A Consultative Document

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

Maintenance History

Date	Change Details	Version
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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.

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	A first-come, first served licensing process shall be employed for the assignment of available spectrum. A competitive licensing process is not warranted at this time.
2.4, 5.7 and 5.8 GHz Bands	2400 – 2483.5 MHz 5470 – 5725 MHz 5725 – 5850 MHz	Point-to-Point systems operating in this band shall be class licensed in accordance with the Authority's Class Licensing Regime[1], in particular, the maximum technical operating parameters for equipment operating in these bands. Such equipment shall be certified by the Authority via its equipment certification process.
5 GHz Band	4400 – 5000 MHz	A first-come, first served licensing process shall be employed for the assignment of available spectrum. A competitive licensing process is not warranted at this time.
Lower 6 GHz Band	5850 – 6425 MHz	A first-come, first served licensing process shall be employed for the assignment of available spectrum. A competitive licensing process is not warranted at this time.

[1] The Authority's Class Licensing Regime document is available on the Website at http://www.tatt.org.tt

Frequency Band	Frequency Range of Operation	Licensing Approach
Upper 6 GHz Band	6430 – 7110 MHz	This frequency band is favoured by 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. 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.
7 GHz Band	7110 – 7900 MHz	A first-come, first served licensing process shall be employed for the assignment of available spectrum. A competitive licensing process is not warranted at this time.
8 GHz Band	7725 – 8500 MHz	A first-come, first served licensing process shall be employed for the assignment of available spectrum. A competitive licensing process is not warranted at this time.
10 GHz Band	10000 – 10680 MHz	A first-come, first served licensing process shall be employed for the assignment of available spectrum. A competitive licensing process is not warranted at this time.
11 GHz Band	10700 – 11700 MHz	A first-come, first served licensing process shall be employed for the assignment of available spectrum. A competitive licensing process is not warranted at this time.

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

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 infrastructure 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 this 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 Plan[2] 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 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 may be directed to the Authority.

[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[3] of Trinidad and Tobago", the views of industry stakeholders on the first draft of this document. The document will be revised with considerations to the comments and recommendations made during the consultation process.

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:

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
1.4 GHz Band (ITU-R Rec. F.1242 No.3): - 1427 – 1517 MHz	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. 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. 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. Therefore, the 1452 – 1492 MHz range shall not be used by the Fixed Service.	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 can be made to point-to-point systems outside these areas (e.g. for offshore links to and between oil platforms). In this band, 50% of the frequencies have been assigned and re-assigned multiple times primarily for the provision of low capacity links. 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. 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.

ITU-R Recommended Frequency Range of Operation	Trinidad and Tobago Frequency Allocation Table (TTFAT)	Current Spectrum Availability and Appropriate Licensing Method
5 GHz Band (ITU-R Rec.F.1099-3): - 4400 – 5000 MHz	The frequency range 4400 – 5000 MHz is allocated in the TTFAT to Fixed service on a co-primary basis. The frequency assignment plan for point-to-point systems in the 5 GHz band comprises this entire range.	In the 5 GHz band, all the frequencies have been assigned and re-assigned multiple times primarily for the provision of high capacity links. 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. 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.
Lower 6 GHz Band (ITU-R Rec. F.383-7 (interleaved)): - 5850 – 6425 MHz	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 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. This entire range is shared with Fixed-Satellite Services on a co-primary basis, through the use of frequency coordination.	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. 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. 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.

ITU-R Recommended Frequency Range of Operation	Trinidad and Tobago Frequency Allocation Table (TTFAT)	Current Spectrum Availability and Appropriate Licensing Method
Upper 6 GHz Band (ITU-R Rec.F.384-8): - 6430 – 7110 MHz	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. 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.	In the Upper 6 GHz band, all of the frequencies have been assigned and re-assigned multiple times primarily for the provision of high capacity links. 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. 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.
7 GHz Band (ITU-R Rec. F.385-7): - 7110 – 7900 MHz	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. The first assignment plan ranges from 7124.5 – 7425.5 MHz and the second ranges from 7425 -7725 MHz. These two ranges separate the 7 GHz band into two (2) sub-bands: the Lower 7 GHz; and Upper 7 GHz bands.	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. 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. 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.

ITU-R Recommended Frequency Range of Operation	Trinidad and Tobago Frequency Allocation Table (TTFAT)	Current Spectrum Availability and Appropriate Licensing Method
8 GHz Band (ITU-R Rec. F.386-6 (Annex 1)): - 7725 – 8500 MHz	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. There are two (2) frequency assignment plans for point-to-point systems in the 7 GHz band. 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.	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. 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. 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.

ITU-R Recommended Frequency Range of Operation	Trinidad and Tobago Frequency Allocation Table (TTFAT)	Current Spectrum Availability and Appropriate Licensing Method
10 GHz Band (ITU-R Rec. F.746-9 (Annex 2)): - 10000 – 10680 MHz	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. 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. The frequency assignment plan for point-to-point systems in the 10 GHz band comprises the entire range of frequencies form 10000 – 10680 MHz.	In the 10 GHz band, 20% of the frequencies have been assigned and re-assigned primarily for the provision of high capacity links. 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. 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.

ITU-R Recommended Frequency Range of Operation	Trinidad and Tobago Frequency Allocation Table (TTFAT)	Current Spectrum Availability and Appropriate Licensing Method
11 GHz Band (ITU-R Rec. F.387-9): - 10700 – 11700 MHz	The frequency range 10700 – 11700 MHz is allocated in the TTFAT to Fixed service on a co-primary basis. The frequency assignment plan for point-to-point systems in the 11 GHz band comprises this entire range. This entire range is shared with Fixed-Satellite Services on a co-primary basis, through the use of frequency coordination.	In the 11 GHz band, 55% the frequencies have been assigned and re-assigned multiple times primarily for the provision of high capacity links. 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. 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.
13 GHz Band (ITU-R Rec. F.497-6): - 12750 – 13250 MHz	The frequency range 12750 – 13250 MHz is allocated in the TTFAT to Fixed service on a co-primary basis. The frequency assignment plan for point-to-point systems in the 13 GHz band comprises this entire range.	In the 13 GHz band, 25% the frequencies have been assigned and re-assigned primarily for the provision of high capacity links. 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. 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.

ITU-R Recommended Frequency Range of Operation	Trinidad and Tobago Frequency Allocation Table (TTFAT)	Current Spectrum Availability and Appropriate Licensing Method
15 GHz Band (ITU-R Rec. F.636-3): - 14500 – 15350 MHz	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. The frequency assignment plan for point-to-point systems in the 15 GHz band comprises this entire range. This entire range is shared with Fixed-Satellite Services on a co-primary basis, through the use of frequency coordination.	In the 15 GHz band, 40% the frequencies have been assigned and re-assigned multiple times primarily for the provision of high capacity links. 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. 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.

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 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 as 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 has 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.

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 follows[5]:
    - 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:

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

Upper half of band: $Hf_n = f_0 + 20.375 + 0.25\,n$ 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			
fo (MHz):		1472	
Reference Channel Bandwidth (MHz):		0.25	
Duplex Spacing(MHz):		**65**	
Lf = fo - 44.625 + 0.25n & Hf= fo + 20.375 + 0.25n			
Channel	***Lf*(MHz)**	**Channel**	***Hf*(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.

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 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.

8.2.4 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			
fo (MHz):			4700
Reference Channel Bandwidth (MHz):			40
Duplex Spacing(MHz):			**300**
Lf = fo - 310 + 40n & Hf= fo - 10 + 40n			
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. 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.

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

Lower half of band: $Lf_n = f_0 - 259.45 + (29.65/2)\ n$ MHz
Upper half of band: $Hf_n = f_0 - 7.41 + (29.65/2)\ n$ MHz

Where,

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

$f0$ = 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, No. 1 and 6 5850 - 6425 MHz				
fo (MHz):				6175
Reference Channel Bandwidth (MHz):				29.65
Duplex Spacing(MHz):				**252.04**
Lf = fo - 259.45 + (29.65/2) n & Hf= fo - 7.41 + (29.65/2) n				
Channel	***Lf*(MHz)**	**Channel**	***Hf*(MHz)**	***Polarization***
1	5930.375	1	6182.415	Horizontal
2	5945.200	2	6197.240	Vertical
3	5960.025	3	6212.065	Horizontal
4	5974.850	4	6226.890	Vertical
5	5989.675	5	6241.715	Horizontal
6	6004.500	6	6256.540	Vertical
7	6019.325	7	6271.365	Horizontal
8	6034.150	8	6286.190	Vertical
9	6048.975	9	6301.015	Horizontal
10	6063.800	10	6315.840	Vertical
11	6078.625	11	6330.665	Horizontal
12	6093.450	12	6345.490	Vertical
13	6108.275	13	6360.315	Horizontal
14	6123.100	14	6375.140	Vertical
15	6137.925	15	6389.965	Horizontal
16	6152.750	16	6404.790	Vertical

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 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 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
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.

[10] Adapted from the Code of Federal Regulations 47, Part 101.113
[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 This frequency band is favoured by 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.

8.4.2 It is recognized that presently, there exists point-to-point systems in this band, other than those used for broadcast auxiliary services. These incumbent point-to-point links shall be allowed to continue operation until such time that the frequencies used are required for assignment to television STLs.

8.4.3 The Authority shall consult with Licensees, who are currently licensed frequency channels 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.

8.4.4 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:

Lower half of band: $Lf_n = f_0 - 152.25 + 3.5n$ MHz

Upper half of band: $Hf_n = f_0 + 5.25 + 3.5n$ 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

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			
fo (MHz):		7275	
Reference Channel Bandwidth (MHz):		3.5	
Duplex Spacing(MHz):		**161**	
Lf = fo - 152.25 + 3.5n & Hf= fo - 5.25 + 3.5n			
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.

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:

Lower half of band: $Lf_n = f0 - 161 + 28n$ MHz

Upper half of band: $Hf_n = f0 - 7 + 28n$ MHz

Where,

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

$f0$ = 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			
fo (MHz):			7575
Reference Channel Bandwidth (MHz):			28
Duplex Spacing(MHz):			**154**
Lf = fo - 152.25 + 3.5n & Hf= fo - 5.25 + 3.5n			
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.

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

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: $Lf_n = f0 - 281.95 + 29.65n$ MHz

Upper half of band: $Hf_n = f0 + 29.37 + 29.65n$ MHz

Where,

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

$f0$ = 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			
fo (MHz):			8000
Reference Channel Bandwidth (MHz):			29.65
Duplex Spacing(MHz):			**311.32**
Lf = fo - 281.95 + 29.65n & Hf= fo + 29.37 + 29.65n			
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:

Lower half of band: $Lf_n = f_0 - 103.25 + 3.5n$ MHz

Upper half of band: $Hf_n = f_0 + 15.75 + 3.5n$ MHz

Where,

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

f_0 = frequency band centre frequency = 8387.5 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 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			
fo (MHz):		8387.5	
Reference Channel Bandwidth (MHz):		3.5	
Duplex Spacing(MHz):		**119**	
Lf = fo - 103.25 + 3.5n & Hf= fo + 15.75 + 3.5n			
Channel	***Lf*(MHz)**	**Channel**	***Hf*(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.

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 that 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.

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			
fo (MHz):			11701
Reference Channel Bandwidth (MHz):			28
Duplex Spacing(MHz):			**350**
Lf = fo - 1561 + 28n & Hf= fo - 1211 + 28n			
Channel	***Lf*(MHz)**	**Channel**	***Hf*(MHz)**
1	10168	1	10518
2	10196	2	10546
3	10224	3	10574
4	10252	4	10602
5	10280	5	10630

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:

Lower half of band: $Lf_n = f_0 - 1202.25 + 3.5n$ MHz

Upper half of band: $Hf_n = f_0 - 1111.25 + 3.5n$ 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			
fo (MHz):	11701		
Reference Channel Bandwidth (MHz):	3.5		
Duplex Spacing(MHz):	**91**		
Lf = fo – 1202.25 + 3.5n & Hf= fo – 1111.25 + 3.5n			
Channel	***Lf*(MHz)**	**Channel**	***Hf*(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

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

8.9.6 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.

8.9.7 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 10 GHz band.

8.9.8 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

8.9.9 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 10 GHz band.

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:

Lower half of band: $Lf_n = f_0 - 525 + 40n$ MHz

Upper half of band: $Hf_n = f_0 + 5 + 40n$ MHz

Where,

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

$f0$ = 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			
fo (MHz):			11200
Reference Channel Bandwidth (MHz):			40
Duplex Spacing(MHz):			**530**
Lf = fo - 525 + 40n & Hf= fo - 5 + 40n			
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.

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:

Lower half of band: $Lf_n = f0 - 259 + 28n$ MHz

Upper half of band: $Hf_n = f0 + 7 + 28n$ MHz

Where,

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

$f0$ = 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			
fo (MHz):			12996
Reference Channel Bandwidth (MHz):			28
Duplex Spacing(MHz):			**266**
Lf = fo - 259 + 28n & Hf= fo + 7 + 28n			
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.

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

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:

Lower half of band: $Lf_n = f_0 + 2786 + 28n$ MHz

Upper half of band: $Hf_n = f_0 + 3626 + 28(15 - n)$ 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

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			
fo (MHz):			11701
Reference Channel Bandwidth (MHz):			28
Duplex Spacing(MHz):			**420**
Lf = fo + 2786 + 28n & Hf= fo + 3626 + 28(15 – n)			
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.

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 specifications[28] 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 5470 – 5725 MHz – 6 dBi 5725 – 5850 MHz – 6 dBi	For every dB gain above 6 dBi, ERP of RF transmitter shall be reduced by 1 dBm.

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

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	15^{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	

Parameter	Maximum Value	Comments
Wideband Transmitter Spectral Mask	**20 MHz Channelization:** F_{tx} +/- 9.5 MHz = 0dBm F_{tx} +/- 10.9 MHz = -25dBm F_{tx} +/- 19.5MHz = -32dBm F_{tx} +/- 29.5MHz = -50dBm **10 MHz Channelization:** F_{tx} +/- 4.75 MHz = 0dBm F_{tx} +/- 5.45 MHz = -25dBm F_{tx} +/- 9.75MHz = -32dBm F_{tx} +/- 14.75MHz = -50dBm	
Transmitter spurious emission limits	**Operating** 25MHz – 1GHz = -69dBm 1GHz to 40GHz = -63dBm **Standby** 25MHz – 1GHz = -90dBm 1GHz to 40GHz = -80dBm	
Maximum Received Signal Level (RSL) at receiver	Receiver threshold + 3dBm	
Receiver spurious emission limits	25MHz – 1GHz = -90dBm 1GHz to 40GHz = -80dBm	
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 applies[29]:

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 a 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.

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).