



Spectrum Plan for the Accommodation of Point-to-Point Radiocommunications Systems

Maintenance History		
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Executive Summary

In the same manner as wireless technologies are used today for the rapid roll out of access networks, wireless technologies are used today for the rapid build-out of the remaining transmission and core networks, through the utilisation of point-to-point radiocommunications systems. The entry of new concessionaires in the marketplace and the deployment of new telecommunications networks have resulted in an increasing demand for the radio spectrum resource, not only as an alternative technology for access networks, but also an alternative medium for transmission of traffic backhauled into and within the core network of these new concessionaires. Similarly for private enterprises and closed-user groups, the use of point-to-point radiocommunications systems have increased with the establishment of Wide Area Networks (WANs), as well as in redundancy solutions for wired backhaul connections.

However, due to the finite spectrum resource, adequate allocation and proper management are necessary in order to maximize the use of this spectrum resource amongst the growing number of spectrum users. In view of this, the Authority has commenced this orderly management with the development of this Spectrum Plan. This Plan seeks to firstly identify the various frequency bands of operation deployed globally and, in particular, by ITU-R Region 2 countries, taking into consideration the frequency bands and assignment plan presently used by point-to-point systems locally. Secondly, it seeks to analyze and summarize the current spectrum availability for the associated frequency bands in Trinidad and Tobago. Finally, based on the above information, it will propose frequency bands and associated assignment plans for the accommodation of point-to-point radiocommunications systems and indicate the appropriate licensing process for the assignment of spectrum to users.

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Table 1 summarizes the proposed frequency band plans and the respective licensing approach for the accommodation of point-to-point radiocommunications systems:

Table 1: Summary of Point-to-Point Radiocommunications Systems Operating Frequency Ranges and the Respective Licensing Approach for Trinidad and Tobago

Frequency Band	Frequency Range of Operation	Licensing Approach
1.4 GHz Band	1427 – 1517 MHz	<p>A first-come, first served licensing process shall be employed for the assignment of available spectrum.</p> <p>A competitive licensing process is not warranted at this time.</p>
2.4, 5.7 and 5.8 GHz Bands	2400 – 2483.5 MHz 5470 – 5725 MHz 5725 – 5850 MHz	<p>Point-to-Point systems operating in this band shall be class licensed in accordance with the Authority’s Class Licensing Regime¹, in particular, the maximum technical operating parameters for equipment operating in these bands.</p> <p>Such equipment shall be certified by the Authority via its equipment certification process.</p>
5 GHz Band	4400 – 5000 MHz	<p>A first-come, first served licensing process shall be employed for the assignment of available spectrum.</p> <p>A competitive licensing process is not warranted at this time.</p>
Lower 6 GHz Band	5850 – 6425 MHz	<p>A first-come, first served licensing process shall be employed for the assignment of available spectrum.</p> <p>A competitive licensing process is not warranted at this time.</p>

¹ The Authority’s Class Licensing Regime document is available on the Website at <http://www.tatt.org.tt>

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Frequency Band	Frequency Range of Operation	Licensing Approach
Upper 6 GHz Band	6430 – 7110 MHz	<p>This frequency band is better suited for the provision of broadcast auxiliary services for the establishment of television Studio-to-Transmitter Links (STLs). Consequently, this band will not be available for assignment to point-to-point systems, unless they are used for the establishment of television STLs.</p> <p>The frequency assignment plan and associated conditions for use of the Upper 6 GHz band for television STLs will be included in the Spectrum Plan for the Accommodation of Broadcasting Auxiliary Services, which is currently being prepared by the Authority.</p>
7 GHz Band	7110 – 7900 MHz	<p>A first-come, first served licensing process shall be employed for the assignment of available spectrum.</p> <p>A competitive licensing process is not warranted at this time.</p>
8 GHz Band	7725 – 8500 MHz	<p>A first-come, first served licensing process shall be employed for the assignment of available spectrum.</p> <p>A competitive licensing process is not warranted at this time.</p>
10 GHz Band	10000 – 10680 MHz	<p>A first-come, first served licensing process shall be employed for the assignment of available spectrum.</p> <p>A competitive licensing process is not warranted at this time.</p>
11 GHz Band	10700 – 11700 MHz	<p>A first-come, first served licensing process shall be employed for the assignment of available spectrum.</p> <p>A competitive licensing process is not warranted at this time.</p>

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Frequency Band	Frequency Range of Operation	Licensing Approach
13 GHz Band	12750 – 13250 MHz	<p>A first-come, first served licensing process shall be employed for the assignment of available spectrum.</p> <p>A competitive licensing process is not warranted at this time.</p>
15 GHz Band	14500 – 15350 MHz	<p>A first-come, first served licensing process shall be employed for the assignment of available spectrum.</p> <p>A competitive licensing process is not warranted at this time.</p>

1. Introduction

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 (hereinafter called, "the Authority") has embarked on the liberalization of the telecommunications sector which will serve to facilitate telecommunications infrastructural growth essential for accessing information and the provision of telecommunications services.

The entry of new concessionaires into the marketplace and the deployment of new telecommunications networks has resulted in an increasing demand for the radio spectrum resource, not only as an alternative technology for the access network, but also an alternative medium for the transmission of traffic backhauled into and within the core network of these new concessionaires. In the same manner as wireless technologies are used today for the rapid roll out of access networks, wireless technologies are used today for the rapid build-out of the remaining transmission and core networks, through the utilisation of point-to-point radiocommunications systems. These point-to-point systems are used to backhaul traffic from the access networks into the core network and vice versa, as a viable alternative to wired backhaul connections using fiber optic cables.

Similarly for private enterprises and closed-user groups, the use of point-to-point radiocommunications systems increased in the establishment of Wide Area Networks (WANs) as well as redundancy for wired backhaul connections. In an environment where communication and connectivity is becoming more and more critical to competitive business operations, point-to-point systems are viewed as opportune for they are reliable and require shorter lead times for start of service than wired backhaul connections.

However, due to the finite spectrum resource, adequate allocation and proper management is necessary in order to maximize the use of this spectrum resource amongst the growing number of spectrum users. In view of this, the Authority has commenced the orderly management with the development of this Spectrum Plan for the Accommodation of Point-to-Point Radiocommunications Systems.

This document is a subset of the National Spectrum Plan² 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.

2. Objectives

The objectives of this spectrum plan are to:

1. Identify the frequency ranges which will be allocated to the provision of point-to-point radiocommunications systems, 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 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 should be directed to the Authority at technical@tatt.org.tt .

² The Authority's National Spectrum Plan is available on the Website at <http://www.tatt.org.tt>

4. The Consultation Process

The Authority will seek, in accordance with its “Procedures for Consultation in the Telecommunications and Broadcasting Sectors of Trinidad and Tobago”³, the views of industry stakeholders on the second draft of this document. The document was revised with consideration to the comments and recommendations made in the first consultation phase (Refer to Annex 1 for the Decisions on Recommendations matrix (DOR)).

The second consultation phase was conducted. Pursuant to this, the consultative document was further revised with consideration to the comments and recommendations made in the second round of consultation (Refer to Annex 2 for the Decisions on Recommendations matrix (DOR)).

The document is now approved and published as the final version.

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 Point-to-Point Radiocommunications Systems include the following:⁴

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

³ Available on the Authority’s Website at <http://www.tatt.org.tt>

⁴ All available on the Authority’s Website at <http://www.tatt.org.tt>

6. Considerations for the Accommodation of Point-to-Point Radiocommunications Systems

In order to comprehensively allocate and plan the use of the specified frequency bands for the accommodation of point-to-point systems, the following information was considered by the Authority:

1. The frequency bands allocated to the Fixed 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 point-to-point radiocommunications systems presently licensed in Trinidad and Tobago;
3. The availability of spectrum in Trinidad and Tobago to accommodate point-to-point radiocommunications systems; 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 the table below:

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Table 2: Summary of the frequency ranges for Point-to-Point systems which can be considered for licensing in the Republic of Trinidad and Tobago

ITU-R Recommended Frequency Range of Operation	Trinidad and Tobago Frequency Allocation Table (TTFAT)	Current Spectrum Availability and Appropriate Licensing Method
<p>1.4 GHz Band (ITU-R Rec. F.1242 No.3): - 1427 – 1517 MHz</p>	<p>The frequency range 1427 – 1517 MHz spans across four (4) frequency allocations in the TTFAT: 1427 – 1429 MHz; 1429 – 1452 MHz; 1452 – 1492 MHz; and 1492 – 1518 MHz.</p> <p>The Fixed service is co-primary in all ranges, save and except 1452 – 1492 MHz, which is allocated on a co-primary basis to Broadcasting and Broadcasting-Satellite services.</p> <p>The frequency assignment plan for point-to-point systems in the 1.4 GHz band comprises the abovementioned frequency ranges that have been allocated to the Fixed service, with the 1452 – 1492 MHz range falling within the duplex spacing of the assignment plan.</p> <p>Therefore, the 1452 – 1492 MHz range shall not be used by the Fixed Service.</p>	<p>In the 1.4 GHz band, although there is a point-to-multipoint system licensed spectrum in this band, its operations are localized to onshore use in specific areas of Trinidad. As a result, frequency assignments have been made to point-to-point systems outside these areas, particularly for offshore links to and between oil platforms.</p> <p>It is expected that this band will continue to be used and in demand by the current systems as there is little near future demand for this band for other radiocommunications systems or services.</p> <p>In this band, 50% of the frequencies have been assigned and re-assigned multiple times primarily for the provision of low capacity links.</p> <p>Considering that spectrum for point-to-point systems are re-used at specific locations, this effectively increases the quantum of spectrum within this finite range. This increase in supply of spectrum, via frequency re-use, will satisfy the demand from prospective point-to-point Licensees in the near future.</p> <p>Consequently, a first-come, first served licensing process can be employed for the assignment of available spectrum, based on the spectrum classification and valuation principles in the Authority’s Fee Methodology. A competitive licensing process is not warranted at this time.</p>

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ITU-R Recommended Frequency Range of Operation	Trinidad and Tobago Frequency Allocation Table (TTFAT)	Current Spectrum Availability and Appropriate Licensing Method
<p>5 GHz Band (ITU-R Rec.F.1099-3): - 4400 – 5000 MHz</p>	<p>The frequency range 4400 – 5000 MHz is allocated in the TTFAT to Fixed service on a co-primary basis.</p> <p>The frequency assignment plan for point-to-point systems in the 5 GHz band comprises this entire range.</p>	<p>In the 5 GHz band, all the frequencies have been assigned and re-assigned multiple times primarily for the provision of high capacity links. This band is primarily used for core network transmission in cellular mobile networks.</p> <p>There has been an allocation of the range 4.9 – 5 GHz in North America and Mexico to public health and safety systems. However, based on the bands the Authority currently have allocated for public health and safety and the demand for this entire band by present systems, the Authority does not see it necessary at this time to re-allocate the 4.9 – 5 GHz band to public health and safety.</p> <p>Also, it is expected that this band will continue to be used by the current systems as there is significant demand for this band for high capacity, long haul links.</p> <p>Considering that spectrum for point-to-point systems are re-used at specific locations, this effectively increases the quantum of spectrum within this finite range. This increase in supply of spectrum, via frequency re-use, will satisfy the demand from prospective point-to-point Licensees in the near future.</p> <p>Consequently, a first-come, first served licensing process can be employed for the assignment of available spectrum, based on the spectrum classification and valuation principles in the Authority’s Fee Methodology. A competitive licensing process is not warranted at this time.</p>

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ITU-R Recommended Frequency Range of Operation	Trinidad and Tobago Frequency Allocation Table (TTFAT)	Current Spectrum Availability and Appropriate Licensing Method
<p>Lower 6 GHz Band (ITU-R Rec. F.383-7 (interleaved)): - 5850 – 6425 MHz</p>	<p>The frequency range 5850 – 6425 MHz spans across two (2) frequency allocations in the TTFAT, both of which are allocated to the Fixed service on a co-primary basis</p> <p>The frequency assignment plan for point-to-point systems in the Lower 6 GHz band comprises the entire range 5850 – 5925 MHz and a portion of the 5925 – 6700 MHz range.</p> <p>This entire range is shared with Fixed-Satellite Services on a co-primary basis, through the use of frequency coordination.</p>	<p>In the Lower 6 GHz band, 50% of the frequencies have been assigned and re-assigned multiple times primarily for the provision of high capacity links.</p> <p>This band is currently heavily utilised by cellular mobile, broadband wireless access (BWA) and private backhaul networks.</p> <p>The demand for this band is expected to continue to grow with the addition of a third cellular mobile operator and new BWA providers. The increase in transmission capacity requirements for private networks may also increase the demand for spectrum in this band.</p> <p>Considering that spectrum for point-to-point systems are re-used at specific locations, this effectively increases the quantum of spectrum within this finite range. This increase in supply of spectrum, via frequency re-use, will satisfy the demand from prospective point-to-point licensees in the near future.</p> <p>Consequently, a first-come, first served licensing process can be employed for the assignment of available spectrum, based on the spectrum classification and valuation principles in the Authority’s Fee Methodology. A competitive licensing process is not warranted at this time.</p>

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ITU-R Recommended Frequency Range of Operation	Trinidad and Tobago Frequency Allocation Table (TTFAT)	Current Spectrum Availability and Appropriate Licensing Method
<p>Upper 6 GHz Band (ITU-R Rec.F.384-8): - 6430 – 7110 MHz</p>	<p>The frequency range 6430 – 7110 MHz spans across three (3) frequency allocations in the TTFAT, all of which are allocated to the Fixed service on a co-primary basis.</p> <p>The frequency assignment plan for point-to-point systems in the Upper 6 GHz band comprises a portion of the 5925 – 6700 MHz the entire range 6700 – 7075 MHz and a portion of the 7075 – 7145 MHz range.</p>	<p>In the interest of allocating sufficient spectrum for the various radiocommunications services that needs to be accommodated, the Authority seeks to give consideration to the spectrum requirements by television Studio-to-Transmitter Links (STLs) broadcast auxiliary services.</p> <p>Considering the planned switch-over from analog-to-digital free-to-air television broadcasting and the method employed to establish the digital terrestrial television networks, there will be a significant increased demand for spectrum in this band, as it is the only band between 3 – 10 GHz that television STLs are manufactured.</p> <p>As a result, this band would be in high demand for use by television STLs, notwithstanding that there are incumbent point-to-point systems currently in operation in this band.</p>

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ITU-R Recommended Frequency Range of Operation	Trinidad and Tobago Frequency Allocation Table (TTFAT)	Current Spectrum Availability and Appropriate Licensing Method
<p>7 GHz Band (ITU-R Rec. F.385-7): - 7110 – 7900 MHz</p>	<p>The frequency range 7110 – 7900 MHz spans across nine (9) frequency allocations in the TTFAT, all of which are allocated to the Fixed service on a co-primary basis. There are two (2) frequency assignment plans for point-to-point systems in the 7 GHz band.</p> <p>The first assignment plan ranges from 7124.5 – 7425.5 MHz and the second ranges from 7425 -7725 MHz.</p> <p>These two ranges separate the 7 GHz band into two (2) sub-bands: the Lower 7 GHz; and Upper 7 GHz bands.</p>	<p>In the 7 GHz band, all of the frequencies have been assigned and re-assigned multiple times primarily for the provision of low, medium and high capacity links.</p> <p>This frequency band is typically used by wireless transmission networks that backhaul data from access networks to the core network, such as inter-cell site transmission links and wide area networks (WANs).</p> <p>It is expected that this band will continue to be used and in demand by the current uses as there is little near future demand for this band for other radiocommunications systems or services.</p> <p>It is also expected that the demand for this band by its current uses shall increase with the introduction of a third cellular mobile operator and the deployment for higher capacity transmission networks by existing cellular mobile operators and BWA providers.</p> <p>Considering that spectrum for point-to-point systems are re-used at specific locations, this effectively increases the quantum of spectrum within this finite range. This increase in supply of spectrum, via frequency re-use, will satisfy the demand from prospective point-to-point licensees in the near future.</p> <p>Consequently, a first-come, first served licensing process can be employed for the assignment of available spectrum, based on the spectrum classification and valuation principles in the Authority’s Fee Methodology. A competitive licensing process is not warranted at this time.</p>

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ITU-R Recommended Frequency Range of Operation	Trinidad and Tobago Frequency Allocation Table (TTFAT)	Current Spectrum Availability and Appropriate Licensing Method
<p>8 GHz Band (ITU-R Rec. F.386-6 (Annex 1)): - 7725 – 8500 MHz</p>	<p>The frequency range 7725 – 8275 MHz spans across seven (7) frequency allocations in the TTFAT, all of which are allocated to the Fixed service on a co-primary basis.</p> <p>There are two (2) frequency assignment plans for point-to-point systems in the 7 GHz band.</p> <p>The first assignment plan ranges from 7725 - 8275 MHz and the second ranges from 8275 - 8500 MHz. These two ranges separate the 8 GHz band into two (2) sub-bands: the Lower 8 GHz; and Upper 8 GHz bands.</p>	<p>In the 8 GHz band, all of the frequencies have been assigned and re-assigned multiple times in the Lower 8 GHz band primarily for the provision of high capacity links. In the Upper 8 GHz band, 80% of the frequencies have been assigned and re-assigned primarily for the provision of high capacity links.</p> <p>The Lower 8 GHz bands are used primarily for high capacity transmission networks for cellular mobile operators and BWA providers. The Upper 8GHz band is more used for medium to low capacity links by closed user group and private networks, and their transmission network capacity requirements are smaller than the public telecommunications networks and service providers.</p> <p>It is expected that this band will continue to be used and in demand by the current uses as there is little near future demand for this band for other radiocommunications systems or services.</p> <p>Considering that spectrum for point-to-point systems are re-used at specific locations, this effectively increases the quantum of spectrum within this finite range. This increase in supply of spectrum, via frequency re-use, will satisfy the demand from prospective point-to-point licensees in the near future.</p> <p>Consequently, a first-come, first served licensing process can be employed for the assignment of available spectrum, based on the spectrum classification and valuation principles in the Authority’s Fee Methodology. A competitive licensing process is not warranted at this time.</p>

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ITU-R Recommended Frequency Range of Operation	Trinidad and Tobago Frequency Allocation Table (TTFAT)	Current Spectrum Availability and Appropriate Licensing Method
<p>10 GHz Band (ITU-R Rec. F.746-9 (Annex 2)): - 10000 – 10680 MHz</p>	<p>The frequency range 10000 – 10680 MHz spans across five (5) frequency allocations in the TTFAT. The range 10500 – 10680 MHz is allocated to the Fixed service on a co-primary basis. However, the range 10000 – 10500 MHz is allocated to the Radiolocation service on a primary basis, which may include point-to-point radiocommunications systems.</p> <p>In view of this, the entire range 10000 – 10680 MHz shall be considered in this Plan, conditioned that the Radiolocation service is for a point-to-point system. Fixed service use shall also be accommodated in the 10500 – 10680 MHz range.</p> <p>The frequency assignment plan for point-to-point systems in the 10 GHz band comprises the entire range of frequencies from 10000 – 10680 MHz.</p>	<p>In the 10 GHz band, 20% of the frequencies have been assigned and re-assigned primarily for the provision of high capacity links.</p> <p>This frequency band is typically used for backhaul transmission networks for cellular mobile operators and point-to-point links for wide area networks (WANs).</p> <p>It is expected that this band will continue to be used and in demand by the current uses as there is little near future demand for this band for other radiocommunications systems or services.</p> <p>Considering that spectrum for point-to-point systems are re-used at specific locations, this effectively increases the quantum of spectrum within this finite range. This increase in supply of spectrum, via frequency re-use, will satisfy the demand from prospective point-to-point licensees in the near future.</p> <p>Consequently, a first-come, first served licensing process can be employed for the assignment of available spectrum, based on the spectrum classification and valuation principles in the Authority’s Fee Methodology. A competitive licensing process is not warranted at this time.</p>

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ITU-R Recommended Frequency Range of Operation	Trinidad and Tobago Frequency Allocation Table (TTFAT)	Current Spectrum Availability and Appropriate Licensing Method
<p>11 GHz Band (ITU-R Rec. F.387-9): - 10700 – 11700 MHz</p>	<p>The frequency range 10700 – 11700 MHz is allocated in the TTFAT to Fixed service on a co-primary basis.</p> <p>The frequency assignment plan for point-to-point systems in the 11 GHz band comprises this entire range.</p> <p>This entire range is shared with Fixed-Satellite Services on a co-primary basis, through the use of frequency coordination.</p>	<p>In the 11 GHz band, 55% the frequencies have been assigned and re-assigned multiple times primarily for the provision of high capacity links.</p> <p>This frequency band is typically used for backhaul transmission networks for cellular mobile operators and point-to-point links for wide area networks (WANs).</p> <p>It is expected that this band will continue to be used and in demand by the current uses as there is little near future demand for this band for other radiocommunications systems or services.</p> <p>Considering that spectrum for point-to-point systems are re-used at specific locations, this effectively increases the quantum of spectrum within this finite range. This increase in supply of spectrum, via frequency re-use, will satisfy the demand from prospective point-to-point licensees in the near future.</p> <p>Consequently, a first-come, first served licensing process can be employed for the assignment of available spectrum, based on the spectrum classification and valuation principles in the Authority’s Fee Methodology. A competitive licensing process is not warranted at this time.</p>

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ITU-R Recommended Frequency Range of Operation	Trinidad and Tobago Frequency Allocation Table (TTFAT)	Current Spectrum Availability and Appropriate Licensing Method
<p>13 GHz Band (ITU-R Rec. F.497-6): - 12750 – 13250 MHz</p>	<p>The frequency range 12750 – 13250 MHz is allocated in the TTFAT to Fixed service on a co-primary basis.</p> <p>The frequency assignment plan for point-to-point systems in the 13 GHz band comprises this entire range.</p>	<p>In the 13 GHz band, 25% the frequencies have been assigned and re-assigned primarily for the provision of high capacity links.</p> <p>This frequency band is typically used for backhaul transmission networks for cellular mobile operators and point-to-point links for wide area networks (WANs).</p> <p>It is expected that this band will continue to be used and in demand by the current uses as there is little near future demand for this band for other radiocommunications systems or services.</p> <p>Considering that spectrum for point-to-point systems are re-used at specific locations, this effectively increases the quantum of spectrum within this finite range. This increase in supply of spectrum, via frequency re-use, will satisfy the demand from prospective point-to-point licensees in the near future.</p> <p>Consequently, a first-come, first served licensing process can be employed for the assignment of available spectrum, based on the spectrum classification and valuation principles in the Authority’s Fee Methodology. A competitive licensing process is not warranted at this time.</p>

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ITU-R Recommended Frequency Range of Operation	Trinidad and Tobago Frequency Allocation Table (TTFAT)	Current Spectrum Availability and Appropriate Licensing Method
<p>15 GHz Band (ITU-R Rec. F.636-3): - 14500 – 15350 MHz</p>	<p>The frequency range 14500 – 15350 MHz spans across two (2) frequency allocations in the TTFAT, all of which are allocated to the Fixed service on a co-primary basis.</p> <p>The frequency assignment plan for point-to-point systems in the 15 GHz band comprises this entire range.</p> <p>This entire range is shared with Fixed-Satellite Services on a co-primary basis, through the use of frequency coordination.</p>	<p>In the 15 GHz band, 40% the frequencies have been assigned and re-assigned multiple times primarily for the provision of high capacity links.</p> <p>This frequency band is typically used by wireless transmission networks that backhaul data from access networks to the core network, such as inter-cell site transmission links and wide area networks (WANs).</p> <p>It is expected that this band will continue to be used and in demand by the current uses as there is little near future demand for this band for other radiocommunications systems or services.</p> <p>It is also expected that the demand for this band by its current uses shall increase with the introduction of a third cellular mobile operator and the deployment for higher capacity transmission networks by existing cellular mobile operators and BWA providers.</p> <p>Considering that spectrum for point-to-point systems are re-used at specific locations, this effectively increases the quantum of spectrum within this finite range. This increase in supply of spectrum, via frequency re-use, will satisfy the demand from prospective point-to-point licensees in the near future.</p> <p>Consequently, a first-come, first served licensing process can be employed for the assignment of available spectrum, based on the spectrum classification and valuation principles in the Authority’s Fee Methodology. A competitive licensing process is not warranted at this time.</p>

7. Frequency Assignment Principles

The following principles apply to the frequency assignment plans developed for the accommodation of point-to-point systems 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 employed by existing point-to-point systems in operation in Trinidad and Tobago.
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. Although the spectrum plan will identify the assignment plan to be employed in specified bands, the use of a bandwidth smaller than the reference channel bandwidth can be considered, subject to its conformance to a multiple of the frequency bandwidth identified in the assignment plan, maintenance of the duplex spacing and the technical conditions and specifications for the specified band.
4. The frequency assignment plans have been developed for Frequency Division Duplexing (FDD). However, the assignment of a single frequency for simplex operation by a point-to-point system can be considered, on a case by case basis, by the Authority.
5. Frequency assignments shall be made in accordance with the selected licensing process, as established by the Authority.

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6. A frequency assignment plan shall be used for the assignment of a single frequency channel, for a simplex mode of operation, or a frequency pair (i.e. an upper and a lower frequency channel separated by a duplex spacing) for a duplex mode of operation.
7. The Authority may assign and re-assign a frequency channel/channel pair in a specified band for one or more point-to-point links for a single licensee or to one or more licensees, provided that a station licence is granted to all licensees. In the event that a spectrum licence is granted to a licensee for the use of a frequency channel/channel pair, then that licensee will have exclusive use for the term of the licence.
8. The Authority shall consider the grant of a spectrum licence for a point-to-point system where it will be impractical to licence the same frequencies to another licensee. This consideration shall take into account, but is not limited to, the number of times the licensed frequency is re-used within the point-to-point system of the Applicant who requests a spectrum licence and the band in which the frequency is requested.
9. The capacity classifications for point-to-point links are defined as follows:
 - Low capacity: < 8.192 Mbps (4 E1s/5T1s)
 - Medium capacity: ≥ 8.192 Mbps (4 E1s/5T1s) and < 155 Mbps (1 STM-1/1 OC-3)
 - High capacity: ≥ 155 Mbps (1 STM-1/1 OC3)
10. The distance classifications for point-to-point links are defined as follows⁵:
 - Short haul link: < 10 km
 - Medium haul link: ≥ 10 km and < 30 km
 - Long haul link: ≥ 30 km

⁵ Extracted from the International Telecommunications Union Handbook: Digital Radio-Relay Systems

8. Proposed Frequency Assignment Plans for Point-to-Point Radiocommunications Systems

The various frequency bands allocated for the accommodation of point-to-point radiocommunications systems can be further sub-divided into frequency channel assignments, predicated on the point-to-point system capacity requirements and path lengths, in accordance with recommendations by the ITU-R for that particular band. These frequency assignment plans are aimed at maximizing the efficient use of this spectrum, especially to promote the re-use of assigned frequencies among different point-to-point systems.

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 point-to-point systems will be determined subject to the availability of unlicensed channels, successful coordination of frequencies for new channel assignments or the ability of the system to re-use a previously licensed frequency channel (successful co-channel coordination).

8.1 1.4 GHz Band: 1427 – 1517 MHz

Frequency Assignment Plan

8.1.1 Point-to-point systems in this band are presently used for low capacity, long haul links. These frequencies are particularly favoured for links where there are restrictions to the possible antenna height above ground or sea level in offshore installations and where distances between links typically extend beyond 30km. The point-to-point systems in this band typically operate in a full duplex mode with a duplex spacing between upper and lower frequency channels.

8.1.2 This frequency band can also be used on land by point-to-multipoint radiocommunications systems, in the deployment of narrowband access networks such as Supervisory Control and Data Acquisition (SCADA) and Wireless Local Loop networks. Nevertheless, the use of this frequency band onshore does not preclude the assignment of these frequencies to point-to-point systems offshore, as this exists currently.

8.1.3 The ITU-R recommends, in Recommendation F.1242, No. 3, a frequency assignment plan that allows for channel bandwidths of 2, 1, 0.5 and 0.25 MHz. The reference channel bandwidth shall be 0.25 MHz, which would allow channel bandwidths of 2, 1, 0.5 and 0.25 MHz to be assigned.

8.1.4 In view of the above, the frequency assignment plan formula shall be as follows:

$$\text{Lower half of band: } Lf_n = f_0 - 44.625 + 0.25 n \text{ MHz}$$

$$\text{Upper half of band: } Hf_n = f_0 + 20.375 + 0.25 n \text{ MHz}$$

Where,

n = frequency channel no. = 1, 2, 3, ... 96.

f_0 = frequency band centre frequency = 1472 MHz

Lf_n and Hf_n = centre frequency of lower and upper frequency channel respectively

The upper and lower frequency channels (i.e. frequency channel pairs) are illustrated in the following table:

Table 3: Frequency Assignment Plan for Point-to-Point Systems in the 1.4 GHz Band

ITU-R Rec. F.1242, No.3			
1427 - 1517 MHz			
<i>fo (MHz):</i>		1472	
<i>Reference Channel Bandwidth (MHz):</i>		0.25	
<i>Duplex Spacing(MHz):</i>		65	
<i>$Lf = fo - 44.625 + 0.25n$ & $Hf = fo + 20.375 + 0.25n$</i>			
Channel	<i>Lf</i>(MHz)	Channel	<i>Hf</i>(MHz)
1	1427.625	1	1492.625
2	1427.875	2	1492.875
3	1428.125	3	1493.125
4	1428.375	4	1493.375
5	1428.625	5	1493.625
:	:	:	:
:	:	:	:
95	1451.125	95	1516.125
96	1451.375	96	1516.375

Recommended Licensing Process and Conditions

8.1.5 The Authority shall license a single frequency channel or a frequency channel pair in accordance with the frequency assignment plan in the table above.

8.1.6 The licensing of a frequency channel or channel pair in the 1.4 GHz band for the accommodation of a point-to-point radiocommunications system shall be on a first come, first served basis, via the licence application process as determined by the Authority.

8.1.7 A frequency channel or channel pair shall only be station licensed by the Authority in the 1.4 GHz band.

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8.1.8 Due to the existing use of the 1.4 GHz band for point-to-multipoint radiocommunications systems onshore, in Trinidad and Tobago, frequencies in the 1.4 GHz band will be only be licensed for use by point-to-point links from onshore to offshore or links established offshore.

Technical Operating Conditions and Specifications

8.1.9 All licensed point-to-point radiocommunications systems shall not exceed the maximum technical operating conditions and specifications identified in the following table, in order to operate in the 1.4 GHz band.

Table 4: Maximum Technical Operating Specifications, 1.4 GHz band, Point-to-Point Systems

Parameter	Maximum Value	Comments
Maximum RF Output Power of Transmitter	10 dBW	
Maximum Equivalent Isotropic Radiated Power (EIRP) ⁶	45 dBW	The EIRP designed for and used by a point-to-point system shall be the minimum amount necessary to effect the desired link, but shall under no circumstances exceed the maximum value of 45 dBW.
Modulation scheme	Digital	Any digital modulation technique e.g. BPSK, QPSK
Maximum Flat Fade Margin ⁷	99.999% Reliability – 48 dB 99.99% Reliability – 38 dB 99.9% Reliability – 28 dB	
Standardization	FCC, Industry Canada, ETSI	

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 system deployed, for example, antenna polarization and emission limits.

⁶ Adapted from the Code of Federal Regulations 47, Part 101.113

⁷ Adapted from ITU-R Online Spectrum Management Course, Spectrum Engineering Practice, Module 2

8.2 5 GHz Band: 4400 - 5000 MHz

Frequency Assignment Plan

- 8.2.1 Point-to-point systems in this band are presently used for high capacity, medium and long haul links. These frequencies are particularly favoured for links where capacity requirements are greater than or equal to 155 Mbps and where distances between links typically extend beyond 30km. The point-to-point systems in this band typically operate in a full duplex mode with a duplex spacing between upper and lower frequency channels.
- 8.2.2 This frequency band is typically used by wireless transmission networks that convey Plesiochronous Digital Hierarchy (PDH) or Synchronous Digital Hierarchy (SDH) data rates, within the core network of public telecommunications network and service providers.
- 8.2.3 The Authority is cognizant of the allocation of the range 4.9 – 5 GHz in jurisdictions such as the USA, Canada and Mexico. It is recognized that the use of this spectrum is designated to public health and safety agencies which require an on-scene or a temporary broadband network. Permanent stations are only licensed on a secondary, non-interference basis to primary users. However, the original commercial use of this spectrum is very much in high demand. In addition to this, spectrum has already been allocated in the 390 – 399.9 MHz range and Upper 700 MHz for public health and safety. Based on these allocations, the Authority does not see it as necessary at this time to disrupt the operation of existing Licensees in the 4.9 GHz public health and safety allocation.

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8.2.4 The ITU-R recommends, in Recommendation F.1099-3, Annex 1, No. 1, a frequency assignment plan that allows for a channel bandwidth of 40 MHz. The reference channel bandwidth shall be 40 MHz, which reflects the typical channel bandwidth employed in this band.

8.2.5 In view of the above, the frequency assignment plan formula shall be as follows:

Lower half of band: $Lf_n = f_0 - 310 + 40 n$ MHz

Upper half of band: $Hf_n = f_0 - 10 + 40 n$ MHz

Where,

n = frequency channel no. = 1, 2, 3, ... 7.

f_0 = frequency band centre frequency = 4700 MHz

Lf_n and Hf_n = centre frequency of lower and upper frequency channel respectively

The upper and lower frequency channels (i.e. frequency channel pairs) are illustrated in the following table:

Table 5: Frequency Assignment Plan for Point-to-Point Systems in the 5 GHz Band

ITU-R Rec. F.1099-3, Annex 1, No. 1			
4400 - 5000 MHz			
<i>f₀ (MHz):</i>		4700	
<i>Reference Channel Bandwidth (MHz):</i>		40	
<i>Duplex Spacing(MHz):</i>		300	
<i>Lf = f₀ - 310 + 40n & Hf= f₀ - 10 + 40n</i>			
Channel	Lf(MHz)	Channel	Hf(MHz)
1	4430	1	4730
2	4470	2	4770
3	4510	3	4810
4	4550	4	4850
5	4590	5	4890
6	4630	6	4930
7	4670	7	4970

Recommended Licensing Process and Conditions

- 8.2.5 The Authority shall license a single frequency channel or a frequency channel pair in accordance with the frequency assignment plan in the table above.
- 8.2.6 The licensing of a frequency channel or channel pair in the 5 GHz band for the accommodation of a point-to-point radiocommunications system shall be on a first come, first served basis, via the licence application process as determined by the Authority.
- 8.2.7 A frequency channel or channel pair shall only be station licensed by the Authority in the 5 GHz band.
- 8.2.8 Considering that this frequency band supports the establishment of high capacity long haul point-to-point links that serve well as a wireless transmission network for public telecommunications network and service providers, preference shall be given to the assignment of frequency channels in this band to public telecommunications network and services providers.

Technical Operating Conditions and Specifications

- 8.2.9 All licensed point-to-point radiocommunications systems shall not exceed the maximum technical operating conditions and specifications identified in the following table, in order to operate in the 5 GHz band.

Table 6: Maximum Technical Operating Specifications, 5 GHz band, Point-to-Point Systems

Parameter	Maximum Value	Comments
Maximum RF Output Power of Transmitter	10 dBW	
Maximum Equivalent Isotropic Radiated Power (EIRP) ⁸	55 dBW	The EIRP designed for and used by a point-to-point system shall be the minimum amount necessary to effect the desired link, but shall under no circumstances exceed the maximum value of 55 dBW.
Modulation scheme	Digital	Any digital modulation technique e.g. BPSK, QPSK
Maximum Flat Fade Margin ⁹	99.999% Reliability – 48 dB 99.99% Reliability – 38 dB 99.9% Reliability – 28 dB	
Standardization	FCC, Industry Canada, ETSI	

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 system deployed, for example, antenna polarization and emission limits.

⁸ Adapted from the Code of Federal Regulations 47, Part 101.113

⁹ Adapted from ITU-R Online Spectrum Management Course, Spectrum Engineering Practice, Module 2

8.3 Lower 6 GHz Band: 5850 - 6425 MHz

Frequency Assignment Plan

- 8.3.1 Point-to-point systems in the Lower 6 (L6) GHz band are presently used for high capacity, medium and long haul links. These frequencies are particularly favoured for links where capacity requirements are greater than or equal to 155 Mbps and where distances between links typically extend beyond 30km. The point-to-point systems in this band typically operate in a full duplex mode with a duplex spacing between upper and lower frequency channels.
- 8.3.2 This frequency band is also shared on a co-primary basis with the Fixed Satellite service (earth – space) stations (i.e. the uplink transmit component of earth stations). Considering that earth station uplink radio characteristics compare with that of a point-to-point system in an extraterrestrial direction, there can be co-existence between point-to-point systems and earth stations in this band, provided that the necessary interference analysis is conducted in the licensing of frequencies and locations of use, for both radio services.
- 8.3.3 This frequency band is typically used by wireless transmission networks that convey Plesiochronous Digital Hierarchy (PDH) or Synchronous Digital Hierarchy (SDH) data rates, within the core network of public telecommunications network and service providers.
- 8.3.4 The ITU-R recommends, in Recommendation F.383-8, No. 1 and 6, a frequency assignment plan that allows for a channel bandwidth of 29.65 MHz. The reference channel bandwidth shall be 29.65 MHz, which reflects the typical channel bandwidth employed in this band.
- 8.3.5 In view of the above, the frequency assignment plan formula shall be as follows:

Lower half of band: $Lf_n = f_0 - 259.45 + (29.65) n$ MHz

Upper half of band: $Hf_n = f_0 - 7.41 + (29.65) n$ MHz

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Where,

n = frequency channel no. = 1, 2, 3, ... 16.

f_0 = frequency band centre frequency = 6175 MHz

Lf_n and Hf_n = centre frequency of lower and upper frequency channel respectively

The upper and lower frequency channels (i.e. frequency channel pairs) are illustrated in the following table:

Table 7: Frequency Assignment Plan for Point-to-Point Systems in the L6 GHz Band

ITU-R Rec. F.383-8			
5850 - 6425 MHz			
<i>fo (MHz):</i>		6175	
<i>Reference Channel Bandwidth (MHz):</i>		29.65	
<i>Duplex Spacing(MHz):</i>		252.04	
<i>$Lf = fo - 259.45 + (29.65/2) n$ & $Hf = fo - 7.41 + (29.65/2) n$</i>			
Channel	<i>Lf</i>(MHz)	Channel	<i>Hf</i>(MHz)
1	5945.20	1	6197.24
2	5974.85	2	6226.89
3	6004.50	3	6256.54
4	6034.15	4	6286.19
5	6063.80	5	6315.84
6	6093.45	6	6345.49
7	6123.10	7	6375.14
8	6152.75	8	6404.79

Recommended Licensing Process and Conditions

8.3.6 The Authority shall license a single frequency channel or a frequency channel pair in accordance with the frequency assignment plan in the table above.

8.3.7 The licensing of a frequency channel or channel pair in the L6 GHz band for the accommodation of a point-to-point radiocommunications system shall be on a

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first come, first served basis, via the licence application process as determined by the Authority.

8.3.8 A frequency channel or channel pair shall only be station licensed by the Authority in the L6 GHz band.

8.3.9 Notwithstanding the fact that this frequency band supports the establishment of high capacity long haul point-to-point links that serve well as a wireless transmission network for public telecommunications network and service providers, considering that these licensees have preferential use of the 5 GHz band, the L6 GHz band shall be made available for assignment to public, private and closed user group telecommunications network and service providers.

Technical Operating Conditions and Specifications

8.3.10 All licensed point-to-point radiocommunications systems shall not exceed the maximum technical operating conditions and specifications identified in the following table, in order to operate in the L6 GHz band.

Table 8: Maximum Technical Operating Specifications, L6 GHz band, Point-to-Point Systems

Parameter	Maximum Value	Comments
Maximum RF Output Power of Transmitter	10 dBW	
Maximum Equivalent Isotropic Radiated Power (EIRP) ¹⁰	55 dBW	The EIRP designed for and used by a point-to-point system shall be the minimum amount necessary to effect the desired link, but shall under no circumstances exceed the maximum value of 55 dBW.
Modulation scheme	Digital	Any digital modulation technique e.g. BPSK, QPSK

¹⁰ Adapted from the Code of Federal Regulations 47, Part 101.113

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Parameter	Maximum Value	Comments
Maximum Flat Fade Margin ¹¹	99.999% Reliability – 48 dB 99.99% Reliability – 38 dB 99.9% Reliability – 28 dB	
Standardization	FCC, Industry Canada, ETSI	

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 system deployed, for example, antenna polarization and emission limits.

¹¹ Adapted from ITU-R Online Spectrum Management Course, Spectrum Engineering Practice, Module 2

8.4 Upper 6 GHz Band: 6430 - 7110 MHz

- 8.4.1 In the interest of allocating sufficient spectrum for the various radiocommunications services that needs to be accommodated, the Authority seeks to give consideration to the spectrum requirements by television Studio-to-Transmitter Links (STLs) broadcast auxiliary services.
- 8.4.2 Research has indicated that frequencies within the Upper 6 GHz band (i.e. 6430 – 7110 MHz) have been allocated for the establishment of television STLs in the USA (i.e. 6425 – 6525 MHz and 6875 – 7125 MHz) and Canada (i.e. 6425 - 6930 MHz and 6930 - 7125 MHz). Additionally, the trend in migrating from analogue radiocommunications systems to digital systems has resulted in equipment manufacturers looking towards frequencies above 3 GHz, as higher capacity systems can be easier accommodated. In the Upper 6 GHz band, channel bandwidths are typically 20 – 30 MHz, thus affording sufficient capacity for these digital STLs.
- 8.4.3 Consistent with the allocation of spectrum for television STLs by other ITU-R region 2 countries and the frequency band in which such equipment is available, the Authority shall allocate spectrum in the Upper 6 GHz band (i.e. 6430 - 7110 MHz) for the establishment of television STLs broadcast auxiliary services. Consequently, this band will no longer be available for assignment to **new** point-to-point systems, unless they are used for the establishment of television STLs.
- 8.4.4 It is recognized that presently, there are point-to-point systems currently in operation in this band, other than those used for broadcast auxiliary services. Noting that these existing point-to-point systems utilise the frequency assignments across this entire band, the Authority would not be able to segregate specified frequency ranges within the Upper 6 GHz band for television STLs. As a result, the entire Upper 6 GHz band shall be made available to television STLs. However, any incumbent point-to-point systems shall be allowed to continue

operation until such time that the frequencies used are required for assignment to television STLs.

- 8.4.5 The Authority anticipates that any decision to move existing point-to-point systems from the Upper 6 GHz band shall result from, but not be limited to, the potential of harmful interference caused by an existing point-to-point system with the same or adjacent frequency assignment to a television STL. Although the Authority's decision to make the entire band available to television STLs would mitigate the occurrence of the aforementioned, such a situation may arise in the future and may warrant the re-farming of the existing point-to-point systems to other frequency band. In the event that the Authority has to make such a decision, it shall consult with Licensees, who are currently licensed frequency assignments in the Upper 6 GHz band and other relevant stakeholders in the development of migration plans to align the frequencies assigned to their point-to-point systems to this Spectrum Plan. A migration process will be undertaken only when deemed necessary, by the Authority.
- 8.4.6 The frequency assignment plan and associated conditions for use of the Upper 6 GHz band for television STLs will be included in the Spectrum Plan for the Accommodation of Broadcasting Auxiliary Services, which is currently being prepared by the Authority.

8.5 Lower 7 GHz Band: 7124.5 - 7425.5 MHz

Frequency Assignment Plan

8.5.1 Point-to-point systems in the Lower 7 (L7) GHz band are presently used for medium and high capacity, medium and long haul links. These frequencies are particularly favoured for links where capacity requirements range from 4 E1s to 1 STM-1 and where distances between links typically range between 10 to 30 km. The point-to-point systems in this band typically operate in a full duplex mode with a duplex spacing between upper and lower frequency channels.

8.5.2 This frequency band is typically used by wireless transmission networks that backhaul data from access networks to the core network, such as inter-cell site transmission links. Another typical use of frequency channels in this band is to establish multi-hop point-to-point systems for Wide Area Networks (WANs) for organisations to backhaul data from satellite offices/locations to their head office.

8.5.3 The ITU-R recommends, in Recommendation F.385-9, a frequency assignment plan that allows for channel bandwidths of 3.5, 7, 14 and 28 MHz. The reference channel bandwidth shall be 3.5 MHz, which would allow channel bandwidths of 3.5, 7, 14 and 28 MHz to be assigned.

8.5.4 In view of the above, the frequency assignment plan formula shall be as follows:

$$\text{Lower half of band: } Lf_n = f_0 - 152.25 + 3.5n \quad \text{MHz}$$

$$\text{Upper half of band: } Hf_n = f_0 + 5.25 + 3.5n \quad \text{MHz}$$

Where,

n = frequency channel no. = 1, 2, 3, ... 40.

f_0 = frequency band centre frequency = 7275 MHz

Lf_n and Hf_n = centre frequency of lower and upper frequency channel respectively

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The upper and lower frequency channels (i.e. frequency channel pairs) are illustrated in the following table:

Table 9: Frequency Assignment Plan for Point-to-Point Systems in the L7 GHz Band

ITU-R Rec. F.385-9			
7110 - 7425 MHz			
<i>fo (MHz):</i>		7275	
<i>Reference Channel Bandwidth (MHz):</i>		3.5	
<i>Duplex Spacing(MHz):</i>		161	
<i>Lf = fo - 152.25 + 3.5n & Hf= fo - 5.25 + 3.5n</i>			
Channel	Lf(MHz)	Channel	Hf(MHz)
1	7126.25	1	7283.75
2	7129.75	2	7287.25
3	7133.25	3	7290.75
4	7136.75	4	7294.25
5	7140.25	5	7297.75
6	7143.75	6	7301.25
7	7147.25	7	7304.75
8	7150.75	8	7308.25
9	7154.25	9	7311.75
10	7157.75	10	7315.25
:	:	:	:
:	:	:	:
:	:	:	:
30	7227.75	30	7385.25
31	7231.25	31	7388.75
32	7234.75	32	7392.25
33	7238.25	33	7395.75
34	7241.75	34	7399.25
35	7245.25	35	7402.75
36	7248.75	36	7406.25
37	7252.25	37	7409.75
38	7255.75	38	7413.25
39	7259.25	39	7416.75
40	7262.75	40	7420.25

Recommended Licensing Process and Conditions

8.5.5 The Authority shall license a single frequency channel or a frequency channel pair in accordance with the frequency assignment plan in the table above.

8.5.6 The licensing of a frequency channel or channel pair in the L7 GHz band for the accommodation of a point-to-point radiocommunications system shall be on a first come, first served basis, via the licence application process as determined by the Authority.

8.5.7 Considering that a Licensee may be required to re-use a frequency channel pair within an area of operation (e.g. Trinidad and Tobago), where the Authority is unable to licence this same channel pair to another Licensee, the Authority may spectrum license the use of that frequency channel pair to the requesting Licensee. Otherwise, a frequency channel or channel pair shall be station licensed by the Authority in the L7 GHz band.

8.5.8 The L7 GHz band shall be made available for assignment to public, private and closed user group telecommunications network and service providers.

Technical Operating Conditions and Specifications

8.5.9 All licensed point-to-point radiocommunications systems shall not exceed the maximum technical operating conditions and specifications identified in the following table, in order to operate in the L7 GHz band.

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Table 10: Maximum Technical Operating Specifications, L7 GHz band, Point-to-Point Systems

Parameter	Maximum Value	Comments
Maximum RF Output Power of Transmitter	10 dBW	
Maximum Equivalent Isotropic Radiated Power (EIRP) ¹²	55 dBW	The EIRP designed for and used by a point-to-point system shall be the minimum amount necessary to effect the desired link, but shall under no circumstances exceed the maximum value of 55 dBW.
Modulation scheme	Digital	Any digital modulation technique e.g. BPSK, QPSK
Maximum Flat Fade Margin ¹³	99.999% Reliability – 48 dB 99.99% Reliability – 38 dB 99.9% Reliability – 28 dB	
Standardization	FCC, Industry Canada, ETSI	

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 system deployed, for example, antenna polarization and emission limits.

¹² Adapted from the Code of Federal Regulations 47, Part 101.113

¹³ Adapted from ITU-R Online Spectrum Management Course, Spectrum Engineering Practice, Module 2

8.6 Upper 7 GHz Band: 7425 - 7725 MHz

Frequency Assignment Plan

8.6.1 Point-to-point systems in the Upper 7 (U7) GHz band are presently used for medium and high capacity, medium and long haul links. These frequencies are particularly favoured for links where capacity requirements range from 4 E1s to 1 STM-1 and where distances between links typically range between 10 to 30 km. The point-to-point systems in this band typically operate in a full duplex mode with a duplex spacing between upper and lower frequency channels.

8.6.2 This frequency band is typically used by wireless transmission networks that backhaul data from access networks to the core network, such as inter-cell site transmission links. Another typical use of frequency channels in this band is to establish multi-hop point-to-point systems for Wide Area Networks (WANs) for organisations to backhaul data from satellite offices/locations to their head office.

8.6.3 The ITU-R recommends, in Recommendation F.385-9, Annex 1, a frequency assignment plan that allows for a channel bandwidth of 28 MHz. The reference channel bandwidth shall be 28 MHz, which reflects the typical channel bandwidth employed in this band.

8.6.4 In view of the above, the frequency assignment plan formula shall be as follows:

$$\text{Lower half of band: } Lf_n = f_0 - 161 + 28n \quad \text{MHz}$$

$$\text{Upper half of band: } Hf_n = f_0 - 7 + 28n \quad \text{MHz}$$

Where,

n = frequency channel no. = 1, 2, 3, 4 and 5.

f_0 = frequency band centre frequency = 7575 MHz

Lf_n and Hf_n = centre frequency of lower and upper frequency channel respectively

The upper and lower frequency channels (i.e. frequency channel pairs) are illustrated in the following table:

Table 11: Frequency Assignment Plan for Point-to-Point Systems in the U7 GHz Band

ITU-R Rec. F.385-9, Annex 1			
7425 - 7725 MHz			
<i>fo (MHz):</i>		7575	
<i>Reference Channel Bandwidth (MHz):</i>		28	
<i>Duplex Spacing(MHz):</i>		154	
<i>Lf = fo - 152.25 + 3.5n & Hf= fo - 5.25 + 3.5n</i>			
Channel	Lf(MHz)	Channel	Hf(MHz)
1	7442	1	7596
2	7470	2	7624
3	7498	3	7652
4	7526	4	7680
5	7554	5	7708

Recommended Licensing Process and Conditions

8.6.5 The Authority shall license a single frequency channel or a frequency channel pair in accordance with the frequency assignment plan in the table above.

8.6.6 The licensing of a frequency channel or channel pair in the U7 GHz band for the accommodation of a point-to-point radiocommunications system shall be on a first come, first served basis, via the licence application process as determined by the Authority.

8.6.7 Considering that a Licensee may be required to re-use a frequency channel pair within an area of operation (e.g. Trinidad and Tobago), where the Authority is unable to licence this same channel pair to another Licensee, the Authority may spectrum license the use of that frequency channel pair to the requesting Licensee.

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Otherwise, a frequency channel or channel pair shall be station licensed by the Authority in the U7 GHz band.

8.6.8 A Licensee granted a spectrum licence for frequency channels in this band can employ a channel bandwidth less than the reference channel bandwidth, provided that the duplex spacing is maintained.

8.6.9 The U7 GHz band shall be made available for assignment to public, private and closed user group telecommunications network and service providers.

Technical Operating Conditions and Specifications

8.6.10 All licensed point-to-point radiocommunications systems shall not exceed the maximum technical operating conditions and specifications identified in the following table, in order to operate in the U7 GHz band.

Table 12: Maximum Technical Operating Specifications, U7 GHz band, Point-to-Point Systems

Parameter	Maximum Value	Comments
Maximum RF Output Power of Transmitter	10 dBW	
Maximum Equivalent Isotropic Radiated Power (EIRP) ¹⁴	55 dBW	The EIRP designed for and used by a point-to-point system shall be the minimum amount necessary to effect the desired link, but shall under no circumstances exceed the maximum value of 55 dBW.
Modulation scheme	Digital	Any digital modulation technique e.g. BPSK, QPSK
Maximum Flat Fade Margin ¹⁵	99.999% Reliability – 48 dB 99.99% Reliability – 38 dB 99.9% Reliability – 28 dB	
Standardization	FCC, Industry Canada, ETSI	

¹⁴ Adapted from the Code of Federal Regulations 47, Part 101.113

¹⁵ Adapted from ITU-R Online Spectrum Management Course, Spectrum Engineering Practice, Module 2

Spectrum Plan for the Accommodation of Point-to-Point Radiocommunications Systems

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 system deployed, for example, antenna polarization and emission limits.

8.7 Lower 8 GHz Band: 7725 - 8275 MHz

Frequency Assignment Plan

8.7.1 Point-to-point systems in the Lower 8 (L8) GHz band are presently used for medium and high capacity, medium and long haul links. These frequencies are particularly favoured for links where capacity requirements range from 4 E1s to 1 STM-1 and where distances between links typically range between 10 to 30 km. The point-to-point systems in this band typically operate in a full duplex mode with a duplex spacing between upper and lower frequency channels.

8.7.2 This frequency band is typically used by wireless transmission networks that backhaul data from access networks to the core network, such as inter-cell site transmission links. Another typical use of frequency channels in this band is to establish multi-hop point-to-point system for Wide Area Networks (WANs) for organisations to backhaul data from satellite offices/locations to their head office.

8.7.3 The ITU-R recommends, in Recommendation F.386-8, Annex 6, a frequency assignment plan that allows for a channel bandwidth of 29.65 MHz. The reference channel bandwidth shall be 29.65 MHz, which reflects the typical channel bandwidth employed in this band.

8.7.4 In view of the above, the frequency assignment plan formula shall be as follows:

Lower half of band: $Lf_n = f_0 - 281.95 + 29.65n$ MHz

Upper half of band: $Hf_n = f_0 + 29.37 + 29.65n$ MHz

Where,

n = frequency channel no. = 1, 2, 3, 4, 5, 6, 7 and 8.

f_0 = frequency band centre frequency = 8000 MHz

Lf_n and Hf_n = centre frequency of lower and upper frequency channel respectively

The upper and lower frequency channels (i.e. frequency channel pairs) are illustrated in the following table:

Table 13: Frequency Assignment Plan for Point-to-Point Systems in the L8 GHz Band

ITU-R Rec. F.386-8, Annex 6			
7725 - 8275 MHz			
<i>fo (MHz):</i>		8000	
<i>Reference Channel Bandwidth (MHz):</i>		29.65	
<i>Duplex Spacing(MHz):</i>		311.32	
<i>Lf = fo - 281.95 + 29.65n & Hf= fo + 29.37 + 29.65n</i>			
Channel	Lf(MHz)	Channel	Hf(MHz)
1	7747.70	1	8059.02
2	7777.35	2	8088.67
3	7807.00	3	8118.32
4	7836.65	4	8147.97
5	7866.30	5	8177.62
6	7895.95	6	8207.27
7	7925.60	7	8236.92
8	7955.25	8	8266.57

Recommended Licensing Process and Conditions

8.7.5 The Authority shall license a single frequency channel or a frequency channel pair in accordance with the frequency assignment plan in the table above.

8.7.6 The licensing of a frequency channel or channel pair in the L8 GHz band for the accommodation of a point-to-point radiocommunications system shall be on a first come, first served basis, via the licence application process as determined by the Authority.

8.7.7 Considering that a Licensee may be required to re-use a frequency channel pair within an area of operation (e.g. Trinidad and Tobago), where the Authority is unable to licence this same channel pair to another Licensee, the Authority may spectrum license the use of that frequency channel pair to the requesting Licensee.

Otherwise, a frequency channel or channel pair shall be station licensed by the Authority in the L8 GHz band.

8.7.8 The L8 GHz band shall be made available for assignment to public, private and closed user group telecommunications network and service providers.

Technical Operating Conditions and Specifications

8.7.9 All licensed point-to-point radiocommunications systems shall not exceed the maximum technical operating conditions and specifications identified in the following table, in order to operate in the L8 GHz band.

Table 14: Maximum Technical Operating Specifications, L8 GHz band, Point-to-Point Systems

Parameter	Maximum Value	Comments
Maximum RF Output Power of Transmitter	10 dBW	
Maximum Equivalent Isotropic Radiated Power (EIRP) ¹⁶	55 dBW	The EIRP designed for and used by a point-to-point system shall be the minimum amount necessary to effect the desired link, but shall under no circumstances exceed the maximum value of 55 dBW.
Modulation scheme	Digital	Any digital modulation technique e.g. BPSK, QPSK
Maximum Flat Fade Margin ¹⁷	99.999% Reliability – 48 dB 99.99% Reliability – 38 dB 99.9% Reliability – 28 dB	
Standardization	FCC, Industry Canada, ETSI	

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 system deployed, for example, antenna polarization and emission limits.

¹⁶ Adapted from the Code of Federal Regulations 47, Part 101.113

¹⁷ Adapted from ITU-R Online Spectrum Management Course, Spectrum Engineering Practice, Module 2

8.8 Upper 8 GHz Band: 8275 - 8500 MHz

Frequency Assignment Plan

8.8.1 Point-to-point systems in the Upper 8 (U8) GHz band are presently used for low and medium capacity, medium and long haul links. These frequencies are particularly favoured for links where capacity requirements range from 4 E1s to 1 STM-1 and where distances between links typically range between 10 to 30 km. The point-to-point systems in this band typically operate in a full duplex mode with a duplex spacing between upper and lower frequency channels.

8.8.2 This frequency band is typically used by wireless transmission networks that backhaul data from access networks to the core network, such as inter-cell site transmission links. Another typical use of frequency channels in this band is to establish multi-hop point-to-point systems for Wide Area Networks (WANs) for organisations to backhaul data from satellite offices/locations to their head office.

8.8.3 The ITU-R recommends, in Recommendation F.386-8, Annex 3, a frequency assignment plan that allows for channel bandwidths of 3.5, 7 and 14 MHz. The reference channel bandwidth shall be 3.5 MHz, which would allow channel bandwidths of 3.5, 7 and 14 MHz to be assigned. This ITU-R recommendation also allows for the interleaving of adjacent channels, by alternating polarization, in order to double the number of frequency channels available for assignment and use by licensees.

8.8.4 In view of the above, the frequency assignment plan formula shall be as follows:

$$\text{Lower half of band: } Lf_n = f_0 - 103.25 + 3.5n \quad \text{MHz}$$

$$\text{Upper half of band: } Hf_n = f_0 + 15.75 + 3.5n \quad \text{MHz}$$

Where,

$$n = \text{frequency channel no.} = 1, 2, 3, 4, 5, \dots, 24.$$

$$f_0 = \text{frequency band centre frequency} = 8387.5 \text{ MHz}$$

Spectrum Plan for the Accommodation of Point-to-Point Radiocommunications Systems

Lf_n and Hf_n = centre frequency of lower and upper frequency channel respectively

The upper and lower frequency channels (i.e. frequency channel pairs) are illustrated in the following table:

Table 15: Frequency Assignment Plan for Point-to-Point Systems in the U8 GHz Band

ITU-R Rec. F.386-8, Annex 3			
8275 - 8500 MHz			
<i>fo</i> (MHz):		8387.5	
<i>Reference Channel Bandwidth</i> (MHz):		3.5	
<i>Duplex Spacing</i> (MHz):		119	
<i>Lf = fo - 103.25 + 3.5n & Hf= fo + 15.75 + 3.5n</i>			
Channel	<i>Lf</i> (MHz)	Channel	<i>Hf</i> (MHz)
1	8287.75	1	8406.75
2	8291.25	2	8410.25
3	8294.75	3	8413.75
4	8298.25	4	8417.25
5	8301.75	5	8420.75
6	8305.25	6	8424.25
7	8308.75	7	8427.75
8	8312.25	8	8431.25
9	8315.75	9	8434.75
10	8319.25	10	8438.25
11	8322.75	11	8441.75
12	8326.25	12	8445.25
13	8329.75	13	8448.75
14	8333.25	14	8452.25
15	8336.75	15	8455.75
16	8340.25	16	8459.25
17	8343.75	17	8462.75
18	8347.25	18	8466.25
19	8350.75	19	8469.75
20	8354.25	20	8473.25
21	8357.75	21	8476.75
22	8361.25	22	8480.25
23	8364.75	23	8483.75
24	8368.25	24	8487.25

Recommended Licensing Process and Conditions

- 8.8.5 The Authority shall license a single frequency channel or a frequency channel pair in accordance with the frequency assignment plan in the table above.
- 8.8.6 The licensing of a frequency channel or channel pair in the U8 GHz band for the accommodation of a point-to-point radiocommunications system shall be on a first come, first served basis, via the licence application process as determined by the Authority.
- 8.8.7 Considering that a Licensee may be required to re-use a frequency channel pair within an area of operation (e.g. Trinidad and Tobago), where the Authority is unable to licence this same channel pair to another Licensee, the Authority may spectrum license the use of that frequency channel pair to the requesting Licensee. Otherwise, a frequency channel or channel pair shall be station licensed by the Authority in the U8 GHz band.
- 8.8.8 The U8 GHz band shall be made available for assignment to public, private and closed user group telecommunications network and service providers.

Technical Operating Conditions and Specifications

- 8.8.9 All licensed point-to-point radiocommunications systems shall not exceed the maximum technical operating conditions and specifications identified in the following table, in order to operate in the U8 GHz band.

Spectrum Plan for the Accommodation of Point-to-Point Radiocommunications Systems

Table 16: Maximum Technical Operating Specifications, U8 GHz band, Point-to-Point Systems

Parameter	Maximum Value	Comments
Maximum RF Output Power of Transmitter	10 dBW	
Maximum Equivalent Isotropic Radiated Power (EIRP) ¹⁸	55 dBW	The EIRP designed for and used by a point-to-point system shall be the minimum amount necessary to effect the desired link, but shall under no circumstances exceed the maximum value of 55 dBW.
Modulation scheme	Digital	Any digital modulation technique e.g. BPSK, QPSK
Maximum Flat Fade Margin ¹⁹	99.999% Reliability – 48 dB 99.99% Reliability – 38 dB 99.9% Reliability – 28 dB	
Standardization	FCC, Industry Canada, ETSI	

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 system deployed, for example, antenna polarization and emission limits.

¹⁸ Adapted from the Code of Federal Regulations 47, Part 101.113

¹⁹ Adapted from ITU-R Online Spectrum Management Course, Spectrum Engineering Practice, Module 2

8.9 10 GHz Band: 10 – 10.68 GHz

Frequency Assignment Plan

- 8.9.1 Point-to-point systems in the 10 GHz band are presently used for low, medium and high capacity, medium and long haul links. These frequencies are particularly favoured for links where capacity requirements range from 16 E1s to 1 STM-1 and where distances between links typically range between 10 to 30 km. The point-to-point systems in this band typically operate in a full duplex mode with a duplex spacing between upper and lower frequency channels.
- 8.9.2 This frequency band is typically used by wireless transmission networks that backhaul data from access networks to the core network, such as inter-cell site transmission links. The capacity requirements there range from low to medium. Another typical use of frequency channels in this band is to establish multi-hop point-to-point systems for the backhauling of radar video and telemetry.
- 8.9.3 The demand for use of this band for point-to-point radiolocation services is not anticipated to be high. The number of spectrum users in this band would not extend further than the Trinidad and Tobago Civil Aviation Authority or the military. As such, it is anticipated that spectrum will be available, particularly in the 10500 – 10680 MHz range for assignment to more low to medium capacity point-to-point systems. Therefore, two (2) assignment plans shall be employed in the 10000 – 10680 MHz range in order to accommodate the existing radiolocation service application and allow for the assignment of available spectrum to more common commercial applications.

Spectrum Plan for the Accommodation of Point-to-Point Radiocommunications Systems

8.9.4 The ITU-R recommends, in Recommendation F.746-9, Annex 2, a frequency assignment plan that allows for a channel bandwidth of 28 MHz for the point-to-point radiolocation service applications. The reference channel bandwidth shall be 28 MHz, which reflects the typical channel bandwidth employed in this band.

8.9.5 In view of the above, the frequency assignment plan formula shall be as follows:

Lower half of band: $Lf_n = f_0 - 1561 + 28n$ MHz

Upper half of band: $Hf_n = f_0 - 1211 + 28n$ MHz

Where,

n = frequency channel no. = 1, 2, 3, 4 and 5.

f_0 = frequency band centre frequency = 11701 MHz

Lf_n and Hf_n = centre frequency of lower and upper frequency channel respectively

The upper and lower frequency channels (i.e. frequency channel pairs) are illustrated in the following table:

Table 17: Frequency Assignment Plan for Point-to-Point (Radiolocation Service) Systems in the 10 GHz Band

ITU-R Rec. F.746-9, Annex 2			
10 – 10.68 GHz			
<i>f₀ (MHz):</i>		11701	
<i>Reference Channel Bandwidth (MHz):</i>		28	
<i>Duplex Spacing(MHz):</i>		350	
<i>L_f = f₀ - 1561 + 28n & H_f = f₀ - 1211 + 28n</i>			
Channel	L_f(MHz)	Channel	H_f(MHz)
1	10168	1	10518
2	10196	2	10546
3	10224	3	10574
4	10252	4	10602
5	10280	5	10630

Spectrum Plan for the Accommodation of Point-to-Point Radiocommunications Systems

8.9.6 The ITU-R recommends, in Recommendation F.747, Annex 1, a frequency assignment plan that allows for a channel bandwidth of 7 MHz for the point-to-point applications. The reference channel bandwidth shall be 3.5 MHz, which will accommodate low capacity point-to-point links in this band.

8.9.7 In view of the above, the frequency assignment plan formula shall be as follows:

$$\text{Lower half of band: } Lf_n = f_0 - 1202.25 + 3.5n \text{ MHz}$$

$$\text{Upper half of band: } Hf_n = f_0 - 1111.25 + 3.5n \text{ MHz}$$

Where,

n = frequency channel no. = 1, 2, 3, 4, 5, ..., 24.

f_0 = frequency band centre frequency = 11701 MHz

Lf_n and Hf_n = centre frequency of lower and upper frequency channel respectively

The upper and lower frequency channels (i.e. frequency channel pairs) are illustrated in the following table:

Table 18: Frequency Assignment Plan for Point-to-Point Systems in the 10 GHz Band

ITU-R Rec. F.747, Annex 1			
10.5 – 10.68 GHz			
<i>f_o (MHz):</i>		11701	
<i>Reference Channel Bandwidth (MHz):</i>		3.5	
<i>Duplex Spacing(MHz):</i>		91	
<i>L_f = f_o – 1202.25 + 3.5n & H_f = f_o – 1111.25 + 3.5n</i>			
Channel	L_f(MHz)	Channel	H_f(MHz)
1	10502.25	1	10593.25
2	10505.75	2	10596.75
3	10509.25	3	10600.25
4	10512.75	4	10603.75
5	10516.25	5	10607.25
6	10519.75	6	10610.75
7	10523.25	7	10614.25
8	10526.75	8	10617.75
9	10530.25	9	10621.25
10	10533.75	10	10624.75
11	10537.25	11	10628.25
12	10540.75	12	10631.75
13	10544.25	13	10635.25
14	10547.75	14	10638.75
15	10551.25	15	10642.25
16	10554.75	16	10645.75
17	10558.25	17	10649.25
18	10561.75	18	10652.75
19	10565.25	19	10656.25
20	10568.75	20	10659.75
21	10572.25	21	10663.25
22	10575.75	22	10666.75
23	10579.25	23	10670.25
24	10582.75	24	10673.75

Recommended Licensing Process and Conditions

8.9.8 The Authority shall license a single frequency channel or a frequency channel pair in accordance with the frequency assignment plan in the tables above.

8.9.9 The licensing of a frequency channel or channel pair in the 10 GHz band for the accommodation of a point-to-point radiocommunications system

shall be on a first come, first served basis, via the licence application process as determined by the Authority.

8.9.10 Considering that a Licensee may be required to re-use a frequency channel pair within an area of operation (e.g. Trinidad and Tobago), where the Authority is unable to licence this same channel pair to another Licensee, the Authority may spectrum license the use of that frequency channel pair to the requesting Licensee. Otherwise, a frequency channel or channel pair shall be station licensed by the Authority in the 10 GHz band.

8.9.11 The 10 GHz band shall be made available for assignment to public, private and closed user group telecommunications network and service providers.

Technical Operating Conditions and Specifications

8.9.12 All licensed point-to-point radiocommunications systems shall not exceed the maximum technical operating conditions and specifications identified in the following table, in order to operate in the 10 GHz band.

Spectrum Plan for the Accommodation of Point-to-Point Radiocommunications Systems

Table 19: Maximum Technical Operating Specifications, 10 GHz band, Point-to-Point Systems

Parameter	Maximum Value	Comments
Maximum RF Output Power of Transmitter	10 dBW	
Maximum Equivalent Isotropic Radiated Power (EIRP) ²⁰	55 dBW	The EIRP designed for and used by a point-to-point system shall be the minimum amount necessary to effect the desired link, but shall under no circumstances exceed the maximum value of 55 dBW.
Modulation scheme	Digital	Any digital modulation technique e.g. BPSK, QPSK
Maximum Flat Fade Margin ²¹	99.999% Reliability – 48 dB 99.99% Reliability – 38 dB 99.9% Reliability – 28 dB	
Standardization	FCC, Industry Canada, ETSI	

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 system deployed, for example, antenna polarization and emission limits.

²⁰ Adapted from the Code of Federal Regulations 47, Part 101.113

²¹ Adapted from ITU-R Online Spectrum Management Course, Spectrum Engineering Practice, Module 2

8.10 11 GHz Band: 10.7 – 11.7 GHz

Frequency Assignment Plan

8.10.1 Point-to-point systems in the 11 GHz band are presently used for high capacity, short and medium haul links. These frequencies are particularly favoured for links where capacity requirements are estimated at STM-1 and where distances between links typically range less than 10 km. The point-to-point systems in this band typically operate in a full duplex mode with a duplex spacing between upper and lower frequency channels.

8.10.2 This frequency band is typically used by wireless transmission networks that backhaul data from access networks to the core network, such as inter-cell site transmission links. Another typical use of frequency channels in this band is to establish multi-hop point-to-point systems for Wide Area Networks (WANs) for organisations to backhaul data from satellite offices/locations to their head office.

8.10.3 This frequency band is also shared on a co-primary basis with the Fixed Satellite Service (space – earth) stations (i.e. the downlink receive component of earth stations). Considering that point-to-point links in this band are highly directional, there can be co-existence between point-to-point systems and earth stations in this band, provided that the necessary interference analysis is conducted in the licensing of frequencies and locations of use, for both radio services.

8.10.4 The ITU-R recommends, in Recommendation F.387-10. No. 1, a frequency assignment plan that allows for a channel bandwidth of 40 MHz. The reference channel bandwidth shall be 40 MHz, which reflects the typical channel bandwidth employed in this band.

8.10.5 In view of the above, the frequency assignment plan formula shall be as follows:

$$\text{Lower half of band: } Lf_n = f_0 - 525 + 40n \quad \text{MHz}$$

$$\text{Upper half of band: } Hf_n = f_0 + 5 + 40n \quad \text{MHz}$$

Spectrum Plan for the Accommodation of Point-to-Point Radiocommunications Systems

Where,

n = frequency channel no. = 1, 2, 3, 4, 5, ... 12.

f_0 = frequency band centre frequency = 11200 MHz

Lf_n and Hf_n = centre frequency of lower and upper frequency channel respectively

The upper and lower frequency channels (i.e. frequency channel pairs) are illustrated in the following table:

Table 20: Frequency Assignment Plan for Point-to-Point Systems in the 11 GHz Band

ITU-R Rec. F.387-10, No. 1			
10.7 – 11.7 GHz			
<i>fo (MHz):</i>		11200	
<i>Reference Channel Bandwidth (MHz):</i>		40	
<i>Duplex Spacing(MHz):</i>		530	
<i>Lf = fo - 525 + 40n & Hf= fo - 5 + 40n</i>			
Channel	Lf(MHz)	Channel	Hf(MHz)
1	10715	1	11245
2	10755	2	11285
3	10795	3	11325
4	10835	4	11365
5	10875	5	11405
6	10915	6	11445
7	10955	7	11485
8	10995	8	11525
9	11035	9	11565
10	11075	10	11605
11	11115	11	11645
12	11155	12	11685

Recommended Licensing Process and Conditions

8.10.6 The Authority shall license a single frequency channel or a frequency channel pair in accordance with the frequency assignment plan in the table above.

8.10.7 The licensing of a frequency channel or channel pair in the 11 GHz band for the accommodation of a point-to-point radiocommunications system shall be on a first come, first served basis, via the licence application process as determined by the Authority.

8.10.8 Considering that a Licensee may be required to re-use a frequency channel pair within an area of operation (e.g. Trinidad and Tobago), where the Authority is unable to licence this same channel pair to another Licensee, the Authority may spectrum license the use of that frequency channel pair to the requesting Licensee. Otherwise, a frequency channel or channel pair shall be station licensed by the Authority in the 11 GHz band.

8.10.9 The 11 GHz band shall be made available for assignment to public, private and closed user group telecommunications network and service providers.

Technical Operating Conditions and Specifications

8.10.10 All licensed point-to-point radiocommunications systems shall not exceed the maximum technical operating conditions and specifications identified in the following table, in order to operate in the 11 GHz band.

Spectrum Plan for the Accommodation of Point-to-Point Radiocommunications Systems

Table 21: Maximum Technical Operating Specifications, 11 GHz band, Point-to-Point Systems

Parameter	Maximum Value	Comments
Maximum RF Output Power of Transmitter	10 dBW	
Maximum Equivalent Isotropic Radiated Power (EIRP) ²²	55 dBW	The EIRP designed for and used by a point-to-point system shall be the minimum amount necessary to effect the desired link, but shall under no circumstances exceed the maximum value of 55 dBW.
Modulation scheme	Digital	Any digital modulation technique e.g. BPSK, QPSK
Maximum Flat Fade Margin ²³	99.999% Reliability – 48 dB 99.99% Reliability – 38 dB 99.9% Reliability – 28 dB	
Standardization	FCC, Industry Canada, ETSI	

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 system deployed, for example, antenna polarization and emission limits.

²² Adapted from the Code of Federal Regulations 47, Part 101.113

²³ Adapted from ITU-R Online Spectrum Management Course, Spectrum Engineering Practice, Module 2

8.11 13 GHz Band: 12.75 – 13.25 GHz

Frequency Assignment Plan

8.11.1 Point-to-point systems in the 13 GHz band are presently used for high capacity, short and medium haul links. These frequencies are particularly favoured for links where capacity requirements range up to 1 STM-1 and where distances between links typically range less than 10 km. The point-to-point systems in this band typically operate in a full duplex mode with a duplex spacing between upper and lower frequency channels.

8.11.2 This frequency band is typically used by wireless transmission networks that backhaul data from access networks to the core network, such as inter-cell site transmission links. Another typical use of frequency channels in this band is to establish multi-hop point-to-point system for Wide Area Networks (WANs) for organisations to backhaul data from satellite offices/locations to their head office.

8.11.3 The ITU-R recommends, in Recommendation F.497-7, No. 1, a frequency assignment plan that allows for a channel bandwidth of 28 MHz. The reference channel bandwidth shall be 28 MHz, which reflects the typical channel bandwidth employed in this band.

8.11.4 In view of the above, the frequency assignment plan formula shall be as follows:

$$\text{Lower half of band: } Lf_n = f_0 - 259 + 28n \quad \text{MHz}$$

$$\text{Upper half of band: } Hf_n = f_0 + 7 + 28n \quad \text{MHz}$$

Where,

n = frequency channel no. = 1, 2, 3, 4, 5, 6, 7 and 8.

f_0 = frequency band centre frequency = 12996 MHz

Lf_n and Hf_n = centre frequency of lower and upper frequency channel respectively

The upper and lower frequency channels (i.e. frequency channel pairs) are illustrated in the following table:

Table 22: Frequency Assignment Plan for Point-to-Point Systems in the 13 GHz Band

ITU-R Rec. F.497-7, No. 1			
12.75 – 13.25 GHz			
<i>fo (MHz):</i>		12996	
<i>Reference Channel Bandwidth (MHz):</i>		28	
<i>Duplex Spacing(MHz):</i>		266	
<i>Lf = fo - 259 + 28n & Hf= fo + 7 + 28n</i>			
Channel	Lf(MHz)	Channel	Hf(MHz)
1	12765	1	13031
2	12793	2	13059
3	12821	3	13087
4	12849	4	13115
5	12877	5	13143
6	12905	6	13171
7	12933	7	13199
8	12961	8	13227

Recommended Licensing Process and Conditions

8.11.5 The Authority shall license a single frequency channel or a frequency channel pair in accordance with the frequency assignment plan in the table above.

8.11.6 The licensing of a frequency channel or channel pair in the 13 GHz band for the accommodation of a point-to-point radiocommunications system shall be on a first come, first served basis, via the licence application process as determined by the Authority.

Spectrum Plan for the Accommodation of Point-to-Point Radiocommunications Systems

8.11.7 Considering that a licensee may be required to re-use a frequency channel pair within an area of operation (e.g. Trinidad and Tobago), where the Authority is unable to licence this same channel pair to another licensee, the Authority may spectrum licence the use of that frequency channel pair to the requesting licensee. Otherwise, a frequency channel or channel pair shall be station licensed by the Authority in the 13 GHz band.

8.11.8 The 13 GHz band shall be made available for assignment to public, private and closed user group telecommunications network and service providers.

Technical Operating Conditions and Specifications

8.11.9 All licensed point-to-point radiocommunications systems shall not exceed the maximum technical operating conditions and specifications identified in the following table, in order to operate in the 13 GHz band.

Table 23: Maximum Technical Operating Specifications, 13 GHz band, Point-to-Point Systems

Parameter	Maximum Value	Comments
Maximum RF Output Power of Transmitter	10 dBW	
Maximum Equivalent Isotropic Radiated Power (EIRP) ²⁴	50 dBW	The EIRP designed for and used by a point-to-point system shall be the minimum amount necessary to effect the desired link, but shall under no circumstances exceed the maximum value of 55 dBW.
Modulation scheme	Digital	Any digital modulation technique e.g. BPSK, QPSK
Maximum Flat Fade Margin ²⁵	99.999% Reliability – 48 dB 99.99% Reliability – 38 dB 99.9% Reliability – 28 dB	
Standardization	FCC, Industry Canada, ETSI	

²⁴ Adapted from the Code of Federal Regulations 47, Part 101.113

²⁵ Adapted from ITU-R Online Spectrum Management Course, Spectrum Engineering Practice, Module 2

Spectrum Plan for the Accommodation of Point-to-Point Radiocommunications Systems

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 system deployed, for example, antenna polarization and emission limits.

8.12 15 GHz Band: 14.5 – 15.35 GHz

Frequency Assignment Plan

8.12.1 Point-to-point systems in the 15 GHz band are presently used for medium and high capacity, medium and long haul links. These frequencies are particularly favoured for links where capacity requirements range from 16 E1s to 1 STM-1 and where distances between links typically range less than 10 km. The point-to-point systems in this band typically operate in a full duplex mode with a duplex spacing between upper and lower frequency channels.

8.12.2 This frequency band is typically used by wireless transmission networks that backhaul data from access networks to the core network, such as inter-cell site transmission links. Another typical use of frequency channels in this band is to establish multi-hop point-to-point systems for Wide Area Networks (WANs) for organisations to backhaul data from satellite offices/locations to their head office.

8.12.3 The ITU-R recommends, in Recommendation F.636-3, No. 1, a frequency assignment plan that allows for a channel bandwidth of 28 MHz. The reference channel bandwidth shall be 28 MHz, which reflects the typical channel bandwidth employed in this band.

8.12.4 In view of the above, the frequency assignment plan formula shall be as follows:

$$\text{Lower half of band: } Lf_n = f_0 + 2786 + 28n \quad \text{MHz}$$

$$\text{Upper half of band: } Hf_n = f_0 + 3626 + 28(15 - n) \quad \text{MHz}$$

Where,

n = frequency channel no. = 1, 2, 3, 4, 5, ... 15.

f_0 = frequency band centre frequency = 11701 MHz

Lf_n and Hf_n = centre frequency of lower and upper frequency channel respectively

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The upper and lower frequency channels (i.e. frequency channel pairs) are illustrated in the following table:

Table 24: Frequency Assignment Plan for Point-to-Point Systems in the 15 GHz Band

ITU-R Rec. F.636-3, No. 1			
14.5 – 15.35 GHz			
<i>fo (MHz):</i>		11701	
<i>Reference Channel Bandwidth (MHz):</i>		28	
<i>Duplex Spacing(MHz):</i>		420	
<i>Lf = fo + 2786 + 28n & Hf= fo + 3626 + 28(15 – n)</i>			
Channel	Lf(MHz)	Channel	Hf(MHz)
1	14515	1	14935
2	14543	2	14963
3	14571	3	14991
4	14599	4	15019
5	14627	5	15047
6	14655	6	15075
7	14683	7	15103
8	14711	8	15131
9	14739	9	15159
10	14767	10	15187
11	14795	11	15215
12	14823	12	15243
13	14851	13	15271
14	14879	14	15299
15	14907	15	15327

Recommended Licensing Process and Conditions

- 8.12.5 The Authority shall license a single frequency channel or a frequency channel pair in accordance with the frequency assignment plan in the table above.
- 8.12.6 The licensing of a frequency channel or channel pair in the 15 GHz band for the accommodation of a point-to-point radiocommunications system shall be on a first come, first served basis, via the licence application process as determined by the Authority.
- 8.12.7 Considering that a licensee may be required to re-use a frequency channel pair within an area of operation (e.g. Trinidad and Tobago), where the Authority is unable to licence this same channel pair to another licensee, the Authority may spectrum licence the use of that frequency channel pair to the requesting licensee. Otherwise, a frequency channel or channel pair shall be station licensed by the Authority in the 15 GHz band.
- 8.12.8 The 15 GHz band shall be made available for assignment to public, private and closed user group telecommunications network and service providers.

Technical Operating Conditions and Specifications

- 8.12.9 All licensed point-to-point radiocommunications systems shall not exceed the maximum technical operating conditions and specifications identified in the following table, in order to operate in the 15 GHz band.

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Table 25: Maximum Technical Operating Specifications, 15 GHz band, Point-to-Point Systems

Parameter	Maximum Value	Comments
Maximum RF Output Power of Transmitter	10 dBW	
Maximum Equivalent Isotropic Radiated Power (EIRP) ²⁶	55 dBW	The EIRP designed for and used by a point-to-point system shall be the minimum amount necessary to effect the desired link, but shall under no circumstances exceed the maximum value of 55 dBW.
Modulation scheme	Digital	Any digital modulation technique e.g. BPSK, QPSK
Maximum Flat Fade Margin ²⁷	99.999% Reliability – 48 dB 99.99% Reliability – 38 dB 99.9% Reliability – 28 dB	
Standardization	FCC, Industry Canada, ETSI	

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 system deployed, for example, antenna polarization and emission limits.

²⁶ Adapted from the Code of Federal Regulations 47, Part 101.113

²⁷ Adapted from ITU-R Online Spectrum Management Course, Spectrum Engineering Practice, Module 2

8.13 2.4 GHz, 5.7 and 5.8 GHz Bands: 2.4 – 2.483.5 GHz, 5.470 – 5.725 GHz and 5.725 – 5.850 GHz

Frequency Assignment Plan

8.13.1 Spread spectrum technologies such as WiFi (IEEE 802.11a/b/g/n standards) and other interference mitigation technologies can be employed to establish point-to-point systems with the use of directional antennas. These technologies are more common in point-to-multipoint or broadband wireless access applications. Nonetheless, directional antennas allow the RF energy to be focussed in a particular direction, in addition to adding more amplification of the signal (antenna gain). This results in a longer possible distance between such radios, which would typically be 100 ft without directional antennas.

8.13.2 Point-to-point systems in the 2.4, 5.7 and 5.8 GHz bands are presently used for low and medium capacity, short and medium haul links. These systems are particularly favoured as a low cost alternative to standard point-to-point systems where reliability of the connection and throughput are typically not critical. For example, such point-to-point links are deployed in a campus Wide Area Network (WAN) or in the backhauling of telemetry data from data logging devices.

8.13.3 The frequency ranges of operation for these point-to-point systems are as follows:

- a) 2.400 – 2.4835 GHz;
- b) 5470 – 5725 GHz; and
- c) 5725 – 5850 GHz.

Recommended Licensing Process and Conditions

8.13.4 The point-to-point radiocommunications systems using the 2.4, 5.7 and 5.8 GHz bands shall only be class licensed, via the Authority’s Class Licensing Regime and in accordance with the technical operating conditions and specifications identified in this Spectrum Plan, and any other term or condition stated in the class licensing regime.

8.13.5 Existing spectrum users in these bands shall claim no protection from harmful interference from point-to-point systems allowed to operate in this band, under the class licence regime.

Technical Operating Conditions and Specifications

8.13.6 All spectrum users shall not exceed the maximum technical operating conditions and specifications²⁸ identified in the following table, in order to operate a point-to-point system in the 2.4, 5.7 and 5.8 GHz bands.

Table 26: Maximum Technical Operating Specifications, 2.4, 5.7 and 5.8 GHz bands, Point-to-Point Systems

Parameter	Maximum Value	Comments
Maximum Effective Radiated Power ERP (i.e. RF Output of Transmitter)	2400 – 2483.5 MHz: 30 dBm 5470 – 5725 MHz: 30 dBm 5725 – 5850 MHz: 30 dBm	For frequency hopping systems employing less than 75 hopping channels ERP shall be no greater than 20.97 dBm
Antenna Gain	2400 – 2483.5 MHz: 6 dBi	For every 3 dB gain above 6 dBi, ERP of RF transmitter shall be reduced by 1 dBm.
	5470 – 5725 MHz: not applicable 5725 – 5850 MHz: not applicable	The EIRP shall be limited to the electromagnetic ionizing radiation emission limit of +55dBW.

²⁸ These specifications were developed with reference to FCC Part 15 rules, and the ETSI standards document EN 300 328

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Parameter	Maximum Value	Comments
Modulation scheme	Digital	Any digital modulation technique e.g. BPSK, QPSK
Multiple Access technique	Frequency Hopping Spread Spectrum (FHSS) Direct Sequence Spread Spectrum (DSSS) Orthogonal Frequency Division Multiplexing (OFDM)	Any other multiple access technology that can co-exist with FHSS, DSSS and OFDM systems can be employed.
Operating Frequency Range	2400 – 2483.5 MHz 5470 – 5725 MHz 5725 – 5850 MHz	
Minimum Channel Bandwidth	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
Maximum Antenna Beamwidth	2400 – 2483.5 MHz: 15 ⁰ 5470 – 5725 MHz: 3 ⁰ 5725 – 5850 MHz: 3 ⁰	
Narrowband Transmitter mask	Un-modulated F _{tx} +/- 3 to 14MHz = -49dBm Modulated F _{tx} +/- 3 to 8MHz = -32dBm F _{tx} +/- 2 to 14MHz = -35dBm	

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Parameter	Maximum Value	Comments
Wideband Transmitter Spectral Mask	<p>20 MHz Channelization: $F_{tx} \pm 9.5 \text{ MHz} = 0\text{dBm}$ $F_{tx} \pm 10.9 \text{ MHz} = -25\text{dBm}$ $F_{tx} \pm 19.5\text{MHz} = -32\text{dBm}$ $F_{tx} \pm 29.5\text{MHz} = -50\text{dBm}$</p> <p>10 MHz Channelization: $F_{tx} \pm 4.75 \text{ MHz} = 0\text{dBm}$ $F_{tx} \pm 5.45 \text{ MHz} = -25\text{dBm}$ $F_{tx} \pm 9.75\text{MHz} = -32\text{dBm}$ $F_{tx} \pm 14.75\text{MHz} = -50\text{dBm}$</p>	
Transmitter spurious emission limits	<p>Operating $25\text{MHz} - 1\text{GHz} = -69\text{dBm}$ $1\text{GHz to } 40\text{GHz} = -63\text{dBm}$</p> <p>Standby $25\text{MHz} - 1\text{GHz} = -90\text{dBm}$ $1\text{GHz to } 40\text{GHz} = -80\text{dBm}$</p>	
Maximum Received Signal Level (RSL) at receiver	Receiver threshold + 3dBm	
Receiver spurious emission limits	$25\text{MHz} - 1\text{GHz} = -90\text{dBm}$ $1\text{GHz to } 40\text{GHz} = -80\text{dBm}$	
Maximum Spectral Power density	FHSS – 1W/100kHz DSSS – 10mW/3kHz	
Standardization	FCC ETSI	

9. Link Length Criteria

The spectrum resources allocated to accommodate point-to-point radiocommunications systems are finite, thus making it imperative to utilize these resources amongst spectrum users in an efficient manner. In this regard, consideration shall be given to the use of specified frequency bands based on the distance between the two (2) stations that comprise a point-to-point link, i.e. the link length.

The common practice in the engineering of a point-to-point system dictates that the lower the frequency band of operation, the longer the link length can be, whilst maintaining reliable link availability. This translates to a general guideline in the efficient use of spectrum and frequency assignment for point-to-point systems, in that, lower frequency bands should be reserved for long link lengths, whilst shorter link lengths can utilise higher frequency bands. Typically, the following table on frequency-distance relationships applies²⁹:

Table 27: Frequency-Distance Relationship for Point-to-Point Systems

Frequency Range	Typical Link Length
1 – 3 GHz	60 – 75 km
3 – 10 GHz	40 – 60 km
10 – 15 GHz	25 – 40 km
> 15 GHz	< 25 km

²⁹ Extracted from the International Telecommunications Union Handbook: Digital Radio-Relay Systems

It is recognized that there are several other factors that must be taken into consideration when determining the suitable frequency for assignment to the particular point-to-point link. Such factors include:

- a. Link Capacity: the frequency bands above 5 GHz favour higher link capacities as larger channel bandwidths can be accommodated in the assignment plan.
- b. Link reliability: the percentage availability required for a point-to-point link can affect the choice of frequency band. Achieving high percentage availability is more difficult in the higher the frequency band.
- c. Rainfall: frequencies above 10 GHz are attenuated more by rainfall than lower frequencies. Consequently, in low rainfall regions, a longer link length is attainable at frequencies above 10 GHz, when compared with high rainfall regions, where the attainable link length will be shorter for such frequencies.
- d. Terrain: the propagation characteristics of a point-to-point link vary over different types of terrain and this would impact the frequency band that can be used in order to establish a reliable link.
- e. System gain: point-to-point systems that utilize radio equipment with a high system gain can effect longer link lengths at higher frequency bands.
- f. Diversity: the use of frequency or space diversity can allow higher frequency bands to be employed for longer link lengths.

The determination of a most suitable frequency band that shall be assigned for a particular point-to-point link based on the link length takes into consideration various factors, as itemized above, which relate to the specific design parameters of that link. As such, it would be difficult to prescribe a frequency-distance relationship for a point-to-point link that will apply in all scenarios.

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Therefore, the Authority shall determine, on a case-by-case basis, suitable frequency assignments for licence applications for point-to-point links, based on, but not limited to, the following criteria:

- i. The frequency requested by the applicant, based on the link design.
- ii. The aforementioned factors listed in (a) to (f).
- iii. The frequency-distance relationship table (Table 27).

10. References

1. Telecommunications Authority of Trinidad and Tobago (TATT), *Class Licensing Regime*, March 2008. Available online at:
<https://tatt.org.tt/Portals/0/Documents/Class%20Licensing%20Regime.pdf>
2. TATT, *The National Spectrum Plan*, September 2008. Available online at:
<https://tatt.org.tt/Portals/0/Documents/National%20Spectrum%20Plan.pdf>
3. TATT, *Procedures for Consultation in the Telecommunications and Broadcasting Sectors of Trinidad and Tobago*, January 2010. Available online:
<https://tatt.org.tt/Portals/0/Documents/Procedures%20for%20Consultation%20in%20the%20Telecommunication%20and%20Broadcasting%20Sectors.pdf>
4. TATT, *Spectrum Plan for the Accommodation of Point-to-Point Radiocommunications Systems*, May 2011. Available online at:
<https://tatt.org.tt/Portals/0/Documents/Point%20to%20Point%20Spectrum%20Plan%20May%2025%2011.pdf>
5. International Telecommunications Union (ITU), *Digital Radio-Relay Systems*, 1996
6. Federal Communications commission (FCC), *Electronic Code of Federal Regulations (eCFR), Title 47, Parts 15, 101-113*. Available online at:
<http://www.gpo.gov/fdsys/bulkdata/CFR/2013>
7. European Telecommunications Standards Institute (ETSI), *Electromagnetic compatibility and Radio spectrum Matters (ERM); Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive (EN 300 328)*, REN/ERM-TG11-009, June 2012
Available online at:
http://www.etsi.org/deliver/etsi_en/300300_300399/300328/01.08.01_60/en_300328v010801p.pdf

11. ANNEX 1 – Decisions on Recommendations Matrix

The following summarises the comments and recommendations received from stakeholders on the first consultative document (dated September 15th 2010), and the decisions made by TATT as incorporated in this revised consultative document (dated May 25th 2011).

Document Sub-Section	Submission Made By: Stakeholder Category ³⁰	Comments Received	Recommendations Made	TATT's Decisions
General				
Section 8				
8.2 – 5 GHz Band: 4400 - 5000 MHz	Green Dot Limited	Authority needs to be aware of the 4.9GHz public safety allocation. 4940 - 4950MHz. This will affect the channel Hf channel 6 and 7. The public safety has many PTMP system that are used for many public related networks (cctv, voice, emergency, etc...).	We propose that the Authority consider this and may even decide to not use channel 6 and 7 for PTP systems	The Authority is cognizant of the allocation of the range 4.9 – 5 GHz in jurisdictions such as the USA, Canada and Mexico. It is recognized that the use of this spectrum is designated to public health and safety agencies which require an on-scene or a temporary broadband network. Permanent stations are only licensed on a secondary, non-interference basis to primary users. However, the original commercial use of this spectrum is very much in high demand. In addition to this, spectrum has already been allocated in the 390 – 399.9 MHz range and Upper 700 MHz for public health and safety. Based on these allocations, the Authority does not see it as necessary at this time to disrupt the operation of existing

³⁰ 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
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Document Sub-Section	Submission Made By: Stakeholder Category ³⁰	Comments Received	Recommendations Made	TATT's Decisions
				Licensees in the 4.9 GHz public health and safety allocation.
8.4 – Upper 6 GHz Band: 6430-7110 MHz	TSTT	<p>The Authority notes in Section 8.4.1 of the Consultative Document that this "...frequency band is favoured by broadcast auxiliary services for the establishment of television Studio-to-Transmitter Links (STLs)". It is submitted that this statement does not communicate that an independent assessment was conducted whether by the Authority or otherwise to determine whether these frequency are indeed better suited to television Studio-to-Transmitter Links rather than any other purpose including its current uses. It is further submitted that the articulation by a person or group of persons of a preferred range of frequencies alone cannot reasonably justify the allocation of same for that purpose especially where such frequencies are currently licensed. By the same token current licensees of these frequencies including TSTT can assert that these frequencies are indeed preferred for their current use. Therefore the rationale of the Authority to "prefer" one against the other should be provided and must be reasonable. TSTT therefore queries the basis of this assertion and trust that the Authority will provide suitable clarification with respect to same.</p> <p>The Authority goes further in Section 8.4.2 of the Consultative document to indicate that "incumbent</p>	The Authority must provide its rationale for the favoured allocation of frequencies in this range to the establishment of television Studio-to-Transmitter Links.	<p>Noted. The rationale of allocating this band to broadcast auxiliary services has been included in the revised Section 8.4.</p> <p>The Authority wishes to be abundantly clear that it has not made a</p>

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Document Sub-Section	Submission Made By: Stakeholder Category ³⁰	Comments Received	Recommendations Made	TATT's Decisions
		<p>point-to-point links shall be allowed to continue in operation until such time that the frequencies used required for assignment to television STLS.” It is therefore understood that upon a request by a Television Studio for a particular frequency in this range the incumbent licensee will be required to migrate to another frequency assignment accordingly. The licences for these frequencies are usually granted for a period of 1 year and are renewable accordingly. The Authority cannot unreasonably refuse to renew such frequencies and notwithstanding this and the above, companies including but not limited to TSTT have invested significant sums to purchase and install relevant equipment utilizing frequencies in this range to support its services. Any requirement therefore to migrate from assigned frequencies will inevitably represent an additional cost to that licensee and possibly downtime and associated loss in quality of service to facilitate same. While that Authority provides for the possibility of a migration process in 8.4,3 this is at the discretion of the Authority. Furthermore, the issue as to who should bear the costs of any such migration is left silent and it is therefore assumed that the incumbent licensee will be required to bear all such costs.</p> <p>It is submitted that if indeed a suitable basis as requested above can be provided, any incumbent</p>	<p>Subject to the reasonableness of the Authority’s rationale</p>	<p>determination that existing licensees in the Upper 6 GHz band shall be migrated. This decision will only be made if, and only if, there is not sufficient spectrum for use by for broadcast auxiliary services. Please note that licences are now for a period of 3 years. The Authority has revised Section 8.4.2 in order to be more explicit with regard to the continued use of this band by these “grandfather” systems and the process by which a migration process, once deemed necessary, shall be undertaken.</p> <p>The Authority opines that the details of a migration process shall be identified only at such time that a migration</p>

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Document Sub-Section	Submission Made By: Stakeholder Category ³⁰	Comments Received	Recommendations Made	TATT's Decisions
		<p>licensee must be afforded a reasonable time and opportunity to migrate to new frequencies and cannot simply be at the discretion of the Authority. It is further submitted that an incumbent licensee should not be required to bear the costs of any such migration. Rather an appropriate mechanism to address same should be developed whether by way of a discount in license fee or otherwise.</p>	<p>above, the Authority should provide for migration in all instances where an incumbent licensee is required to migrate accordingly and a clear position regarding how the costs for any such migration will be allocated.</p>	<p>process is deemed necessary. Also, the issue of who would “bear the cost” of any such migration shall be stated, in accordance with the governing policies of the Authority at that time.</p>
<p>8.13 – 2.4 GHz, 5.7 and 5.8 GHz Bands: 2.4 – 2.483.5 GHz, 5.470 – 5.725 GHz and 5.725 – 5.850 GHz</p>	<p>TSTT</p>	<p>The Technical Operating Conditions and Specifications relating to these Bands specifically in Table 26: Maximum technical Operating Specifications, 2.4, 5.7 and 5.8 GHz bands, Point to Point Systems, require that the maximum value for the antenna gain should be “<u>6dBi and for every dB gain above 6dBi the Effective Radiated Power of the RF Transmitter should be reduced by 1dBm.</u>”</p> <p>It is noted that exist several designed systems internationally which utilize antennas within the range 22dBi to 32.5dBi and with a transmit power as of high as 25 dBm. In such a case, the Authority’s specifications would therefore require an operator of such a system to reduce the transmit power by 16dBi (in the case of a 22dBi antenna) i.e. to 9 dBm. In such a case this would place significant constraints on the ability of an operator</p>	<p>As such it is recommended greater clarification of the rationale for the application of this condition in Trinidad and Tobago or alternatively that the Authority reconsider its position on this issue and amend the same accordingly.</p>	<p>The Authority recognizes an error in its condition. It should have read, “For every 3 dB gain above 6 dBi, ERP of RF transmitter shall be reduced by 1 dBm.”</p> <p>The Authority has to take a conservative approach for the maximum allowable EIRP in the 2.4 GHz, 5.7 GHz and 5.8 GHz bands for use by point-to-point systems in order to mitigate the potential for harmful interference to lower powered radiocommunications systems that are also permitted to operate in these bands.</p> <p>One such system is point-to-multipoint (WiFi) radiocommunications system</p>

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Document Sub-Section	Submission Made By: Stakeholder Category ³⁰	Comments Received	Recommendations Made	TATT's Decisions
		<p>to utilize such antennas for the provision of backhaul transmission thereby affecting quality and reliability of the service delivered. TSTT is indeed on such operator and the implementation of these specifications would therefore necessitate TSTT making adjustments to its network to address such a change. Needless to say this will be at a cost and would inevitably require some downtime to facilitate same.</p> <p>It is submitted that such systems have been operational for a number of years without issue and as such the rationale for this specification and condition is therefore unclear.</p> <p>Please note that this response and comment is considered CONFIDENTIAL and is therefore submitted in accordance with Condition A29 of TSTT's Concession as CORPORATE AND PROPRIETARY AND CONFIDENTIAL and trust that TATT shall exercise reasonable care and take all reasonable steps in protecting same.</p>		<p>that may be used for outdoor use and even in the provision of public telecommunications services. TSTT would appreciate that the Authority has class licensed both the point-to-multipoint and point-to-point systems that utilise these bands to the benefit of spectrum users. Consequently, in order to prevent a concentration of higher powered systems in these bands, a maximum EIRP limit has been set.</p> <p>Such a limit has been instituted for point-to-multipoint systems that utilise these bands, as stated in the Spectrum Plan for the Accommodation of Broadband Wireless Access Services, and the Authority is seeking to place a limit for point-to-point systems.</p> <p>The result of this limit would allow the various radiocommunications systems to maximize the use of the 2.4 GHz, 5.7 GHz and 5.8 GHz bands.</p>
Section 9				
Link Length Policy	Green Dot Limited	Distance limitations: The authority needs to take into consideration the geographic land mass of Trinidad and Tobago coupled with the cost of equipment to determine the maximum distances.	We recommend that those limitations of minimum distance are not required, and	The Authority recognises that a Link length policy is needed in order to guide the spectrum user towards a principle of frequency and distance

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Document Sub-Section	Submission Made By: Stakeholder Category ³⁰	Comments Received	Recommendations Made	TATT's Decisions
		<p>Although the proposed requirements of minimum distances make sense on paper in practice in Trinidad it may not work. Most of the PTP links are much shorter than the minimum distances. Apart from the cellular providers and a few of the WISP's the high data rates are not required by most other users, hence they would be forced to use expensive equipment which will be overkill for their requirements.</p> <p>Furthermore the higher up you go in the spectrum the larger the dishes you will need and that will put strain on the tower requirements, further barriers to possible users, especially as the tower collocation is not financially viable.</p>	<p>TATT uses their discretion on approval with no minimum distances. Applicant should be sensible in applying and take all factors into consideration on the spectrum, equipment and costing taken into consideration or TATT should revise the minimum requirements.</p>	<p>relationship in the selection of frequencies.</p> <p>The Authority questions the validity of Green Dot's statement with regards to the size of dishes, as it can be readily observed that there exist point-to-point systems in the 7 GHz and even 15 GHz range with dish sizes of 2 ft or less.</p> <p>Nonetheless, the Authority notes Green Dot comments on the practicality of employing the link length policy. It is this very recognition by the Authority that is reflected in the Authority's position, as stated in this section, not to use the frequency-distance relationship alone in frequency assignment. In addition the frequency-distance relationship, the various other factors listed in this Section (e.g. terrain) shall also be considered in an application for a point-to-point radiocommunications systems.</p> <p>This Plan sets out the principles and rules the Authority shall follow in the assignment of frequencies for point-to-point systems.</p>

12. ANNEX 2 – Decisions on Recommendations Matrix

The following summarises the comments and recommendations received from stakeholders on the first consultative document (dated May 25th 2011), and the decisions made by TATT as incorporated in this revised consultative document (dated August 29th 2011).

Document Sub-Section	Submission Made By: Stakeholder Category ³¹	Comments Received	Recommendations Made	TATT's Decisions
Section 8				
8.4 – Lower 6 GHz Band: 5850 – 6425 MHz	Digicel	With regards to the Lower 6GHz frequency, can the adjacent channel spacing and polarization be clarified? Also on the same Lower 6GHz frequency the bandwidths between the channel (e.g. channel 1 and channel 2) is 14.825, is this how it should be?		The Authority has revised the channel assignment plan for this band based on the latest ITU-R Recommendation. It should be noted that the number of channel pairs has been reduced to eight (8) due to the removal of the interleaved channel pairs and there is no restrictions to the polarization that can be employed for a given channel pair.
8.4 – Upper 6 GHz Band: 6430-7110 MHz	TSTT	TSTT acknowledges that the Authority has sought to amend Section 8.4 of the document in light of TSTT's comments. Notwithstanding this however, the Authority's position remains that "... <i>the entire Upper GHz band shall be made available to television STLs.</i> " As the Authority is aware, the frequencies in the Upper 6 GHz band are well suited and have been widely employed to establish terrestrial high-speed data links (backhauls) to support	The Authority having provided some indication of its rationale for its preferred use of the Upper 6 GHz band for the establishment of television STLs it is respectfully submitted that these band would better	In addition to the rationale for allocating this band for television STLs in Section 8.4, the Authority further submits that consideration was given to the need for such spectrum as backhaul links for the migration to digital terrestrial television. TSTT should also be cognizant of the fact the, unlike the US and Canada, there are few broadcast transmitting sites in Trinidad and Tobago. Thus, this limits

³¹ 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
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Spectrum Plan for the Accommodation of Point-to-Point Radiocommunications Systems

Document Sub-Section	Submission Made By: Stakeholder Category ³¹	Comments Received	Recommendations Made	TATT's Decisions
		<p>telecommunications systems.</p> <p>The Authority's preferred use of these frequencies for the establishment of television STLs based on the fact that very large countries such as USA and Canada have done so is unreasonable. It must be recognized is not so already, that large countries such as the USA and Canada necessarily have several television studios given the large market size that they possess. It is respectfully submitted that Trinidad and Tobago's population of 1.3 M persons (CSO (2010)) simply cannot support the quantum of Television Stations and by extension the number of television STLs to warrant the allocation of the entire Upper 6GHz band. Furthermore, is this the Authority's vision? If so, it is incumbent upon the Authority to support this position appropriate evidence of the realistic demand for such services and the capacity of the links estimated to support same.</p> <p>In the absence of such it is submitted that the Authority's proposed "exclusive use" for this band of frequencies is not a necessity especially in Trinidad and Tobago. Furthermore, the selection of any frequency band for STLs or indeed any link for the matter, depends on many other factors including path length, RFI at the sites in question and path geometry.</p> <p>That having been said, it must be remembered that</p>	<p>serve the development of Trinidad and Tobago if it were used to support other telecommunications services included terrestrial high-speed data links.</p> <p>It is therefore recommend that the assignments of frequency pairs in the Upper 6 GHz band be left as it stands i.e. first come first served basis for available spectrum at specified sites.</p>	<p>the ability to re-use frequency channel pairs and, by extension, reduce the total quantum of spectrum needed for the television broadcasters. Consequently, all the channel pairs may be required for assignment.</p> <p>Further, notwithstanding TSTT's purported economic sustainability of this market segment, the Authority recognizes that the Upper 6 GHz band is the only frequency band that is allocated to TV STLs in the TTFAT. Also, we would like to re-emphasize that this is the only band below 10 GHz where equipment is available for TV STLs and as an equipment importer, Trinidad and Tobago needs to be guided by these specifications. Other point-to-point systems have access to all other bands.</p> <p>Finally, the Authority would like to re-iterate that any migration of incumbent point-to-point systems in this band will only occur if deemed necessary and through a consultative process with affected licensees.</p> <p>It should be noted that by assigning the entire band to TV STLs, the probability of harmful interference by incumbent</p>

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		<p>the development of Trinidad and Tobago's ICT infrastructure is one of the pillar-initiatives of the Government of Trinidad and Tobago. In that regard, given the fact (as noted above) that the frequencies in the Upper 6 GHz band can be utilized to support provider's broadband and other telecommunications services, it is strongly recommended that this should indeed be the Authority's preferred use. As such, we trust that the Authority will carefully reconsider its position on this issue and amend same accordingly.</p>		<p>systems and the need for re-farming is lowered, as there are more channel pairs available for assignment to broadcasters.</p>
<p>8.13 – 2.4 GHz, 5.7 and 5.8 GHz Bands: 2.4 – 2.483.5 GHz, 5.470 – 5.725 GHz and 5.725 – 5.850 GHz</p>	<p>TSTT</p>	<p>Notwithstanding the Authority's clarification and correction in this Section of the Consultative document, TSTT wishes to reiterate the concerns previously articulated.</p> <p>It will be recognized that international equipment manufacturers have established recommend operating parameters in particular the Antenna Gain for systems utilizing these frequencies. Needless to say one can be reasonably assured that these parameters necessarily comply with various regulatory Authorities internationally including but not limited to the USA and Canada and it given the proliferation of point to multipoint radiocommunications systems in those jurisdictions, must necessarily operate in the same place.</p> <p>As previously indicated, the Authority's position would ultimately require in the majority of cases,</p>	<p>It is recommended that the Authority provide its basis for the establishment of 6 dBi as the limit for the Antenna Gain for systems operating in these frequency bands and the Authority (if it has not yet already done so) conduct the relevant tests and analyses necessary to determine the effect of its policy in this regard on existing systems operating in these bands and advise of same</p>	<p>The Authority has relied on extensive tests conducted by the FCC and ETSI in their standardization process for the operating parameters for point-to-point systems operating in these bands as referenced in footnote 28. The Authority went a conservative step further to normalize the limits across all bands here.</p> <p>It should be noted that the proposed limits are the same used for Broadband Wireless Access (BWA) systems that share the use of these bands as well. Therefore, to minimize the potential for harmful interference to BWA systems that provide public telecommunications services in these bands, the Authority has equated the Antenna Gain limits for both systems. Also, this limit to antenna gain</p>

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		<p>if not all, that such systems be operated below their manufacturers recommended parameters. The effects on the efficiency and quality of the links as a result of this proposed change are unclear. Needless to say that any reduction in the EIRP of such systems will inevitably have some impact on the efficiency of the relevant link to transport the signals between the relevant points and thereby impact the efficiency of the quality of the services supported by same.</p> <p>From our estimates, based on the Authority's proposed policy the EIRP of some systems would have to be reduced in some cases by as much as 75%. Indeed it is possible that such a significant reduction in EIRP may require links to be shortened and therefore more sites will have to be established to support a greater number of links to cover the same distance which could therefore significantly increase the costs of providing the services that are supported by such systems.</p> <p>As such it is submitted that the Authority advise of its basis for its choice of the threshold gain of 6 dBi and the results of the tests (if any) it has conducted or evidence of the impact of its proposed policy in this regard on the operation and efficiency of point to point links utilizing these frequencies. In the event the Authority has not conducted such tests or research, it is submitted that it is critical that this be provided prior to the</p>	<p>accordingly. Further depending on the results of such tests and analyses to amend its policy accordingly.</p>	<p>will also mitigate undue harmful interference to low powered (indoor) devices such as Wi-Fi access points.</p> <p>It should be also noted that equipment manufacturers do not establish operating parameters but employ the parameters approved by the Regulatory body within the jurisdiction in which it wishes to trade. It is further respected that jurisdictions sometime do not share the same conditions for the operating parameters of equipment.</p> <p>However, recognizing the following:</p> <ol style="list-style-type: none"> 1. constraints expressed by TSTT; 2. the preferred 2.4 GHz frequency band used for public BWA systems and Wi-Fi devices; and 3. the propagation characteristics in the 5 GHz bands. <p>The Authority shall accede to remove the antenna gain limit for the 5.470 – 5.725 GHz and 5.725 – 5.850 GHz ranges. However, the antenna beam width has been reduced in order to further reduce the potential for harmful interference to other systems that operate in these 5 GHz bands.</p>

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		implementation of this policy accordingly.		The Authority further advises that any operator providing public telecommunications service should look towards station licensed frequencies for backhaul (as in the other bands of this document) as multiple systems share these bands and are all class licensed.