equipment eco-system would grow once the aforementioned issues persist.
- ii. The 716 – 728 MHz range is designated as “Base Station Transmit” spectrum in the USA and, as such, cannot be used in a TDD mode of operation. Also, there would be a high probability of harmful interference to the adjacent “Mobile Station Transmit” frequency range 704 – 716 MHz, since there would be overlapping use of both ranges throughout Trinidad and Tobago and both ranges may be assigned to different operators. Also, the 716 – 728 MHz range can only be used via a LTE-Advanced technique known as ‘carrier aggregation’, which bonds this unpaired spectrum with

paired blocks either in the 1900 MHz or AWS bands⁴, which makes this unpaired spectrum unusable in isolation.

8.1.10 Consequently, the manner in which the 716 – 728 MHz frequency range can be used does not adhere to the frequency assignment principles set out in this Spectrum Plan and does not promote the effective use of 700 MHz spectrum for public mobile telecommunications service.

8.1.11 Therefore, the frequency ranges 698 – 704 MHz and 716 – 734 MHz **WILL NOT** be considered for inclusion in the 700 MHz band for the provision of public mobile telecommunications services.

8.1.12 Similar to the US Band Plan, 24 MHz in the Upper 700 MHz band has been assigned to PHS services. Blocks 764-776 MHz and 794-806 MHz have been allocated to PHS services.

8.1.13 Therefore, a total of **ONLY** 48 MHz of spectrum will be made available in the 700 MHz band (i.e. the frequency ranges 704 – 716 MHz, 734 – 758 MHz and 776 – 788 MHz) to accommodate the provision of public domestic mobile telecommunications networks and services, as outlined in Table 5 below.

⁴ Cited from: 3rd Generation Partnership Project, “Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception (Release 11) - 3GPP TS 36.101 V11.3.0”, December 2012, page 22.
Telecommunications Authority of Trinidad and Tobago
June 2013

Table 5: Frequency Assignment Plan for 700 MHz Band:

Band	Frequency Range/MHz		
700 MHz	Mobile Station Transmit	Base Station Transmit	Block Name
Package 1a	704 – 710	734 – 740	B'
Package 1b	710 – 716	740 – 746	B''
Package 2a	776 – 782	746 – 752	C'
Package 2b	782 – 788	752 – 758	C''

8.1.14 Further to the above, the frequency ranges 698 – 704 MHz and 716 – 734 MHz, ***WILL NOT*** be re-classified for the provision of public mobile telecommunications services.

Recommended Licensing Process and Conditions

8.1.15 The licensing of spectrum in the 700 MHz band shall be for the provision of public mobile telecommunications services, on a national basis.

8.1.16 Frequency assignment of available spectrum to new spectrum users shall be via a competitive licensing process.

8.1.17 The allocated spectrum in the 700 MHz band shall be licensed in accordance with the proposed frequency assignment plan (Table 5). The minimum assignment shall be 12 MHz (i.e. 2x6 MHz or one (1) spectrum package).

8.1.18 The Spectrum Cap for the 700 MHz band shall be 24 MHz (i.e. 2x12 MHz) for the available spectrum. There shall also be a limitation in the combinations for spectrum packages for assignments of 24 MHz. The two (2) spectrum packages are limited to Package 1a with 1b or Package 2a with 2b.

Technical Operating Conditions and Specifications

8.1.19 All spectrum users shall not exceed the maximum technical operating conditions and specifications identified in the following table, in order to operate public mobile telecommunications services in the 700 MHz band.

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

Table 6: Maximum Technical Operating Specifications, 700 MHz band, Public Mobile Telecommunications Services

Parameter	Maximum Value	Comments
Maximum Effective Radiated Power (E.R.P.) ⁵	Base Station: 30 dBW Mobile Station: 4.77 dBW	Total power of all channels.
Modulation scheme	Digital	Any digital modulation technique e.g. BPSK, QPSK.
Out of Band Emissions Limits	-43 dBW	Attenuation (α) on max power (P) of emissions calculated using: $\alpha = 43 + 10 \log (P)$
Standardization	FCC, Industry Canada, ETSI	

⁵ These specifications were developed with reference to FCC Part 27 rules Telecommunications Authority of Trinidad and Tobago
June 2013

8.2 850 MHz Band: 824 – 849/869 – 894 MHz

Frequency Assignment Plan

- 8.2.1 Generally, there exists two (2) predominant spectrum plans globally; that of North America and that of the European Union. Administrations worldwide develop spectrum plans that either adhere completely with one of these spectrum plans, or use a blend of both designations for accommodations of mobile services within their jurisdiction due to availability of the relevant systems. North America has operated mobile telecommunications systems in the 800MHz (824 – 849/869 – 894MHz) and 1900MHz (1850 – 1910/1930 – 1990MHz) spectrum bands, whereas their counterpart systems in Europe operate in the 900MHz (880 – 915/925 – 960MHz) and 1800MHz (1710 – 1785/1805 – 1880MHz) bands.
- 8.2.2 The blend of spectrum plans and consequently, systems from Europe and North America presents its own challenges, due to the inability of radio equipment designed for one market to coexist in the same environment as those designed for another market, causing potential quality degradation and interference occurrence. A blend of spectrum plans requires extraordinary steps to engineer adjacent systems generally resulting in inefficient use of spectrum, supporting the position to adopt a spectrum plan that conforms to only one of the available plans.
- 8.2.3 Trinidad & Tobago belongs to ITU Region 2, and imports a significant portion of equipment from North America. It is advisable that Trinidad & Tobago adopts spectrum band plans that conform to North American markets to ensure equipment availability, and in particular handset availability. Additional factors requiring consideration include compatibility of international and regional cross-border systems such as mobile-satellite communications systems and coexistence with widely available radiocommunications systems, such as Industrial, Scientific and Medical (ISM) applications, which operate in the band 902 – 928MHz.

- 8.2.4 Various other radiocommunications systems exist in the 900 MHz band that are used to license Region 1 cellular mobile networks. These include Studio to Transmitter Auxiliary Links for Broadcasting Services, paging systems, low powered tele-metering systems and the Industrial, Scientific and Medical (ISM) applications and systems. In Trinidad and Tobago, making spectrum available in this band would be difficult due to the operation of these numerous radiocommunications systems in the 900 MHz band.
- 8.2.5 The predominant second generation mobile telecommunications technologies are Code Division Multiple Access (CDMA), Global System for Mobile (GSM) Communications and its variants such as Enhanced Data rates for GSM Evolution (EDGE). Third generation systems have generally been based upon Wideband CDMA, such as Universal Mobile Telecommunications Service (UMTS) and its data variants of High Speed Packet Access (HSPA).
- 8.2.6 The Authority also recognizes that this spectrum can be used for 4G cellular mobile technologies such as LTE.
- 8.2.7 The Authority's assignment plan for the 850 MHz band will be based on the North American band plan, for the provision of public mobile telecommunications services as shown in Table 7 below.

Table 7: Frequency Assignment Plan for 850 MHz Band:

Band	Frequency Range/MHz		
	Mobile Station Transmit	Base Station Transmit	Block Name
850MHz	824 – 825	869 – 870	A'
	825 – 830	870 – 875	A1
	830 – 835	875 – 880	A _u
	835 – 845	880 – 890	B
	845 – 846.5	890 – 891.5	A''
	846.5 – 849	891.5 – 894	B'

Recommended Licensing Process and Conditions

8.2.8 The licensing of spectrum in the 850 MHz band shall be for the provision of public mobile telecommunications services, on a national basis.

8.2.9 Frequency assignment of available spectrum to new spectrum users shall be via a competitive licensing process.

8.2.10 The allocated spectrum in the 850 MHz band shall be licensed in accordance with the proposed frequency assignment plan (Table 7). The minimum assignment shall be 10 MHz, i.e. 2 x 5 MHz. Additionally, the minimum assignment shall be accompanied by a quantum of spectrum for guard bands (no less than 2 x 1 MHz).

8.2.11 The Spectrum Cap for the 850 MHz band shall be 10 MHz, i.e. 2 x 5 MHz. Additionally, each 2 x 5 MHz assignment shall be accompanied by a quantum of spectrum for guard bands (not to exceed 2 x 2.5 MHz). In the event that a Licensee has remaining spectrum

after the establishment of guard bands, said spectrum may be utilized for the provision of public mobile telecommunications services.

Technical Operating Conditions and Specifications

8.2.12 All spectrum users shall not exceed the maximum technical operating conditions and specifications identified in Table 8 below, in order to operate public mobile telecommunications services in the 850 MHz band.

Table 8: Maximum Technical Operating Specifications, 850 MHz band, Public Mobile Telecommunications Services

Parameter	Maximum Value	Comments
Maximum Effective Radiated Power (E.R.P.) ⁶	Base Station: 27 dBW Mobile Station: 8.45 dBW	Total power of all channels.
Modulation scheme	Digital	Any digital modulation technique e.g. BPSK, QPSK.
Out of Band Emissions Limits	-43 dBW	Attenuation (α) on max power (P) of emissions calculated using: $\alpha = 43 + 10 \log (P)$
Standardization	FCC, Industry Canada, ETSI	

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

⁶ These specifications were developed with reference to FCC Part 22 rules Telecommunications Authority of Trinidad and Tobago
June 2013

1900 MHz Band: (1850 – 1910/1930 – 1990 MHz)

Frequency Assignment Plan

8.2.14 The 1900 MHz band, called the personal communications services (PCS) block in North America, is used throughout the region for the provision of mobile voice and data services. The North American allocation is such that the band is divided into two (2) sub-bands, the lower sub-band and the upper sub-band. The sub-bands are divided into six (6) paired blocks, three (3) 15 MHz blocks and three (3) 5 MHz blocks.

8.2.15 Generally, there exists two (2) predominant spectrum plans globally; that of North America and that of the European Union. Administrations worldwide develop spectrum plans that either adhere completely with one of these spectrum plans, or use a blend of both designations for accommodations of mobile services within their jurisdiction due to availability of the relevant systems. North America has operated mobile telecommunications systems in the 800MHz (824 – 849/869 – 894MHz) and 1900MHz (1850 – 1910/1930 – 1990MHz) spectrum bands, whereas their counterpart systems in Europe operate in the 900MHz (880 – 915/925 – 960MHz) and 1800MHz (1710 – 1785/1805 – 1880MHz) bands.

8.2.16 The blend of spectrum plans and consequently, systems from Europe and North America presents its own challenges, due to the inability of radio equipment designed for one market to coexist in the same environment as those designed for another market, causing potential quality degradation and interference occurrence. A blend of spectrum plans requires extraordinary steps to engineer adjacent systems generally resulting in inefficient use of spectrum, supporting the position to adopt a spectrum plan that conforms to only one of the available plans.

8.2.17 Trinidad & Tobago belongs to ITU Region 2, and imports a significant portion of equipment from North America. It is advisable that Trinidad & Tobago adopts spectrum band plans that conform to North American markets to ensure equipment availability, and

in particular handset availability. Additional factors requiring consideration include compatibility of international and regional cross-border systems such as mobile-satellite communications systems and the reservation of spectrum for Advanced Wireless Services (AWS) in the 1.7 GHz and 2.1 GHz bands.

8.2.18 The predominant second generation mobile telecommunications technologies are Code Division Multiple Access (CDMA), Global System for Mobile (GSM) Communications and its variants such as Enhanced Data rates for GSM Evolution (EDGE). Third generation systems have generally been based upon Wideband CDMA, such as Universal Mobile Telecommunications Service (UMTS) and its data variants of High Speed Packet Access (HSPA).

8.2.19 The Authority also notes that this spectrum may be used for 4G cellular mobile technologies such as LTE in the future, as it is cited as an operating band (i.e. Band 2) in the 3GPP Evolved Universal Terrestrial Radio Access (E-UTRA) technical specifications document (release 11)⁷.

8.2.20 The Authority assignment plan for the 1900 MHz band will be based on the North American PCS Band Plan, for the provision of public mobile telecommunications services as shown in table 9 below.

⁷ Referenced from: 3rd Generation Partnership Project, “Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception (Release 11) - 3GPP TS 36.101 V11.3.0”, December 2012.
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Table 9: Frequency Assignment Plan for 1900 MHz Band:

Band	Frequency Range/MHz		
1900MHz	Mobile Station Transmit	Base Station Transmit	Block Name
	1850 – 1865	1930 – 1945	A
	1865 – 1870	1945 – 1950	D
	1870 – 1875	1950 – 1955	B1
	1875 – 1880	1955 – 1960	B2
	1880 – 1885	1960 – 1965	B3
	1885 – 1890	1965 – 1970	E
	1890 – 1895	1970 – 1975	F
	1895 – 1910	1975 – 1990	C

Recommended Licensing Process and Conditions

8.2.21 The licensing of spectrum in the 1900 MHz band shall be for the provision of public mobile telecommunications services, on a national basis.

8.2.22 Frequency assignment of available spectrum to new spectrum users shall be via a competitive licensing process.

8.2.23 The allocated spectrum in the 1900 MHz band shall be licensed in accordance with the proposed frequency assignment plan (Table 9). The minimum assignment shall be 10 MHz (i.e. 2x5 MHz).

8.2.24 The Spectrum Cap for the 1900 MHz band shall be 40 MHz (i.e. 2x20 MHz) for the available spectrum.

Technical Operating Conditions and Specifications

8.2.25 All spectrum users shall not exceed the maximum technical operating conditions and specifications identified in Table 10 below, in order to operate public mobile telecommunications services in the 1900 MHz band.

Table 10: Maximum Technical Operating Specifications, 1900 MHz band, Public Mobile Telecommunications Services

Parameter	Maximum Value	Comments
Maximum Effective Radiated Power (E.R.P.) ⁸	Base Station: 27 dBW Mobile Station: 3 dBW	Total power of all channels.
Modulation scheme	Digital	Any digital modulation technique e.g. BPSK, QPSK.
Out of Band Emissions Limits	-43 dBW	Attenuation (α) on max power (P) of emissions calculated using: $\alpha = 43 + 10 \log (P)$
Standardization	FCC, Industry Canada, ETSI	

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

⁸ These specifications were developed with reference to FCC Part 24 rules
Telecommunications Authority of Trinidad and Tobago
June 2013

Annex I – Decisions on Recommendations Matrix (First Round of Consultation)

(Attached as a separate document)

Annex II – Decisions on Recommendations Matrix (Second Round of Consultation)

(Attached as a separate document)