

RADIO SPECTRUM MANAGEMENT



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Television White Space devices certification and licensing rules



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Purpose

This document describes an interim licencing arrangement for the use of white space devices in the UHF television bands. It is intended that these rules will be incorporated into the next issue of the 'Spectrum Licence Certification Rules in Crown Management Rights' (PIB 39).

Background

Television White space devices (TVWS) are a group of developing technologies that can dynamically use the UHF television spectrum as a secondary user, working around television use and avoiding interference. TVWS devices operate on a secondary basis to the primary use, Digital Terrestrial Television (DTT¹), whereby they must not cause interference and have no receive protection from interference.

Internationally, TVWS regulatory models typically include expectations that the white space use does not have any receive protection and must not create interference for the primary licensee. There are several approaches to TVWS developing, most of which are heading towards a database approach.

In New Zealand, television licences are relatively static over time and new television licences are often publicly known before actual transmissions commence. Radio Spectrum Management (RSM) has therefore decided to create an interim licensing scheme to allow some preliminary usage and trials in the UHF television band (510 – 606 MHz). Once international frameworks and regulatory regimes are developed and there is a clear path for New Zealand to follow, RSM will further investigate the type of long term regime that will best suit New Zealand.

The frequencies that DTT services use could change at any time, with services being either modified or established. Anyone operating under a TVWS licence must be mindful of this. TVWS must not cause harmful interference to DTT services and it is expected that TVWS licensees anticipate any potential issues and make adjustments before harmful interference occurs. Should an issue occur, licensees must immediately rectify the issue. This may involve changing frequency, reducing power, or ceasing operation. That may also require a change to the licence.

As this is an interim licensing regime to trial TVWS in New Zealand the RSM is seeking information to assist with the development of a long term regime. Licensees must complete the form in Appendix 1 before a licence will be registered.

Types of technology permitted

Ultimately, equipment or devices operating under any TVWS licence should be compatible with any long term regime developed. These could be devices accepted by the FCC (USA) or devices accepted by Ofcom (UK). The databases that TVWS use relies on in some other jurisdictions for the self-management of interference are not implemented in New Zealand at this stage.

¹ Please note that specific DTT channels are referred to as "DTV XX". In New Zealand, "XX" is a number between 25 and 47.

Devices or equipment that operate under any TVWS licence must be a recognised TVWS technology. Non-TVWS technologies are not permitted. Equipment or devices must conform to one of the following standards:

- FCC CFR Title 47, Part 15, Subpart H - Television Band Devices 15.701 – 15.717; or
- ETSI EN 301 598 V1.1.1 *'White Space Devices (WSD); Wireless Access Systems operating in the 470 MHz to 790 MHz TV broadcast band'*

These standards assume the use of a geo-location database. There is no mandatory geo-location database implemented in New Zealand. Therefore, equipment deployed in New Zealand will not be expected to conform to those aspects of the standard that relate to geo-location databases. However, licensees must be able to provide reasonable documented evidence that its equipment would conform to these standards if operated in either the United States or United Kingdom.

In addition, licences may be created that exceed the 250m Height Above Average Terrain (HAAT) limit required in FCC CFR Title 47, Part 15, Subpart H - Television Band Devices 15.701 – 15.717.

Examples of technologies that are not recognised TVWS technologies:

- Digital television broadcasting (DVB-T);
- Audio / Video senders; and
- Fixed links using conventional fixed equipment.

TVWS devices may only operate within the New Zealand Digital Television Channel Raster, which is based on an 8 MHz channel.²

Licence acquisition limit

A licensee is allowed licences for a maximum of four (4) contiguous or non-contiguous channels within any Territorial Local Authority. For clarification, in a frequency division duplex system this would mean a limit of 2x2 channels.

If a TVWS licensee is associated with another TVWS licensee within the same Territorial Local Authority then the acquisition limit applies to this associated group, i.e. the two licensees must not hold more than four TVWS licenses between them. For a definition of association please refer to appendix 2.

Interim licence regime period

These licensing rules are intended as an interim solution, to:

- Promote innovative ways of providing wireless broadband
- Allow users to take advantage of the growing body of TVWS equipment that is commercially available internationally

² Bandwidths of less than 8 MHz would be permitted, as long as they are completely within one 8 MHz DTV channel.

- Allow industry to test TVWS technology locally
- Give industry a licensing option under which to explore the future creation of a geo-location database
- Gauge whether widespread TVWS deployment in New Zealand is feasible and likely.

Note that the use of geo-location databases is permitted, but not mandatory. Operators are able to use the licensing regime to test the use of databases, but database use is not linked to the licence conditions.

There is no fixed end point for the interim license regime period, neither are there set criteria which must be met for the interim licence regime to be continued, revoked, or replaced.

Security of tenure

There will be no security of tenure for TVWS licences under the interim licencing scheme, recognising that a balance must be struck between allowing interim use and development of TVWS systems, and protecting the rights of incumbent users. The Crown as the Manager has the right under section 57A of the Radiocommunications Act 1989 to cancel a TVWS licence. The Crown may exercise this right with very limited notice.

It is envisaged that licences may be cancelled in the following situations:

- where the interim TVWS licencing regime is replaced by a long-term scheme such as a database approach to TVWS use;
- where changes to television licencing require subsequent changes to TVWS licencing;
- where a TVWS licensee is causing interference to television services; or
- where two or more TVWS licensees in the same area are unable to come to a coexistence agreement, noting that TVWS licences will have no receive or transmit protection.

The Crown also reserves the absolute right to cancel licences in other situations.

Technical analysis

A full technical analysis by an Approved Radio Engineer (ARE) is required to ensure that any TVWS licence certified is technically compatible with DTT and no harmful interference will occur.

Any certified licence must only permit TVWS devices to operate on frequencies that are deemed to be technically compatible by the ARE.

No reliance on the TVWS device being able to self-manage interference shall be considered.

When assessing technical compatibility for licencing purposes, AREs can ignore other TVWS licences as all licences are on a non-interference basis.

Interference analysis

The '1 dB threshold degradation' method is to be used. This means that any signals from white space transmissions must not raise the noise floor of a DTT receiver by more than 1 dB. To achieve this it requires that any signals from TVWS devices arriving at a DTT receiver are at least 6 dB below the thermal noise floor.

This is a conservative approach but is appropriate for this interim licensing scheme. Although PIB 39 identifies protection ratios specified for DTT and MPIS values specified on licences, these are not appropriate for interference calculations involving TVWS as they have been designed for assessing interference between two (or more) DTT services, not between other services and DTT.

For TVWS analysis, the following parameters should be used:

- Any signal(s) from any TVWS devices (fixed stations, base stations and user equipment) arriving at a DTT receiver within the 48 dB μ V/m³ coverage contour must be lower than -106 dBm. This is based on:
 - The thermal noise floor calculated based on a 7.77 MHz bandwidth; and
 - A noise figure of 6 dB⁴ for DTT receivers.
- Consider antenna gains and directivity. Antenna gain comes from Annex 2 of Recommendation ITU-R BT.1368-11 and is 14 dBi. AREs need to take care where there is overlapping coverage, infill sites, or a single frequency network is operating. There may be uncertainty about which direction viewers' antennas are pointing. As a worst case an ARE could assume no directivity and the maximum gain of the antenna (Refer to Recommendation ITU-R BT.419-3 for details on directivity. The recommendation specifies either 16 dB discrimination for orthogonal polarisation or up to 16 dB for direction discrimination – depending on the angle); and
- Cable and feeder losses should not be considered as there are unknown factors in this and the use of mast head amplifiers can largely overcome cable losses.

³ Freeview publishes coverage maps which could give some guidance to AREs. AREs still need to conduct their own calculations in the certification process. Freeview coverage maps can be found: <http://www.freeviewnz.tv/coverage/coverage-maps.aspx>

⁴ This noise figure is specified in Recommendation ITU-R BT.2036 "Characteristics of a reference receiving system for frequency planning of digital terrestrial television systems".

The analysis that should be conducted by the ARE is the following:

- Consider the expected coverage area of the DTT services(s). This may need to be calculated and predicted. Refer to Section 3.4, 'Television Broadcasting', in the Spectrum Licence Certification Rules for Crown Management Rights (PIB 39) for details on calculating coverage and the minimum field strengths. While the minimum field strength is defined as 48 dB μ V/m, AREs should take care noting that there may be receivers operating satisfactorily in areas with a field strength of 44 dB μ V/m.
- Conduct calculations to prove that any signals produced by devices operating under the proposed TVWS licences are 6 dB or more below the noise floor of a DTT receiver anywhere within the coverage of a DTT transmitter.
- It is not acceptable to conduct an interference assessment only against the protection locations on DTT licences. These protection locations are only 'survey points' and are designed for assessing DTT to DTT situations; and
- Consider adjacent channel leakage from the TVWS device and adjacent channel selectivity of DTT. Calculations for adjacent channel leakage should be conducted relative to 6 dB or more below the noise floor of the receiver (-106 dBm). Calculations for the adjacent channel selectivity should be conducted relative the minimum DTT wanted signal. Also, note that values specified are in different bandwidths and these may need to normalised.
 - Conduct calculations to ensure that the proposed TVWS licence will not cause interference through adjacent channel leakage. Details of the adjacent channel leakage of TVWS can be found in equipment specifications or the standards FCC CFR Title 47, Part 15, Subpart H – Television Band Devices 15.701-15.717 and ETSI EN 301 598 V1.1.1.
 - Conduct calculations to ensure that the proposed TVWS licence will not cause interference through the adjacent channel selectivity of the DTT receiver. Details of adjacent channel figures can be found in Recommendation ITU-R BT.2033 '*Planning criteria, including protection ratios, for second generation of digital terrestrial television broadcasting systems in the VHF/UHF bands*' or ETSI EN 300 744. In the absence of more detailed information a protection ratio of -30 dB can be applied for the first adjacent channel and -43 dB can be applied for the second adjacent channel or greater.

Table 1: Adjacent channel leakage ratios derived from Table 2 in ETSI EN 301 598

| Channel (8 MHz) | Frequency (MHz) | Adjacent Channel Leakage Ratio (dB) | | | | |
|-----------------|-----------------|-------------------------------------|---------|---------|---------|---------|
| | | Class 1 | Class 2 | Class 3 | Class 4 | Class 5 |
| Third adj | -28 | 84 | 74 | 84 | 74 | 64 |
| Second adj | -20 | 79 | 74 | 74 | 64 | 53 |
| First adjacent | -12 | 74 | 74 | 64 | 54 | 43 |
| Co channel | Fc | | | | | |
| First adjacent | 12 | 74 | 74 | 64 | 54 | 43 |
| Second adj | 20 | 79 | 74 | 74 | 64 | 53 |
| Third adj | 28 | 84 | 74 | 84 | 74 | 64 |

Table 2: Unwanted emission limits derived from 15.709 in FCC CFR 47, Part 15, Subpart H – Television Band Devices 15.701-15.717

| Limits within DTV bands dBm / 100 kHz (EIRP) | | |
|--|--|---------------------------|
| Fixed (conducted +6dBi antenna gain) | Personal / Portable Adjacent to occupied TV channels | Other personal / portable |
| -36.8 | -56.8 | -52.8 |

Licensing

TVWS can be licenced in the following ways:

Coverage

This is a base station located at a fixed point with mobile / user equipment operated within the base station’s coverage area. A licence to transmit is required for the base station and another licence is required for the mobiles to transmit within the coverage area. One mobile / user equipment licence allows an unlimited number of mobile or user equipment devices to be used.

Fixed

This can be a fixed point-to-point or fixed point-to-multipoint system. Each transmitter must be licenced for a specific point location. Fixed point-to-point systems must use directional antennas. For fixed point-to-multipoint systems, the hub site may use a non-directional antenna.

Where there is a relationship between licences these must be associated with each other in SMART. For example, with a 'Coverage' system the base station licence and the mobile licence must be associated. For a 'Fixed' system the licences for the ends of the fixed links should be associated. These can be added after the licence has been certified and the licence status is 'planned'.

Licence types

The licence type "Other < 10 dBW (Spectrum)" is to be used.

The fee category will be OZ1 as per Schedule 6 of the Radiocommunications Regulations 2001. A copy of the fees schedule can be found on the RSM website at <http://www.rsm.govt.nz/cms/policy-and-planning/spectrum-policy-overview/legislation/fees-schedules/radio-spectrum-licence-fees-from-1-july-2005>. To select this category in SMART, an applicant will need to select FIXED > CROWN SPECTRUM > OTHER < 10 dBW (Spectrum), as shown in Figure 1 below.



The screenshot shows a web form for creating a new licence. At the top, there are two radio buttons: 'New Licence' (selected) and 'Modify Existing Licence'. Below this is the 'Licence Type' section, which contains three dropdown menus. The first dropdown is set to 'Fixed', the second to 'Crown Spectrum', and the third to 'Other <10dBW (Spectrum)'. There are also two checkboxes: 'Direct Engineering' and 'Suppress Licence Details', both of which are currently unchecked.

Figure 1: Licence type selection for creating a licence in SMART.

Management right

The Crown-owned management right where TVWS is permitted is:

MR: 365 510 – 606 MHz (DTT channels DTV26 – DTV37)

TVWS use is not permitted in the other frequencies allocated for DTT (DTV38 – DTV47).

DTV channels 38 and 39 (606-622 MHz) are covered by a management right owned by Te Putahi Paoho and any use wherein must be by agreement with Te Putahi Paoho as the Manager.

DTT channels DTV40 – DTV47 (622-686 MHz) do not currently contain long-term spectrum licences for television broadcasting (DTT licences currently in these channels are soon to be restacked below 606 MHz). TVWS is not permitted in these channels for two reasons:

- The aim of the interim TVWS scheme is to allow potential licensees to trial TVWS use in real-world conditions. TVWS devices are designed to operate in the spaces between allocated television channels, not in clear spectrum.
- Pending possible future allocation, the Crown wishes to keep these channels clear.

Contents of a licence

Basic details

The licence must be for 'licence transmit' only, i.e. under section 48(1)(b) of the Radiocommunications Act. No reception or protection from interference shall be specified on the licence.

Spectrum details

This will be frequencies or DTV channels on which the TVWS device(s) will operate. TVWS is only permitted on the New Zealand DTV raster. Up to four contiguous or non-contiguous channels, or an equivalent frequency range, that covers the usage must be specified under spectrum details. DTV channels can be used where the emission is 8 MHz or less. If the emission is greater than 8 MHz, this must be entered as part of the licenced channels/frequency range.

EIRP

This must reflect the actual EIRP of the devices. In any case the maximum EIRP must not exceed 10 dBW.

Emission designator

This must accurately describe the bandwidth of the transmission and type of modulation. This should preferably be taken from the manufacturer's specifications.

Transmit details location

Depending on what licence is being created, this could be one of the following:

Fixed

This will be a specific geographic location 'point' location type describing an end of the fixed link. Equipment detail and antenna details must be specified. Unless the fixed link is uni-directional, another licence will be required for the other end of the fixed link.

Base station

This will be a specific geographic 'point' location type describing the base station. Equipment detail and antenna details must be specified.

Mobile

This is the mobile or the user equipment operating within the coverage of a base station. This is a 'multiple point' location type and should be a complex polygon that describes the coverage of the base station and limits the area where mobiles / user equipment are permitted to operate.

Radiation pattern

This must be set to describe the directivity of the antennas being used. In the case of a mobile or user terminal this is likely to be omni.

Conditions

The Authorisations must be set as:

Transfer Licence: Rightholder and Manager

Modify Licence: Rightholder or Manager

Cancel Licence: Manager

The following specific conditions must be placed on the licence:

- a) Transmissions pursuant to this licence must not cause interference to reception of services licensed and protected pursuant to a spectrum licence or a radio licence, the manager reserves the right cancel this licence or require that any transmission pursuant to this licence change frequency, reduce power or cease operation.
- b) This licence offers no reception protection from other services licensed pursuant to a spectrum licence or a radio licence. The manager does not accept liability under any circumstances for any loss or damage of any kind occasioned by the unavailability of frequencies or interference to reception.
- c) Digital Terrestrial Television services may be established or modified at any time. If transmissions pursuant to this licence are likely to cause harmful interference to new or modified DTT services, this licence may be required to change frequency, reduce power or cease operation.
- d) This licence provides for the trial of TVWS devices and is an interim arrangement. It is intended that a long term regime will be developed. Once a long term regime has been developed this licence will be cancelled and transmissions pursuant to this licence must either cease operation or comply with the new regime.
- e) Equipment operated under this licence must either conform with FCC CFR 47, Part 15, Subpart H – Television Band Devices 15.701-15.717 or ETSI 301 598, with the following exceptions:
 - devices are not required to conform to the parts of these standards that require the use of a geo-location database; and

licences may be created that exceed the 250m Height Above Average Terrain (HAAT) limit required in the FCC standard Unwanted emission limit

An unwanted emission limit must be set on the licence using either 'TVWS8', 'TVWS16', 'TVWS24' or 'TVWS32' spectrum masks depending on the bandwidth being licenced.⁵

⁵ Note that these are not yet entered into SMART, but will be when the TVWS rules are implemented.

Appendix 1 – TVWS use survey

Radio Spectrum Management (RSM) has developed an interim licensing scheme for television white space (TVWS) to allow some preliminary usage, trials, and to gain a better understanding of benefits for New Zealand. RSM is watching international developments and is investigating what sort of long term regime would best to accommodate TVWS in New Zealand.

RSM is gathering information on TVWS use in New Zealand and requests that licence applicants complete the following form. The form should be submitted to RSM at the same time as the licence application. Licences will not be registered if they do not have an accompanying form.

RSM will not be making this information public. However, applicants should be aware that any information you provide is subject to the Official Information Act 1982 (“the OIA”). The OIA allows members of the public to request information that public agencies hold. There are grounds for public agencies to withhold information that has been requested, and this can include commercial information such as trade secrets, etc. Section 9 of the OIA contains the common grounds for withholding information. There are several subsections of section 9 under which commercially sensitive information can be withheld, depending on the situation. If your information is requested from RSM by a third party, usual practice is to consult you regarding its potential release.

Name of Licensee: _____

Full name of person completing this form: _____

Position/job title: _____

Date: _____

Signature: _____

What type of service do you intend to deliver? For example, broadband or utilities monitoring and control.

Please give a general description of the services you intend to deliver :

What do you envisage the service being used for (e.g. general IP connectivity, broadband provision, SCADA, voice, etc)?

What type of connection are you intending for your service (e.g. always on, ad hoc, report at specific times, or polled at specific time)?

Who is this service for? Who are the customers? Are you charging them for the service?

If this service will be used to provide services to an end customer, how is it networked and backhauled? How many devices are intended to be deployed? Please attach any technical information which may provide a better understanding of the system.

Which standard does your equipment comply with? FCC CFR 47, Part 15, Subpart H - Television Band Devices 15.701 – 15.717, or ETSI 301 598?

Will you be using a TVWS database? If so which database are you using and who is the provider?

Appendix 2 – Definitions of Association

For the purposes of the Television White Space Licensing rules, person A is an Associate of person B (and vice versa) if:

- (a) person A is a body corporate, and person B is:
 - (i) a director of that body corporate; or
 - (ii) a Related Body Corporate of that body corporate; or
 - (iii) a director of a Related Body Corporate of that body corporate; or
- (b) person A is in the same immediate family as person B (including a spouse, civil union partner, de facto partner, child (including step-child), parent (including step-parent) or sibling (including step-siblings and half-siblings) of person B); or
- (c) person A is a nominee or trustee for person B; or
- (d) person A is a director of a body corporate, or person A holds any voting power in the body corporate, and person A and person B are parties to an agreement relating to:
 - (i) the control of that body corporate; or
 - (ii) any of the voting power in that body corporate; or
- (e) person A holds or controls directly or indirectly any of the voting power, or any of the issued shares, in person B; or
- (f) person B (or a director, employee or other Associate of person B) is the trustee of a trust acting in that capacity and person A is a settlor, beneficiary, or trustee, of that trust; or
- (g) person A is a person who, in making a decision or exercising a power materially affecting a Business, is accustomed, or under an obligation, or proposes or is likely (in the Chief Executive of the Ministry of Business, Innovation and Employment's sole opinion, which is final), to act in accordance with the directions or instructions or wishes of person B; or
- (h) person A and person B are acting, or propose or are likely to act (in the Chief Executive of the Ministry of Business, Innovation and Employment's sole opinion, which is final), jointly or in concert in relation to a Business; or
- (i) person A (being a person other than the Chief Executive of the Ministry of Business, Innovation and Employment) and person B are parties to an Agreement that entitles one of the persons to a substantial degree of influence, or the right to obtain a substantial degree of influence, over radio

frequency spectrum covered by the Television White Space Licence and in respect of which the other person is or will be a rightholder under the Act.

- (j) person A is an Associate of another person that is an Associate of person B under these Terms and Conditions, including an Associate in a chain of Associates.

Associate Group means the holder of a Television White Space Licence together with any Associate of that person that is also the holder of a Television White Space Licence.