Submission on TV White Space Licensing Rules

September 2014

1. Summary

We thank the Ministry for the opportunity to comment on the draft TV White Space (TVWS) licensing rules. We make the following comments:

- We agree with the Ministry that this interim arrangement of licensing each TVWS service is an appropriate way for TVWS preliminary usage and trials to be undertaken.
- We would like to clarify that harmful interference as described in the document should not interpreted simply as defined in the Radiocommunications Act (i.e. co-channel interference). Interference that is harmful to DTT services includes adjacent channel interference as well.
- We note that the 1 dB threshold may be insufficient if there are multiple TVWS transmissions, and we recommend a 0.5 dB threshold to allow for multiple TVWS devices.
- The use of DTT antenna directivity becomes complicated in regions where there are multiple DTT sites and we suggest that antenna directivity cannot be claimed when licensing TVWS services in regions with multiple DTT transmission sites.
- We agree that interference assessment using DTT licence protection locations only is not acceptable, and that the entire coverage area of a DTT services needs to be considered. We suggest that DTT coverage prediction maps published by Freeview can give AREs a good indication of expected DTT coverage areas, and we recommend their use.
- While an ARE can determine where a TVWS service can be licensed, the licensing rules make it clear that TVWS services cannot be licensed in certain locations. We suggest that the document is updated to clarify that a TVWS licence cannot be located within the coverage area of a co-channel DTT service, and most likely not within the coverage area of an adjacent channel DTT service either. Effectively, TVWS services can only be licensed outside all DTT coverage areas.
- The process for undertaking adjacent channel selectivity (ACS) calculations is not clear. We presume that the ACS should not be applied to the -106 dBm interference threshold but instead to the minimum wanted DTT receive signal. We suggest that the ACS calculation method is clarified and explained in more detail for AREs.
- We agree that DTT channels DTV40 to DTV47 cannot be used for TVWS devices, but we also recommend that DTV26 and DTV27 should not be permitted for TVWS use either, since these channels are only licensed at a few locations and are clear spectrum for a large part of New Zealand. The DTT channels permitted for TVWS devices should be limited to DTV28 to DTV37.

More detail on these and other comments are made in the following section.

We look forward to engagement with the Ministry on the content of our submission. Any questions on this submission should be directed to Susie Stone at Kordia (Susie.stone@kordia.co.nz, 09 551 7116).

2. Kordia Comments

2.1 Harmful interference is more than just co-channel interference

References are made to harmful interference in the document. Harmful interference is defined in the Act under section 99 as applying only to co-channel emissions, but we know that adjacent channel interference can be an issue with TVWS systems as well. The very nature of TVWS technology is to operate in unused spectrum which is often in-between existing licensed services (i.e. adjacent channel). To ensure that the term "harmful interference" in the document is not interpreted simply as defined in the Act, we recommend that all references in the report to harmful interference are re-worded to explicitly state "…harmful interference (either co-channel interference and/or adjacent channel interference)…".

2.2 Licence acquisition limit is unclear

The section on licence acquisition limits is not clear. This first paragraph suggests that the limitation is only on the number of channels - four - that can be used in a Territorial Local Authority (TLA) by a licensee, not on the number of transmission sites that can be licensed throughout the TLA.

However, the second paragraph, when explaining associations between licensees, suggests that a maximum of 4 licences can be held by a licensee or group in a TLA. This implies a maximum of 4 transmission sites (regardless of the number of RF channels in use, since one licence can be crafted to contain up to 4 channels).

We recommend that MBIE clarify what the intended limitations are per licensee/group – a maximum number of channels per TLA, a maximum number of licences (sites) per TLA, or both.

2.3 1 dB threshold degradation may be insufficient

A 1 dB threshold may be insufficient if there are multiple TVWS transmissions, and we recommend that individual interference powers are more than 10 dB below the DTT receiver noise floor to allow for the aggregation of interference from multiple TVWS devices. This requires a degradation threshold of 0.5 dB.

2.4 Use of DTT antenna directivity is complicated in regions with multiple DTT sites

The use of DTT receive antenna directivity has been allowed when assessing interference. However, in regions where there are multiple DTT transmission sites available for viewers to receive from, caution is required when attempting to claim directivity. While "best server" coverage calculations can be undertaken by an ARE to determine which locations are best served by the multiple DTT transmission sites available, viewers will not always use the best server site. Viewers may point to other DTT sites due to localised clutter or obstructions at the viewer's location, or due to a legacy antenna for analogue UHF television that was installed before additional DTT-only transmission sites were installed.

Regions with multiple DTT transmitter sites are:

- Auckland
- Hamilton / Tauranga
- Gisborne
- Hawkes Bay
- Wanganui
- Wellington
- Nelson

It is proposed that AREs not be allowed to claim DTT receive antenna directivity when assessing interference to DTT services in any of the above regions.

2.5 Existing DTT coverage prediction maps are available to assist AREs

We agree with the Ministry that it is not acceptable to undertake an interference assessment using DTT licence protection locations only, and that the entire coverage area of DTT services needs to be considered when an ARE undertakes TVWS licence analysis.

For guidance, Freeview publishes coverage maps of all DTT transmission sites on its website[1] and we suggest that these can be used by AREs to give a good indication of expected DTT coverage areas. The light blue coverage grade on Kordia's coverage prediction map shown in Figure 1 below – "Likely with high aerial" – corresponds to a field strength of 48 dBµV/m.

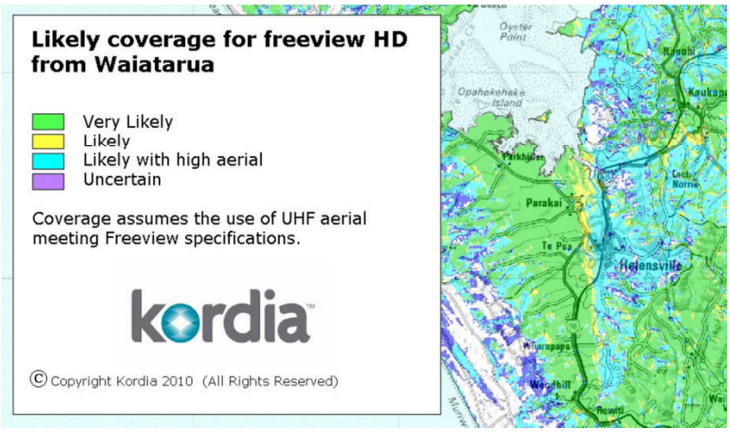

Figure 1 – Coverage grades on Kordia's coverage prediction maps available on Freeview's website

However, given the note in the MBIE document that there may be receivers operating satisfactorily in areas with less field strength, it is suggested that the purple "Uncertain" coverage grade, which corresponds to 44 dBµV/m, is used to set the DTT coverage area instead.

[1] http://www.freeviewnz.tv/coverage/coverage-maps.aspx

2.6 Co-ordination requirements apply to subscribers as well as base stations

The MBIE document mentions base station and mobile/fixed CPE devices ("subscribers"). We suggest that the MBIE document should explain that -106 dBm co-ordination distances apply to both the base station and subscriber devices. When a subscriber device is installed near the edge of the TVWS coverage area, that subscriber device's -106 dBm co-ordination area could exceed the designed TVWS coverage area, and an additional guard zone to any nearby DTT coverage area needs to be created to ensure the DTT service is not affected. Figure 2 below shows a scenario where the -106 dBm co-ordination zone from a subscriber device does infringe on a DTT service's coverage area.

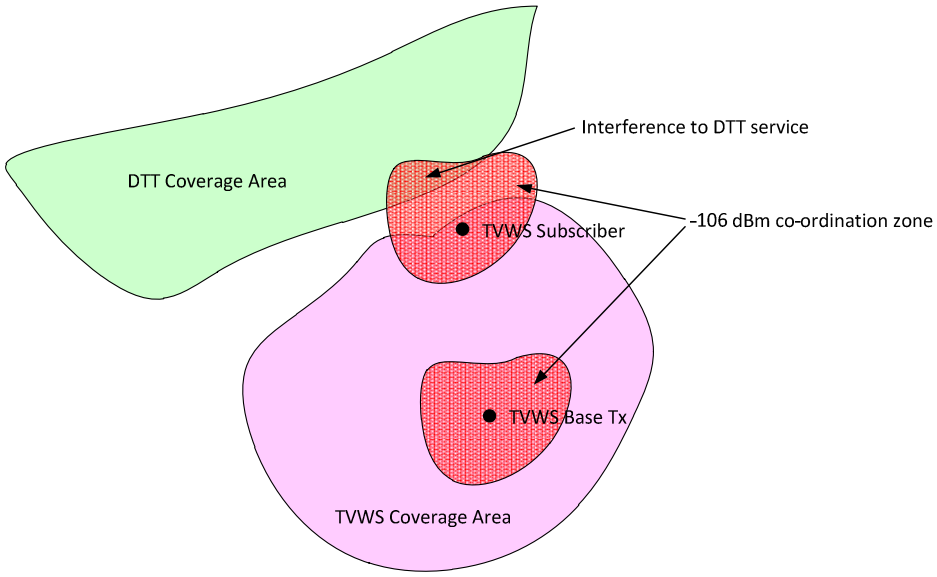

Figure 2 – Scenario where a subscriber can infringe on a DTT service coverage area

2.7 ACLR values are based on mixed bandwidths

We suggest that MBIE highlight the fact that the ACLR values shown in Table 1 of the MBIE document (Table 2 of ETSI 301 598) are based on the total TVWS device transmit power in an 8 MHz channel but the resulting adjacent channel leakage is a power spectral density in dBW/100 kHz, as per the definition of ACLR in ETSI 301 598:

> *"Adjacent Channel Leakage Ratio (ACLR): ratio of the in-band transmit power measured in an 8 MHz TV channel, to the out-of-band emission measured in 100 kHz in an adjacent TV channel"*

To determine whether the total maximum interference power of -106 dBm in an 8 MHz channel is exceeded by the ACLR, the resulting ACLR power spectral density needs to be increased by a factor of 19 dB. For example, a Class 1 TVWS device operating at 10 dBW EIRP must have a power spectral density of no more than -64 dBW/100 kHz in the first adjacent channel. This equates to a maximum power in the 8 MHz adjacent channel of -45 dBW.

2.8 TVWS devices cannot be used inside DTT coverage areas

While the licensing rules allow an ARE to determine where a TVWS service can be licensed, we recommend that the document makes it clear where TVWS services cannot be licensed:

- A TVWS device cannot operate within the coverage area of a co-channel DTT service, since the interference levels around the TVWS device will exceed the -106 dBm interference limit.

- A TVWS device most likely cannot operate within the coverage area of an adjacent channel DTT service. For example, a 10 dBW EIRP Class 1 TVWS service will transmit up to -45 dBW EIRP in the adjacent DTT channel (as shown in section 2.7 above).
  A line-of-sight path loss calculation based on -45 dBW EIRP and a 14 dBi DTT receive antenna indicates that the co-ordination distance to the -106 dBm interference limit is 8 km. Antenna directivity is unlikely to apply to a TVWS device inside a DTT coverage area since there are likely to be some DTT viewers pointing their antenna through the TVWS site to the DTT transmission site. Cross-polar discrimination may apply, but even then, the co-ordination distance is still 1.2 km.

AREs need to very carefully consider the feasibility of licensing a TVWS service inside the coverage area of an adjacent channel DTT service. Even a 0 dBW EIRP Class 1 service (which probably has limited useful coverage of its own) that is cross-polar to an adjacent channel DTT service will still have a LOS co-ordination distance of 400 metres – enough to interfere with numerous DTT viewers.

These findings are consistent with FCC rules[2] for TVWS devices, specifically §15.712 (a)(2):

> *"Required separation distance. TVBDs must be located outside the contours[3] indicated in paragraph (a)(1) of this section of co-channel and adjacent channel stations by at least the minimum distances specified in the following table…"*

Antenna height above average terrain of unlicensed device[4]	Required separation (km) from digital or analog TV (full service or low power) protected contour	
	Co-channel (km)	Adjacent channel (km)
Less than 3 meters	4.0	0.4
3-Less than 10 meters	7.3	0.7
10-Less than 30 meters	11.1	1.2
30-Less than 50 meters	14.3	1.8
…	…	…

TVWS has been publicised as technology that is designed to operate in the spaces between allocated television channels, implying that it can be used anywhere there is a vacant channel. We recommend that MBIE makes it clear where TVWS services cannot be licensed, and suggest the following text is added to the MBIE document:

[2] FCC OCR Title 47, Part 15, Subpart H

[3] The FCC document lists a protected contour for DTT services in dBu, similar in effect to the 48 dBμV/m described in the MBIE document.

[4] Height above average terrain (HAAT) is an FCC concept that represents an average of the terrain within 16 km of a transmitter site, providing a single value for use with coverage calculations and regulatory requirements.

> *"To clarify, a TVWS licence cannot be located within the coverage area of a co-channel DTT service. Additionally, it is highly likely that a TVWS licence cannot be located within the coverage area of an adjacent channel DTT service either, due to ACLR restrictions. Effectively, TVWS services can only be licensed outside all DTT coverage areas."*

2.9 Adjacent channel selectivity rule is unclear

It is not clear how the adjacent channel selectivity (ACS) calculations are to be undertaken. The MBIE document refers to various planning documents[5] and a suggested ACS/protection ratio of -30 dB. We presume that this protection ratio should not be compared to the -106 dBm interference threshold described in the document, but instead to the minimum wanted DTT receive signal (since a DTT protection ratio applies relative to the wanted DTT receive signal, not the DTT noise floor). Since the document uses a 1 dB threshold degradation approach, we suggest this is used for the ACS calculation as well. Based on a 1 dB threshold degradation noise floor of -106 dBm, a DTT service C/N of 20 dB, and -30 dB protection ratio, the maximum allowed level of an adjacent TVWS service is -56 dBm.

ACS calculations indicate that a TVWS device most likely cannot operate within the coverage area of an adjacent channel DTT service. For example, a 10 dBW EIRP TVWS service has a co-ordination distance of 13 km LOS to the -56 dBm adjacent channel limit (based on a 14 dBi DTT receive antenna). Antenna directivity is unlikely to apply to a TVWS device inside a DTT coverage area. Cross-polar discrimination may apply, but even then, the co-ordination distance is still 2 km.

We suggest that the intention of the clause relating to ACS is clarified. If the intended calculation method is as described above, we recommend that the maximum allowed adjacent channel level is explained in more detail and derived for AREs.

2.10 Some DTT channels should not be permitted for TVWS use

Kordia agrees with MBIE that DTT channels DTV40 to DTV47 cannot be used for TVWS devices. However, TVWS use also should not be permitted in DTV26 and DTV27, since these channels are only licensed at a few locations and are clear spectrum for a large part of New Zealand. As stated in MBIE's document:

> *"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."*

Therefore, the DTT channels permitted for TVWS devices should be limited to DTV28 to DTV 37.

2.11 What spectrum mask will be used?

The MBIE document states that spectrum masks will be developed for TVWS for the unwanted emission limit set in the licence. What specification will these spectrum masks be based on? The ACLR specified in ETSI 301 598 is recommended.

---

[5] Reference to ETSI 300 744 is probably not relevant since it doesn't include ACS values. ITU-R Recommendation BT.1368-11 *"Planning criteria, including protection ratios, for digital terrestrial television services in the VHF/UHF bands"* is more suitable.