Spectrum Plan for the Accommodation of Radio and Television Broadcast Auxiliary Services

Maintenance History		
Date	**Change Details**	**Version**
March 16, 2015	Revised consultative document based on comments and recommendations received in the first round of consultation	0.1
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June 23, 2020	Revised consultative document based on comments and recommendations received from a targeted stakeholder consultation	0.3
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List of Abbreviations

ACMA	Australian Communications and Media Authority
ATSC	Advanced Television Systems Committee
AWS	Advanced Wireless Services
BAS	broadcast auxiliary services
BER	bit error rate
BWA	broadband wireless access
DRLs	data return links
DoRs	decisions on recommendations
DTT	digital terrestrial television
EIRP	equivalent isotropic radiated power
ENG	electronic news gathering
ERP	effective radiated power
FDD	frequency division duplexing
GHz	gigahertz
IMT	International Mobile Telecommunications
ITU	International Telecommunication Union
kHz	kilohertz
MHz	megahertz
NSP	National Spectrum Plan
OB	Outside broadcast
RPU	remote pickup unit
STL	studio-to-transmitter link
TATT	Telecommunications Authority of Trinidad and Tobago
TDD	time division duplexing
TSL	transmitter-to-studio link
TTL	transmitter-to-transmitter link

Executive Summary

Broadcast auxiliary services (BAS) are used for relaying aural and television broadcast signals from the studio to the transmitter or between two points, such as the main studio and an auxiliary studio. In addition to studio-to-transmitter links (STLs), BASs also include outside broadcast (OB) links or remote pickup units (RPUs) which relay signals from a remote location back to the studio.

A spectrum audit of all BAS frequency bands in Trinidad and Tobago, conducted by the Telecommunications Authority of Trinidad and Tobago (the Authority) in 2011, revealed:

i. a larger spectrum usage than that authorised by the Authority, particularly in the frequency range 900 MHz – 960 MHz. As of 2020, this has been rectified by the regularisation of all unauthorised users.

ii. broadcasters operating on legacy assignments made by the former Telecommunications Division under the Wireless and Telegraphy (WT) Ordinance are not aligned with the current provisions in the Trinidad and Tobago Frequency Allocation Table (TTFAT) and the International Telecommunication Union, Radiocommunication Bureau (ITU-R) table of frequency allocation for Region 2 countries.

iii. with the advent of digital terrestrial television (DTT) and its signal distribution architecture, broadcasters in Trinidad and Tobago are disinclined to relinquish noncompliant frequencies and migrate to the recommended bands.

This document, *Spectrum Plan for the Accommodation of Radio and Television Broadcast Auxiliary Services* (the Spectrum Plan) seeks, firstly, to identify the various frequency bands available for use by BAS in accordance with the TTFAT and the ITU-R table of frequency allocation for Region 2. Secondly, it summarises the results of an analysis of the current spectrum occupancy for the associated frequency bands in Trinidad and Tobago. Finally, it provides the additional frequency bands that have been made available for BAS (STL and OB) and the appropriate licensing process for the assignment of spectrum.

Table 1 summarises the frequency assignment plans and the individual licensing approach for the provision of BAS.

Table 1. Operating frequency ranges for BAS and their respective licensing approaches

Frequency Band (MHz)	Application	Licensing Approach
225 – 322	Fixed or mobile broadcasting, electronic news gathering (ENG) / radio OB	This band is favoured for the establishment of radio OB links. A first-come, first-served licensing process shall be employed for the assignment of the available spectrum.
450 – 451 455 – 456	Fixed or mobile broadcasting, remote pickup unit (RPU), radio ENG/radio OB	Due to the allocation of the band 450 – 470 MHz for the provision of BWA and land mobile systems, a moratorium shall be placed on the licensing of spectrum in these bands.
940 – 960	Radio BAS, STL, ICR	This frequency band is favoured for the establishment of FM radio STLs and OB links. A first-come, first-served licensing process shall be employed for the assignment of the available spectrum.
2025 – 2110	Fixed or mobile broadcasting ENG/television OB	This frequency band accommodates television OB activities. It is favoured by broadcasters in Trinidad and Tobago for television STLs across long hops. A moratorium shall be placed on the licensing process, pending the completion of the document *Reframing Plan for Television Outside Broadcast Systems in the 2 GHz band*.
2200 – 2300	Fixed or mobile broadcasting ENG/television OB	The preferred channel arrangement defined in this Spectrum Plan provides for the development of TV pick-up systems transmitting up to twelve 8 MHz one-way radio frequency (RF) channels.

Frequency Band (MHz)	Application	Licensing Approach
		A first-come, first-served licensing process shall be employed for the assignment of the available spectrum. With limited spectrum available, a spectrum cap of two channels per broadcaster shall be imposed.
2360 – 2400	Broadcasting ENG/TV OB	Currently congested, no new television OB links will be authorised in this band. The Authority will coordinate with existing users when refarming this band for new services.
6430 – 7110	Television STLs	Broadcasters favour this frequency band for the establishment of television STLs. A first-come, first-served licensing process shall be employed for the assignment of the available spectrum. A competitive licensing process is not warranted at this time, as the demand for spectrum is much lower than the supply. A competitive process shall be considered when demand tends to supply.

1. Introduction

1.1 Rationale

The spectrum used by broadcasters to bring live news from the field to the studio and to transmit programming from the studio to the transmitter is called broadcast auxiliary service (BAS) spectrum. This spectrum continues to be squeezed as the Federal Communications Commission (FCC) and others push for more sharing of spectrum.

The Telecommunications Authority of Trinidad and Tobago (the Authority) is mandated under the Telecommunications Act, Chap. 47:31 (the Act), section 41(1) to:

> "….. regulate the use of the spectrum in order to promote the economic and orderly utilisation of frequencies for the operation of all means of telecommunications and to recover the cost incurred in the management of the spectrum."

The Authority seeks to execute this mandate through the development of a spectrum plan that facilitates the efficient use of the spectrum for BAS, in keeping with the changes recommended by the ITU. Additionally, as both FTA radio and television are transitioning from analogue to digital broadcasting, spectrum plans for BAS are being revised globally to meet these changes.

1.2 Purpose

This *Spectrum Plan for the Accommodation of Radio and Television Broadcast Auxiliary Services* (Spectrum Plan):

i. identifies the optimal frequency bands for BAS, as allocated globally and, in particular, for ITU-R Region 2 countries[1], taking account of current technologies.

ii. support the regularization of all legacy broadcast auxiliary systems that are not aligned with the current provision in the TTFAT and the ITU-R table of frequency allocation for Region 2 countries.

This Spectrum Plan is a subset of the *National Spectrum Plan* (NSP) and should be considered part of the entire NSP. The NSP provides a framework for the regulation of spectrum, in an orderly, efficient manner, in accordance with the Authority's mandate.

[1] The International Telecommunication Union, Radiocommunications Bureau (ITU-R) Region 2 countries are the Americas and Caribbean countries.

1.3 Background

An STL is defined in this Spectrum Plan as "a fixed point-to-point station that is authorised to transmit sound or television broadcasting programme material from a broadcasting studio to a broadcasting transmitter in another location"[2]. Broadcasters employing STLs usually have a transmitter-to-studio link (TSL) to return telemetry information.

Electronic news gathering (ENG), more commonly called outside broadcast (OB), is defined as "the collection of video and/or sound material without the use of film or recorder, using small, often handheld, electronic cameras and/or microphones with radio links to the newsroom and/or to the portable tape or other recorders" ITU-R Report BT.2069-5 (2011). Video and/or sound reporting is usually unpredictable in terms of both timing and location. It is often required that such links be established quickly, allowing very little time for frequency co-ordination and licensing.

Not all the BAS assignments made under the Wireless and Telegraphy (WT) Ordinance of 1936 are consistent with the frequency bands allocated in the TTFAT or with changes in the industry. As such, legacy assignments made by the former Telecommunications Division under the WT Ordinance for STLs and OBs were not aligned with the Authority's TTFAT, 2010 and contemporary frequency bands used by the broadcasting industry. A 2011 spectrum audit that included a desk study of all BAS frequency bands revealed this and called for the regularisation of these legacy assignments.

This Spectrum Plan, in addition to the TTFAT, identifies the frequency bands allocated by the Authority for STLs and OBs and shall also apply to legacy assignments made under the WT Ordinance.

[2] Australian Communications and Media Authority (ACMA) 2018

1.4 Objectives

This Spectrum Plan:

i. identifies the frequency ranges allocated for the accommodation of BAS, in accordance with the TTFAT and ITU Radiocommunication (ITU-R) Regulations.

ii. outlines the licensing process for the assignment of frequency channels, including any specific licensing conditions.

iii. specifies the technical operating conditions and parameters to be imposed on the licensed radiocommunications systems in the allocated frequency ranges.

1.5 Relevant Legislation

The sections of the Act that inform this Spectrum Plan are:

Section (18)(1)(i):

> "Subject to the provisions of this Act, the Authority may exercise such functions and powers as are imposed on it by this Act and in particular –
> Plan, supervise, regulate and manage the use of the radio frequency spectrum, including –
> *(i)* the licensing and registration of radio frequencies and call signs to be used by all stations operating in Trinidad and Tobago or on any ship, aircraft, or other vessels or satellite registered in Trinidad and Tobago;
>
> *(ii)* the allocation, assignment, and reallocation or reassignment of frequency bands where necessary."

Section 36(1):

> "Subject to subsection (2), no person shall –
> *(a)* establish, operate or use a radio-communication service;
> *(b)* install, operate or use any radio transmitting equipment; or
> *(c)* establish, operate or use any radio-communication service on board any ship, aircraft, or other vessel in the territorial waters or territorial airspace of Trinidad and Tobago, other than a ship of war or a military aircraft or satellite registered in Trinidad and Tobago without a licence granted by the Authority."

Section 41(1):

> "The Authority shall regulate the use of the spectrum in order to promote the economic and orderly utilisation of frequencies for the operation of all means of

> telecommunications and to recover the cost incurred in the management of the spectrum."

Section 41(2):

> "The Authority shall develop a spectrum plan in order to regulate the use of the spectrum."

Section 41(3):

> "The National Spectrum Plan shall be made available to the public in the manner prescribed by the Authority."

Section 41(4):

> "The National Spectrum Plan shall state how the spectrum shall be used and the procedures for licensing frequency bands."

Section 42 (1):

> "Subject to subsection (2), the Authority may, in accordance with the spectrum plan allocate and re-allocate frequency bands."

Section 42 (2):

> "In the allocation or assignment and re-allocation or reassignment of frequency bands by the Authority priority shall be given to the needs of the State in respect of matters of national security."

1.6 Review Cycle

This Spectrum Plan will be modified periodically by the Authority, at least five years from the last published version, with a view to adapting it to the needs of the broadcasting industry and meeting changing and unforeseen circumstances. When such a need arises, the Authority will announce its intention to review the document, thereby allowing for input from representatives from the telecommunications and broadcasting sectors or any other pertinent stakeholder(s).

Questions or concerns regarding the maintenance of this Spectrum Plan may be directed to the Authority via e-mail to info@tatt.org.tt.

1.7 Consultation Process

In accordance with its *Procedures for Consultation in the Telecommunications Sector of Trinidad and Tobago* (ver. 2.0) (TATT 2015), the Authority sought the views of industry stakeholders on the proposals put forward in this Spectrum Plan.

It should be noted that versions 0.1 and 0.2 are the revised versions of the document following the first and second consultative rounds, respectively; however, the finalised draft was not approved for publication at the time.

In June 2020, key stakeholders in the broadcasting sector were engaged to provide feedback on the document via a targeted stakeholder consultation that included the Trinidad and Tobago Publishers and Broadcasters Association (TTPBA), and representatives from free-to-air (FTA) radio and television broadcasters. Following this consultation, the document was revised as version 0.3 and is now ready for final approval.

The comments and recommendations received from the targeted stakeholder consultation and the Authority's decisions are compiled in the decisions on recommendations (DoRs) in Appendix V.

There were no material revisions made to the content of the document based on the comments and recommendations received from the targeted stakeholders' consultation.

1.8 Other Relevant Documents

In addition to the NSP, the following relevant policies, plans, and regulations prepared by the Authority contain provisions which, through reference in this document, constitute the provisions of this Spectrum Plan:

i. *Authorisation Framework for the Telecommunications and Broadcasting Sectors of Trinidad and Tobago*, currently in effect.

ii. *Recommendations for Spectrum Management Policy*, currently in effect.

iii. *National Spectrum Plan*, currently in effect.

iv. *Trinidad and Tobago Frequency Allocation Table (9 kHz – 1000 GHz)*, currently in effect.

1.9 Definitions

Adjacent channel: The channel (or frequency) that is directly above and below a specific channel (frequency). Two systems are deemed to be adjacent if their emissions do not overlap (ACMA 2018).

Data return link (DRL): the DRL channels permit a "feedback" or "return" link to be established from an electronic news group (ENG) receive-only (ENG-RO) site to an originating TV pickup station (commonly referred to as ENG truck) (ATSC 2008).

Equivalent isotropic radiated power (EIRP): the product of the power supplied to the antenna and the antenna gain in a given direction, relative to an isotropic antenna (absolute or isotropic gain) (ITU-R 2016).

Effective radiated power (ERP) (in a given direction): the product of the power supplied to the antenna and its gain relative to a half-wave dipole in a given direction (ITU-R 2016)

Primary service: a radiocommunications service for which stations can claim protection from harmful interference from stations of a secondary service (ITU-R 2016)

Protection ratio: the radio frequency (RF) protection ratio is the minimum value of wanted-to-unwanted signal ratio, usually expressed in decibels at the receiver input, determined under specified conditions such that a specific reception quality is achieved at the receiver output (ITU-R BS.412-9, 1998).

Remote pickup broadcast mobile station: A broadcast station authorised for use while in motion or during halts at unspecified locations. As used in this subpart, mobile stations include hand-carried, pack-carried and other portable transmitters (47 C.F.R. § 74.401).

Secondary service: a radiocommunications service for which stations shall not cause harmful interference to stations of primary services and cannot claim protection from interference from stations of primary services (ITU-R 2016)

Station: one or more transmitters or receivers, or a combination of transmitters and receivers, including the accessory equipment, necessary at one location for carrying on a radiocommunications service or radio astronomy service (ITU-R 2016)

Studio-to-transmitter link (STL): a fixed point-to-point station that is authorised to transmit sound or television broadcasting programme material from a broadcasting studio to a broadcasting transmitter in another location (ACMA 2018)

Transmitter-to-studio link (TSL): the TSL of a radio station or television station is a return link which carries telemetry data from the remotely located radio transmitter or television transmitter back to the studio for monitoring purposes (ITU-R, 2020)

2. Considerations for the Accommodation of Radio and Television Broadcast Auxiliary Services

International, regional and national regulatory frameworks significantly influence spectrum plan formulation, harmonisation and implementation. In developing the spectrum plan for radio and television BAS that facilitates the efficient allocation and assignment of spectrum to users, the following information was considered by the Authority:

i. The frequency bands allocated to radio and television BAS, in accordance with the ITU-R Region 2 Table of Frequency Allocations and the TTFAT.

ii. The current spectrum bands used by broadcasters for auxiliary broadcast systems in Trinidad and Tobago.

iii. The availability of spectrum to accommodate radio and television BAS.

iv. The following spectrum plans that contain frequency bands that overlap with the bands identified by the Authority for BAS:

    a. The spectrum plan for the accommodation of broadband wireless access (BWA) services

    b. The spectrum plan for the accommodation of land mobile radiocommunications systems.

    c. The spectrum plan for the accommodation of point-to-point radiocommunications systems

v. The appropriate licensing method for the assignment of spectrum to users.

The information discussed and collated relating to the abovementioned considerations have been summarised and illustrated in table 2 below:

Table 2. Summary of frequency ranges for BAS which can be considered for licensing in the Republic of Trinidad and Tobago

Service Applications[3]	Frequency Range of Operation	Trinidad and Tobago Frequency Allocation Table (TTFAT)	Current Spectrum Availability and Appropriate Licensing Method
Broadcasting – FM radio OB links	225 – 322 MHz	The frequency range 225 – 322 MHz spans seven frequency allocations in the TTFAT, all of which are allocated to the fixed and mobile services on a co-primary basis. The frequency assignment plan for broadcast auxiliary systems in this band comprises the entire 225 – 322 MHz range, all of which have been allotted to fixed services.	Based on the results of a spectrum audit, this band is underutilised and was specifically allocated to radio OB systems. A first-come, first-served licensing process shall be employed for the assignment of the available spectrum.
Broadcasting – television OB links	450 – 451 MHz 455 – 456 MHz	The frequency ranges 450 – 451 MHz and 455 – 456 MHz fall within the frequency band 450 – 470 MHz. According to footnote **TT14** in the TTFAT, *Studio Transmitter Links (STLs), Electronic News Gathering (ENG) and Outside Broadcast (OB) systems will no longer be licensed in the band 450 – 470 MHz.*	These frequency ranges accommodate ENG and television OB activities. Due to the allocation of the band 450 – 470 MHz for the provision of Land Mobile services, no new BAS users will be licensed in the frequency ranges 450 – 451 MHz and 455 – 456 MHz.
Broadcasting – FM radio STLs	940 – 960 MHz	Footnote **TT22** in the TTFAT states, *The band 942 – 960 MHz is intended for Radio Broadcast Studio Transmitter Links (STLs). All other uses will be considered secondary*. Due to the high demand for spectrum and, in keeping with the TTFAT, this band	Approximately 50% of the frequencies in this band have been assigned and re-assigned multiple times, primarily for the provision of low capacity links.

[3] All services are primary unless otherwise stated. Stations of secondary service: a) shall not cause harmful interference to stations of primary service to which frequencies are already assigned or to which frequencies may be assigned at a later date; b) cannot claim protection from harmful interference from stations of a primary service to which frequencies are already assigned or may be assigned at a later date; and c) can, however, claim protection from harmful interference from stations of the same service or from other secondary service(s) to which frequencies may be assigned at a later date.

Service Applications[3]	Frequency Range of Operation	Trinidad and Tobago Frequency Allocation Table (TTFAT)	Current Spectrum Availability and Appropriate Licensing Method
		was extended to 940 – 960 MHz for fixed services on a co-primary basis.	A first-come, first-served licensing process shall be employed for the assignment of the available spectrum.
Broadcasting – ENG and/or television OB links	1990 – 2110 MHz	Footnote **TT27** in the TTFAT states, *In the bands, 1990 – 2025 MHz and 2160 – 2200 MHz, a moratorium has been placed on the licensing of new systems in the fixed service. Existing fixed service systems operating in these bands will be displaced to enable the implementation of mobile-satellite service systems in certain sub-bands*. According to footnote **TT28** in the TTFAT, *The band 2025 – 2110 MHz is intended for Electronic News Gathering (ENG) and Outside Broadcast (OB) activities. Studio Transmitter Links (STLs) and other fixed services will not be authorized in this band.*	This frequency band accommodates ENG and television OB activities. A moratorium shall be placed on the licensing process, pending the completion of a document entitled, "*Reframing Plan for Television Outside Broadcast Systems in the 2 GHz band."* A first-come, first-served licensing process shall be employed for the assignment of the available spectrum.
Broadcasting – ENG and/or television OB links	2200 – 2300 MHz	The TTFAT allows for fixed and mobile systems; however, according to footnote **TT31** in the TTFAT, *The band 2200 – 2300 MHz is intended for fixed point-to-point systems only*.	This frequency band is unoccupied and will be used to accommodate ENG and television OB activities. A first-come, first-served licensing process shall be employed for the assignment of the available spectrum. Due to the limited spectrum, a spectrum cap of two channels per broadcaster shall be imposed.
Broadcasting – ENG and/or	2360 – 2400 MHz	The TTFAT allocates this frequency range to fixed, mobile (except aeronautical mobile), and broadcasting services on a co-primary basis.	This frequency range is currently congested. A moratorium shall be placed on the licensing process until such time

Service Applications[3]	Frequency Range of Operation	Trinidad and Tobago Frequency Allocation Table (TTFAT)	Current Spectrum Availability and Appropriate Licensing Method
television OB links			that the Authority deems it necessary to conduct a refarming exercise to make spectrum available.
Broadcasting – television STL links	6430 – 7110 MHz	The frequency range 6430 – 7110 MHz spans three frequency allocations in the TTFAT, all of which are allocated to fixed service on a co-primary basis. The frequency assignment plan for BAS in the upper 6 GHz band comprises a portion of the frequency range 5925 – 6700 MHz, the entire 6700 – 7075 MHz range and a part of the 7075 – 7145 MHz range.	In the upper 6 GHz band, all the frequencies can be assigned and re-assigned multiple times, where technically feasible, for the provision of low-, medium- and high-capacity links. A first-come, first-served licensing process shall be employed for the assignment of the available spectrum. This recommended licensing approach will be implemented with immediate effect for broadcasters upgrading their services.

3. Frequency Assignment Principles

The following principles apply to the frequency assignment plan developed for the accommodation of BAS in Trinidad and Tobago:

1. The frequency assignment plan for a specified frequency band shall follow the relevant ITU-R recommendations and take into consideration the principal frequency assignment plan utilised for BAS currently operating 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. Frequency assignments shall be made in accordance with the selected licensing process, as established by the Authority.

4. 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.

5. The notional antenna for BAS is specified as that which has technical characteristics similar to those of a two-meter grid parabolic. Operators should upgrade their antenna systems to the notional antenna specifications if:
    i. their use of a lower-performance antenna inhibits necessary assignments that would have been possible if the notional antenna were in use.
    ii. there is a possibility of interference to or from other services.

6. OB shall be spectrum licensed and shall be granted for the assignment of a frequency channel for exclusive use to the licensee. STLs shall be station licensed and shall be granted for the assignment of a frequency channel at a specified fixed location. Frequency re-use shall be considered when the spectrum utilisation in the specified band exceeds spectrum availability in that band.

7. The frequency spectrum blocks or frequency channels in the assignment plan for STL services do not include any guard bands. All necessary guard bands or isolation for users authorised to use adjacent blocks or channels for STLs are achieved through geographic separation.

8. OB usually operates on a short-term, non-interference basis and shall be discontinued upon notification that perceptible interference is being caused to the operation of adjacent services.

9. The effective radiated power (ERP) / equivalent isotropic radiated power (EIRP) and antenna height designed for, and used by, STL and OB stations shall, to a practical extent, be the minimum amount necessary to achieve the desired level of service.

10. The frequency coordination procedure involves calculating the wanted to unwanted (W/U) signal level ratio for the proposed service and each existing service in the coordination area. The calculated W/U ratios are compared with the required protection ratios for the services involved. The protection ratio values required to protect a radio STL from unacceptable interference from another STL, OB and other links are based on the ITU recommendation ITU-R BT.2215-6, 2016, and are summarised in table 3.

Table 3: Protection ratio (ITU-R Report – ITU-R BT.2215-6, 2016)

Relationship	**Protection Ratio**
Co-channel	50 dB
Adjacent channel	0 dB

4. Frequency Assignment Plans for Radio and Television Broadcast Auxiliary Services

The various frequency bands allocated for the accommodation of radio and television BAS can be further sub-divided into frequency channels or block assignments predicated on the type(s) of technologies that can be employed using the allocated spectrum. These frequency assignment plans are aimed at maximising the efficient use of the allocated spectrum and promoting the efficient re-use of assigned frequencies.

The following sub-sections outline the various frequency ranges under consideration: the frequency assignment plan, inclusive of its rationale; the recommended licensing process and conditions; and the technical operating conditions and specifications for the radiocommunications systems operating in the stated frequency band.

The actual availability of frequency channels for radio and television BAS will be determined subject to the availability of unlicensed channels, the 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).

4.1 250 MHz Band (225 – 322 MHz)

4.1.1 Frequency Assignment Plan

The 250 MHz band (225 – 322 MHz) is currently used for OB links associated with FM radio broadcasting services in Trinidad and Tobago. The frequency assignment plan for radio BAS comprises the entire frequency range 225 – 322 MHz, all of which has been allotted to fixed and mobile services in the TTFAT.

The frequency range 225 – 322 MHz is divided into frequency channels of 200 kHz bandwidth for the operation of radio OB systems, as shown in Figure 1.

There are no restrictions on the number of hops (channels) to be authorised. This is based on the proposed system configuration and availability of spectrum; however, systems requiring multiple hops should be designed to optimise spectrum utilisation.

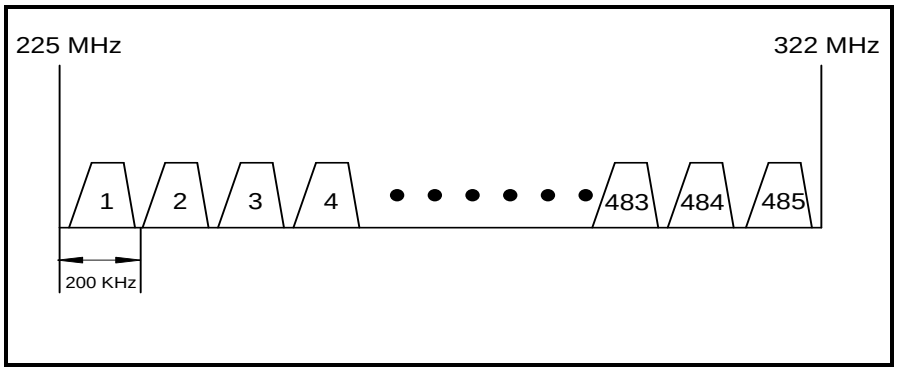

Figure 1. Channel plan for 225 – 322 MHz range

4.1.2 Licensing Process and Conditions

The rules for licensing are as follows:

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

ii. Frequency assignments will be issued on demand, provided that the frequency requested will not cause harmful interference to users. The Authority reserves the right to assign frequencies other than those requested if, in its opinion, such action is warranted.

iii. A frequency channel or channel pair shall be spectrum licensed by the Authority in the 225 – 322 MHz band.

iv. A licence for an ENG/OB link will be issued to the licensee of an AM, FM, non-commercial FM, low-power FM or international broadcast station.

v. The licensing of a frequency channel or channel pair in this band for the accommodation of a radio OB system shall be on a first-come, first-served basis, via the licence application process, as determined by the Authority.

vi. All fixed point-to-point links shall use directional antennas with a minimum gain with respect to a half-wave dipole of 9 dB in the VHF band (30–300 MHz) and 12 dB in the UHF band (above 300 MHz).

vii. An increase in transmitter power over the specified limits depicted in Table 4 may be permitted if technical justification is provided.

4.1.3 Technical Operating Conditions and Specifications

No licensed radio auxiliary system shall exceed the maximum technical operating conditions and specifications identified in Table 4, in order to operate in the stated band.

Table 4. Maximum technical operating specifications for the 225 – 322 MHz Band

Parameters	Maximum Value	Comments
Maximum transmitter output power delivered to the antenna	10 dBW	The transmitter power delivered to the antenna input per RF channel shall be the minimum amount necessary to achieve the desired level of service and shall not, under any circumstances, exceed the maximum permissible value.
Maximum Equivalent Isotropic Radiated Power (EIRP)[4]	40 dBW	The EIRP designed for and used by a point-to-point system shall be the minimum amount necessary to effect the desired level of service, but shall under no circumstances exceed the maximum value of 45 dBW
Modulation scheme	Analogue or digital	Analogue or digital modulation technique
Channel bandwidth	200 kHz	Channels are allocated based on the requirement of equipment used for radio auxiliary systems.

Notwithstanding the parameters identified in Table 4, additional technical operating conditions may be instituted and identified in the respective schedules of the licence document for the specific radiocommunications technology deployed.

[4] Adapted from the Code of Federal Regulations 47, Part 101.113

4.2 450 – 451 MHz and 455 – 456 MHz

The frequency ranges 450 – 451 MHz and 455 – 456 MHz are utilised by broadcasters in the ITU-R Region 2 countries for STLs, Radio (OB/ENG) and mobile operations associated with broadcasting undertakings. However, due to the allocation of these frequency ranges for the provision of BWA and land mobile radiocommunications services, no new BAS users will be licensed in the stated frequency ranges.

4.2.1 Licensing Process and Conditions

The rules for licensing are as follows:

i. No new OB links for AM and/or FM shall be authorised in these frequency ranges.

ii. All existing broadcasters operating auxiliary services, as indicated by TTFAT footnote TT14, shall be allowed to continue operation until such time that the Authority deems it necessary for broadcasters to migrate to the authorised frequency bands.

iii. Existing broadcasters wishing to migrate to the Authority's recommended bands shall be required to relinquish all existing 450 MHz or 455 MHz assigned frequencies and replace them with an assignment in the authorised bands.

iv. Broadcasters operating auxiliary services other than those indicated by TTFAT footnote TT14 shall be required to migrate to the respective band.

4.3 900 MHz Band: 940 – 960 MHz

4.3.1 Frequency Assignment Plan

The 900 MHz band (940 – 960 MHz) is designated for FM radio BAS, specifically radio STL, radio TSL and TTL.

STLs may utilise a variety of channel bandwidths greater than 25 kHz, to a maximum of 400 kHz, depending on the application, the mode of operation and the number of control or programme subcarriers used. Although most STLs are still analogue, the 2011 audit showed a 30% conversion to digital technologies. Typical STL channel bandwidths are 250 kHz for equipment using digital modulation and range from 60 kHz to 400 kHz for analogue equipment.

The frequency channel arrangements defined in the assignment plan (see Figure 2) provide for 300 kHz STLs, which can be concatenated to allow a bandwidth of 600 kHz.

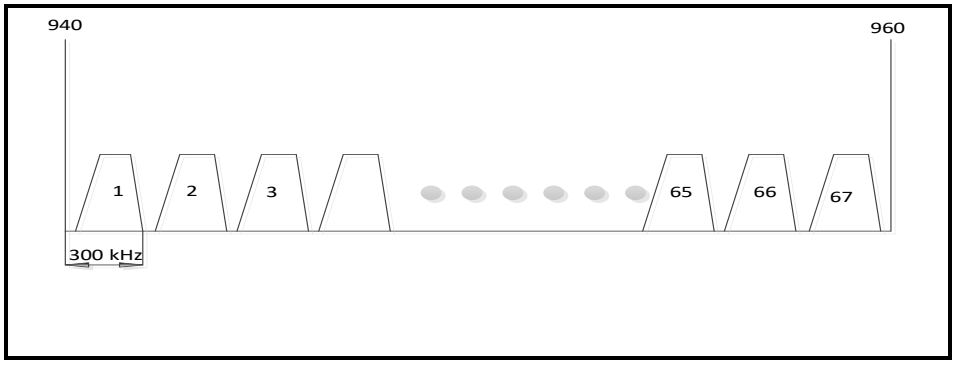

Figure 2. Frequency assignment channel plan for 940 – 960 MHz band

4.3.2 Licensing Process and Conditions

The rules for licensing are as follows:

i. A first-come, first-served licensing process shall be employed for the assignment of the available spectrum.

ii. A single broadcast auxiliary station may be authorised up to a maximum of two channels (600 kHz total bandwidth) for transmission of programme material between a single origin and one or more fixed points.

iii. The use of two links operating on different frequencies and carrying the same programme over the same path is not permitted. System backup (redundancy/diversity) can be achieved using hot standby configurations.

iv. A station licence shall be granted for BAS in this band.

v. Each radio STL will be licensed for a specified transmitter location to communicate with a specified receiving location, and such STL shall not operate at any other location without prior written approval from the Authority. The directivity of the main radiation lobe shall be a term of the station authorisation.

vi. With respect to channel reuse, the assignment of an STL frequency or frequencies to the holder of an authorised FM radio station does not confer a monopoly on the use of the frequency or frequencies, nor shall an STL authorisation be construed as conferring any right of continuing tenure regarding the frequency or frequencies.

vii. Stations must employ antennas that meet the performance standards in Appendix I, Figure 5, except that, subject to technical justifications, antennas meeting other standards may be employed. It should, however, be noted that the use of high-performance antennas (Appendix I, Figure 5) or better will be required where problems due to interference can be resolved by their deployment.

4.3.3 Technical Operating Conditions and Specifications

No licensed STL shall exceed the maximum technical operating conditions and specifications identified in Table 5 when operating in the stated frequency band.

Table 5. Maximum technical operating specifications for the 940 – 960 MHz band

Parameters	Maximum Value	Comments
Maximum transmitter output power delivered to the antenna	10 dBW	The transmitter power delivered to the antenna input per RF channel shall be the minimum amount necessary to achieve the desired level of service and shall not, under any circumstances, exceed the maximum permissible value.
Maximum Equivalent	40 dBW	The EIRP designed for and used by a point-to-point system shall be the minimum amount necessary to effect the desired level of service, but

Parameters	Maximum Value	Comments
Isotropic Radiated Power (EIRP)[5]		shall under no circumstances exceed the maximum value of 45 dBW
Modulation scheme	Analogue or digital	Analogue or digital modulation technique
Channel bandwidth	300 kHz	Channels are allocated based on the requirement of equipment used for radio auxiliary systems.

Notwithstanding the parameters identified in Table 5, additional technical operating conditions may be instituted and identified in the respective schedules of the licence document for the specific radiocommunications technology deployed.

[5] Adapted from the Code of Federal Regulations 47, Part 101.113

4.4 2 GHz Band (2025 – 2110 MHz)

4.4.1 Frequency Assignment Plan

The 2 GHz band (1990 – 2110 MHz) is allocated on a primary basis for television OB services and is shared with fixed point-to-point systems. Specific systems include fixed point-to-point video links, TTL and mobile links for ENG equipment.

The frequency range 1990 – 2110 MHz is divided into seven channels, as illustrated in Figure 3 — one with bandwidth 18 MHz and six with bandwidth 17 MHz. These channels are used by broadcasters for the operation of television OB in analogue mode.

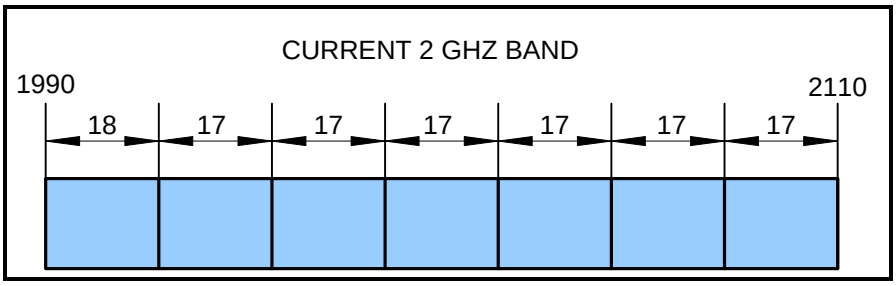

Figure 3. Existing channel plan for 2 GHz band

- Total spectrum: 120 MHz (1990 – 2110 MHz)
- Seven channels: six 17 MHz and one 18 MHz; all analogue channels
- Used for ENG/OB

With the introduction of digital technology into the market and, in keeping with TTFAT footnotes TT27 and TT28, this band shall be refarmed for digital operation with a bandwidth of 8 MHz, thus freeing spectrum for the emerging mobile satellite service (MSS) and advanced wireless services (AWS), as seen in Figure 4.

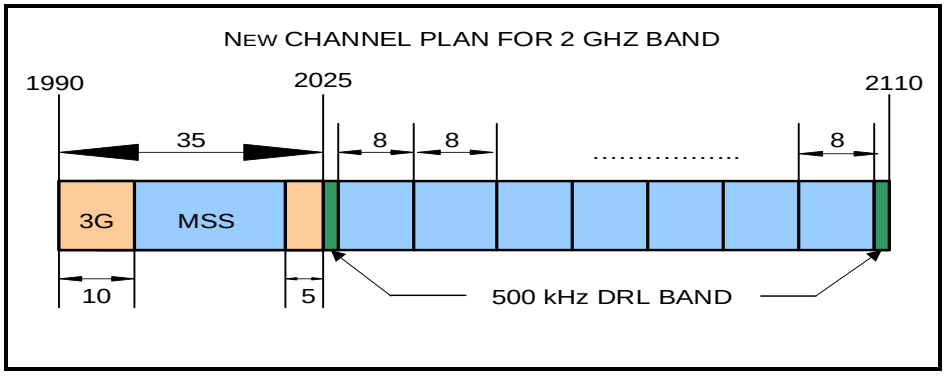

Figure 4. New Frequency Assignment Channel Plan for 2 GHz band

- Total spectrum: 85 MHz (2025 – 2110 MHz)
- 10 channels: each 8 MHz; all digital channels
- DRL is used for return bit error rate (BER) information
- Used for ENG/OB

4.4.2 Licensing Process and Conditions

Following the completion of the document *Refarming Plan for Television Outside Broadcast Systems in the 2 GHz band*, the rules for licensing will be as follows:

i. All applications for spectrum in this frequency band shall indicate the relevant operating TV broadcast station and shall specify the area in which the proposed operation is intended (i.e., Trinidad and Tobago, Trinidad only or Tobago only).

ii. Television pickup services shall be authorised to operate on one channel only, according to the following relationship (see Appendix II Figure 6 for detailed channel plan):

Lower half of the band G(n) = 2021.5 + 8n

Where: n = 1 to 10, and G(n) is the centre frequency of the channel

iii. Licensees of TV broadcast stations may be authorised to operate one or more TV OB and TV relay stations for the purpose of relaying signals over a path that cannot be covered with a single station.

iv. The centre frequency of the emission shall be maintained within ± 0.001% of the assigned frequency.

v. Television pickup systems shall use a highly directive antenna system. The co-polarised radiation pattern envelope in the horizontal plane of the antenna must remain within envelope B, shown in Appendix II, Figure 1, for both vertical and horizontal polarisations.

vi. The licensing of a frequency channel in this band for the accommodation of a TV OB system shall be on a first-come, first-served basis, via the licence application process, as determined by the Authority.

4.4.3 Technical Operating Conditions and Specifications

No licensed radiocommunications systems shall exceed the maximum technical operating conditions and specifications identified in Table 6.

Table 6. Maximum technical operating specifications for the 2025 – 2110 MHz band

Parameter	Maximum Value	Comments
Maximum transmitter output power delivered to the antenna	10 dBW	The transmitter power delivered to the antenna input per RF channel shall be the minimum amount necessary to achieve the desired level of service and shall not, under any circumstances, exceed the maximum permissible value.
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 level of service, but shall under no circumstances exceed the maximum value of 45 dBW
Channel bandwidth	8 MHz	Digital channels
Modulation scheme	Digital	Any digital modulation technique, e.g., QPSK

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

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

4.5 2.2 GHz Band: 2200 – 2300 MHz

The 2.2 GHz band (2200 – 2300 MHz) is planned for the operation of television OB systems transmitting up to 8 MHz one-way RF channels.

4.5.1 Frequency Assignment Plan

With the introduction of digital technology and the availability of equipment, this band shall be licensed for digital operation with a bandwidth of 8 MHz.

The preferred radio-frequency channel arrangement for up to 12 one-way channels, each accommodating digital medium-capacity systems, shall be expressed by the following relationship:

Upper half of the band: $f_n = 2196.5 + 8n$ MHz

Where, n = frequency channel no. = 1, 2, 3,.....12

f_n = centre frequency of each channel respectively

4.5.2 Licensing Process and Conditions

The rules for licensing are as follows:

i. Licensees of TV broadcast stations may be authorised to operate one or more TV OB and TV relay stations for the purpose of relaying the same content over a path that cannot be covered with a single station. Notwithstanding this, due to the limited spectrum available, a spectrum cap of two channels per broadcaster shall be imposed.

ii. The Authority reserves the right to assign frequencies other than those requested if, in its opinion, such action is warranted.

iii. For TV pickup systems, the use of highly directive antenna systems is encouraged.

iv. The licensing of a frequency channel in this band for the accommodation of a TV OB system shall be on a first-come, first-served basis, via the licence application process, as determined by the Authority.

4.5.3 Technical Operating Conditions and Specifications

No licensed radiocommunications systems shall exceed the maximum technical operating conditions and specifications identified in Table 7.

Table 7. Maximum technical operating specifications for the 2200 – 2300 MHz band

Parameter	Maximum Value	Comments
Maximum transmitter output power delivered to the antenna	10 dBW	The transmitter power delivered to the antenna input per RF channel shall be the minimum amount necessary to achieve the desired level of service and shall not, under any circumstances, exceed the maximum permissible value.
Maximum Equivalent Isotropic Radiated Power (EIRP)[7]	45 dBW	The EIRP designed for and used by a point-to-point system shall be the minimum amount necessary to effect the desired level of service, but shall under no circumstances exceed the maximum value of 45 dBW
Channel bandwidth	8 MHz	Digital channels
Modulation scheme	Digital	Any digital modulation technique, e.g., QPSK

Notwithstanding the parameters identified in Table 7, additional technical operating conditions may be instituted and identified in the respective schedules of the licence document for the specific radiocommunications technology deployed.

[7] Adapted from the Code of Federal Regulations 47, Part 101.113

4.6 2.3 GHz Band: 2360 – 2400 MHz

The 2.3 GHz band (2360 – 2400 MHz) is currently congested and is favoured for the operation of medical body area networks (MBAN) devices. No new users shall be authorised in this band.

4.6.1 Licensing Process and Conditions

The rules for licensing are as follows:

i. The Authority recognises that, at present, there are point-to-point systems in this band other than those used for auxiliary broadcast services. These licensed point-to-point links shall be allowed to continue operation until the Authority deems it necessary for all to migrate.

ii. The Authority shall consult with licensees and other relevant stakeholders in this band on the development of migration plans, to align the frequencies assigned for point-to-point systems to their respective spectrum plans. A migration process will be undertaken only when deemed necessary by the Authority.

iii. Existing broadcasters wishing to migrate to the Authority's recommended bands shall be required to relinquish all assigned frequencies.

4.7 Upper 6 GHz Band: 6430 – 7110 MHz

ITU-R Region 2 countries use the upper 6 GHz band (6430 – 7110 MHz) for BAS, such as television STLs, TTLs and ENG. Cable television studio-headend links and television inter-studio programme links are also permitted on a secondary basis. Consistent with other Region 2 countries, this frequency band shall also be utilised for BAS in Trinidad and Tobago.

4.7.1 Frequency Assignment Plan

In keeping with the TTFAT, this band is allocated for television STLs on a primary basis. The use of this spectrum for direct delivery of video programmes to the general public is not permitted.

The entire upper 6 GHz band (6425 – 7125 MHz) shall be made available for backhaul capacity to DTT networks. On completion of the analogue to digital switchover, broadcasters shall no longer be required to maintain traditional backhaul systems (STLs), as this spectrum will be assigned to DTT signal distributors.

The assignment of a frequency or frequencies to a holder of an authorised television station in this band does not confer a monopoly on the use of the frequency or frequencies. The frequency or frequencies may be assigned to more than one system in the same area, where technically feasible.

The ITU-R Recommendation F.384-10 (09/07) describes the necessary RF channel arrangements for fixed wireless systems operating in the upper 6 GHz (6425 – 7125 MHz) band, which may be used for high-, medium- and low- capacity fixed systems.

The preferred RF channel arrangement for up to 16 go and 16 return channels, each accommodating plesiochronous digital or synchronous medium-capacity rates, should be obtained by interleaving additional channels between those of the main pattern, and shall be expressed by the following relationship:

Lower half of the band: $fn = f0 – 350 + 20\ n$ MHz

Upper half of the band: $fn2 = f0 – 10 + 20\ n$ MHz

Where,

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

f0 = frequency band centre frequency = 6770 MHz

fn and fn2 = centre frequency of lower and upper frequency channels, respectively

The upper and lower frequency channels (frequency channel pairs) are illustrated in Table 8.

Table 8. Frequency assignment plan for BAS in the upper 6 GHz band

ITU-R Rec. F.384-10 **6430 – 7110 MHz**				
fo (MHz):			6770	
Reference Channel Bandwidth (MHz):			20	
Duplex Spacing(MHz):			340	
fn = fo - 350 + (20) n & fn2= fo - 10 + 20 n				
Channel	***Lf*(MHz)**	**Channel**	***Hf*(MHz)**	***Polarization***
1	6440.000	1’	6780.000	Horizontal
2	6460.000	2’	6800.000	Vertical
3	6480.000	3’	6820.000	Horizontal
4	6500.000	4’	6840.000	Vertical
5	6520.000	5’	6860.000	Horizontal
6	6540.000	6’	6880.000	Vertical
7	6560.000	7’	6900.000	Horizontal
8	6580.000	8’	6920.000	Vertical
9	6600.000	9’	6940.000	Horizontal
10	6620.000	10’	6960.000	Vertical
11	6640.000	11’	6980.000	Horizontal
12	6660.000	12’	7000.000	Vertical
13	6680.000	13’	7020.000	Horizontal
14	6700.000	14’	7040.000	Vertical
15	6720.000	15’	7060.000	Horizontal
16	6740.000	16’	7080.000	Vertical

4.7.2 Licensing Process and Conditions

The rules for licensing are as follows:

i. The Authority shall license a single frequency channel or a frequency channel pair in accordance with the frequency assignment plan in Table 8.

ii. The licensing of a frequency channel or channel pair in the upper 6 GHz band for the accommodation of BAS shall be on a first-come, first-served basis, via the Authority’s licensing process. A competitive licensing process is not warranted at this time, as the demand for spectrum is much lower than the supply. A competitive process shall be considered when demand tends to supply

iii. The use of improved digital modulation techniques that increase channel loading capacity is encouraged and will be given priority in frequency assignment.

iv. Technical characteristics of the equipment used in this band shall conform to all applicable Trinidad and Tobago standards, international standards, and the ITU-R radio regulations.

v. Different channel bandwidths are applicable to those systems deployed or purchased prior to this revision. The usage of different channel bandwidths is limited until the end of the system lifespan of the apparatus. The licensed channel bandwidth (video, audio and subscriber channels) shall be 20 MHz.

vi. Each television STL will be licensed at a specified transmitter location to communicate with a specified receiving location, and the directivity of the main radiation lobe of the antenna shall be a term of the station authorisation.

vii. For FM systems, the maximum peak-to-peak deviation of the RF carrier by composite video baseband signals shall not exceed 8 MHz. Sub-carriers with sound programme channels may be multiplexed with the video signal. The carriage of AM/FM STLs as a sub-carrier of TV STLs will be encouraged in order to conserve the spectrum.

4.7.3 Technical Operating Conditions and Specifications

No licensed broadcast auxiliary systems shall exceed the maximum technical operating conditions and specifications, identified in Table 9, in order to operate in the upper 6 GHz band.

Table 9. Maximum Technical Operating Specifications for the 6430 – 7110 MHz band

Parameter	Maximum Value	Comments
Maximum transmitter output power delivered to the antenna	10 dBW	The transmitter power delivered to the antenna input per RF channel shall be the minimum amount necessary to achieve the desired level of service and shall not, under any circumstances, exceed the maximum permissible value.

Parameter	Maximum Value	Comments
Maximum Equivalent Isotropic Radiated Power (EIRP)[8]	45 dBW	The EIRP designed for and used by a point-to-point system shall be the minimum amount necessary to effect the desired level of service, but shall under no circumstances exceed the maximum value of 45 dBW
Channel bandwidth	20 MHz	Digital channels
Modulation scheme	Digital	Any digital modulation technique, e.g., QPSK

Notwithstanding the parameters identified in Table 9, additional technical operating conditions may be instituted and identified in the respective schedules of the licence document for the specific radiocommunications technology deployed.

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

References

- Industry Canada, "*SRSP-507 — Technical Requirements for Radio Systems in the Fixed Service Operating in the Band 941.5-944MHz*", 1995.
- Industry Canada, "*SRSP-300.953 — Technical Requirements for Radio Systems in the Fixed Service Operating in the Band 953-960 MHz*", 2009.
- Australia Communications and Media Authority, "*Television Outside Broadcast Service (1980–2110 MHz and 2170–2300 MHz) Frequency Band Plan 2012*", Federal Register of Legislative Instruments F2012L00731, 2012
- Industry Canada, "*SRSP-302.0 – Technical Requirements for Fixed Line-of-Sight Radio Systems Operating in the Bands 2025-2110 MHz and 2200-2285 MHz*", 2000
- ITU-R. "*Rec. ITU-R F.384-10: Radio-frequency channel arrangements for medium- and high capacity digital fixed wireless systems operating in the upper 6 GHz (6 425-7 125 MHz) band*", 2007
- Industry Canada, "*SRSP-306.4 – Technical Requirements for Fixed Line-of-Sight Radio Systems Operating in the Band 6425-6930 MHz*", 2006
- Industry Canada, "*SRSP-306.5 — Technical Requirements for Line-of-sight Radio Systems Operating in the Fixed Service and Providing Television Auxiliary Services in the Bands 6590-6770 and 6930-7125 MHz*", 1990
- Industry Canada, "*SRSP-512 — Technical Requirements for Land Mobile and Fixed Radio Services Operating in the Band 220–222 MHz*", 2010
- International Telecommunication Union – Radiocommunication Sector, "*System Characteristics of Television Outside Broadcast, Electronic News Gathering and Electronic Field Production in the Fixed Service for use in Sharing Studies*" Recommendation ITU-R F.1777-1, 2015.

Appendix I – Technical Specifications for 940 – 960 MHz Band

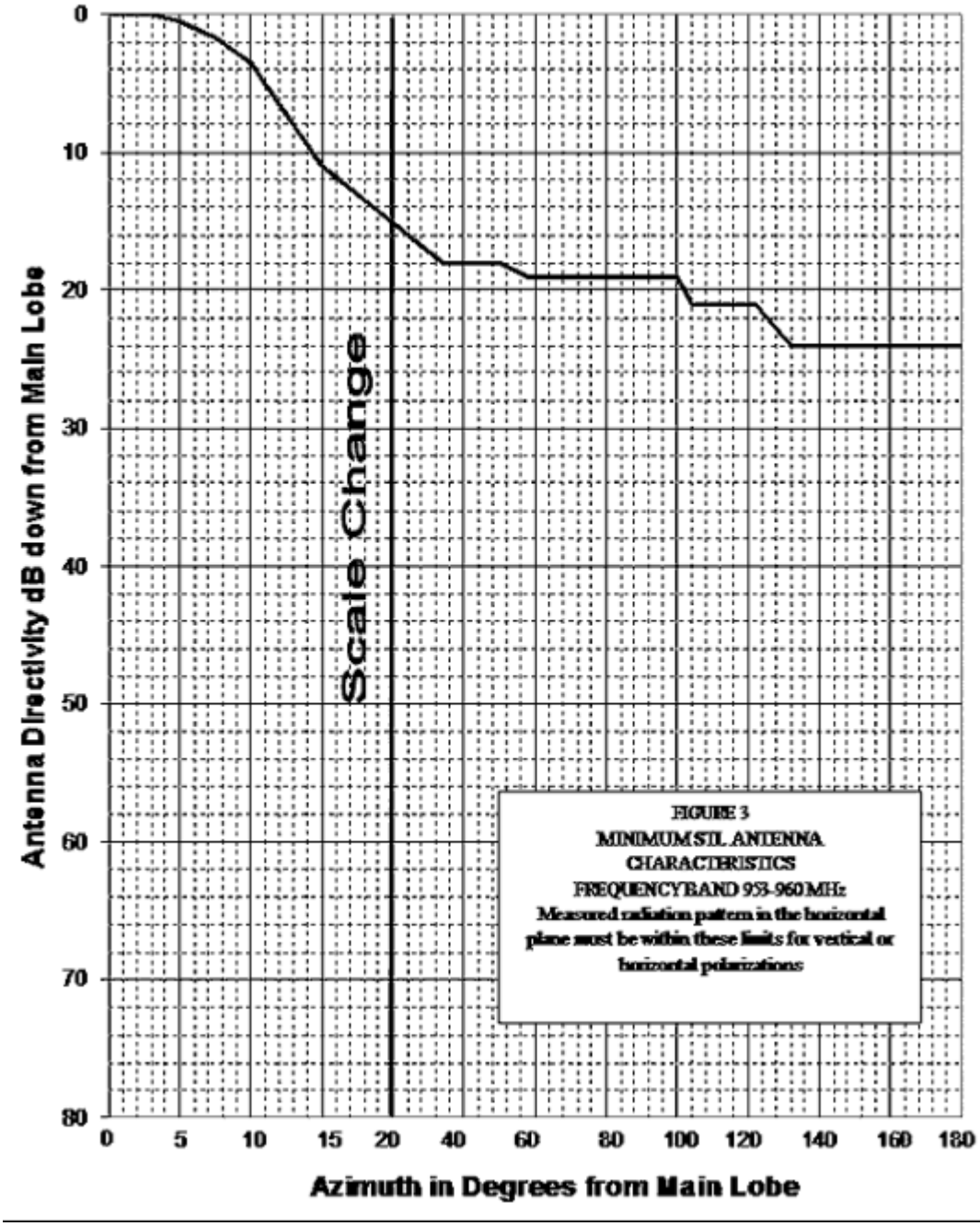

Figure 5. STL antenna characteristics (Industry Canada SRSP-300.953)

Appendix II – Technical Specifications for 2025 – 2110 MHz Band

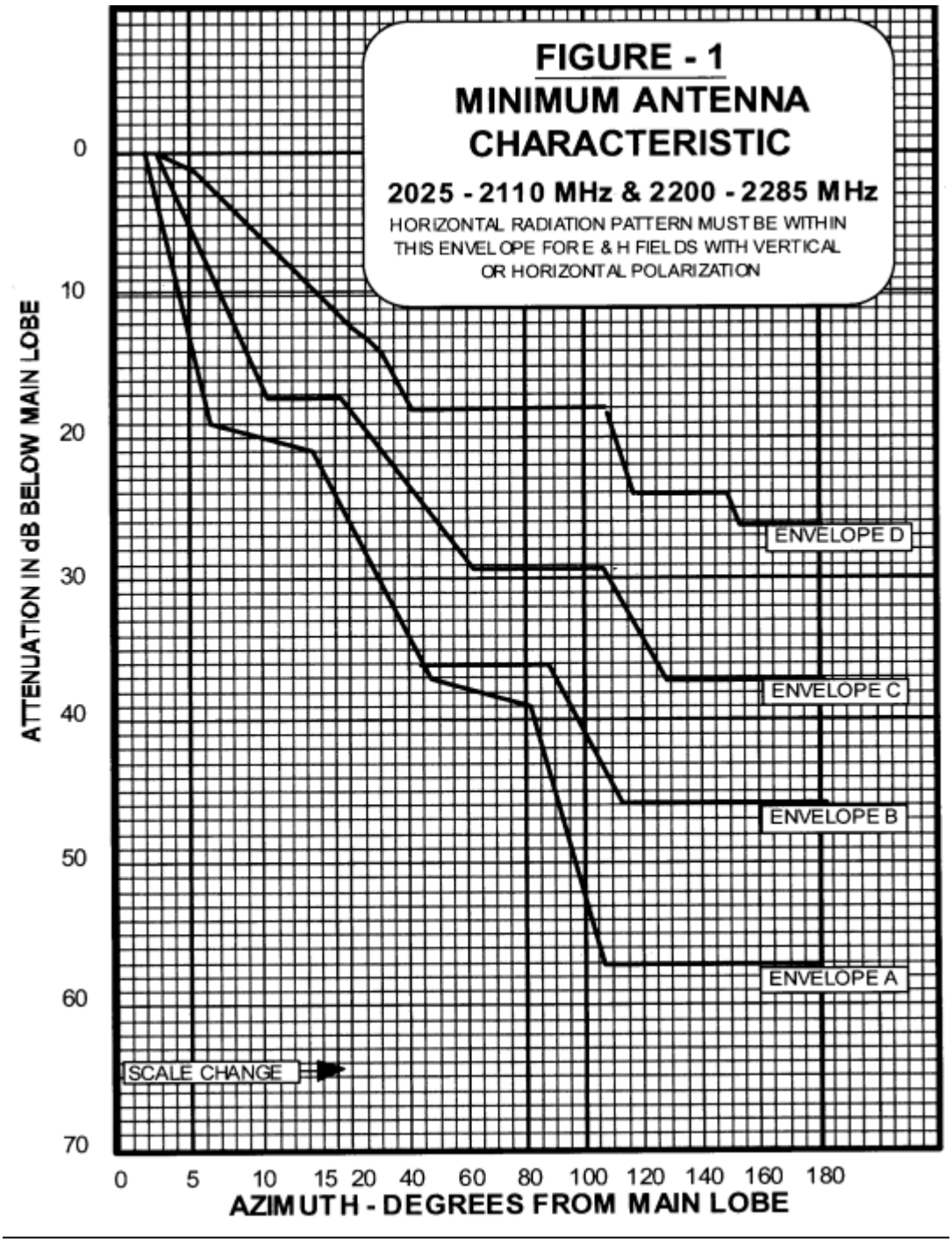

Figure 6. Antenna characteristics (Industry Canada SRSP-302.0)

TV PICKUP CHANNELS (MHZ)
G1: 2029.50
G2: 2037.50
G3: 2045.50
G4: 2053.50
G5: 2061.50
G6: 2069.50
G7: 2077.50
G8: 2185.50
G9: 2101.50

Figure 7. TV pickup frequency plan (Industry Canada SRSP-302.0)

Appendix III – Decisions on Recommendations Matrix for the First Consultation Round

(…Matrix is attached separately…)

Appendix IV – Decisions on Recommendations Matrix for the Second Consultation Round

(…Matrix is attached separately…)

Appendix V – Decisions on Recommendations Matrix for the Targeted Stakeholder Consultation

(…Matrix is attached separately…)