Before the

FEDERAL COMMUNICATIONS COMMISSION

Washington, D.C. 20554

In the Matter of	)	
Unlicensed Operations in the TV	)	ET Docket 04-186
Broadcast Bands	)	

Spectrum Bridge Inc., Comments and Updates on Petitions for Reconsideration.

After the FCC's Second Memorandum Opinion and Order[1] a number of Petitions For Reconsideration were filed[2,3], which Spectrum Bridge broadly supported. Since that time additional practical experience has been gained around the world. In this filing we update the support for those Reconsideration Requests and propose rule changes that will allow more flexibility in the operation of devices while maintaining, or improving the co-channel and adjacent-channel protection for incumbent devices.

In summary the FCC decided that 36dBm EIRP was acceptable for fixed devices, but was concerned about the impact of narrow band devices, the FCC chose to measure Power Spectral Density (PSD) across the entire channel in increments of 100 KHz. In practice no device can use an entire channel, emissions must roll-off near the band edges to meet the adjacent channel emissions limits. Therefore the current method by which PSD is specified effectively reduces maximum allowable transmit power of devices to a value lower than the 36dBm EIRP the FCC intended. Consequently, this does not facilitate the most efficient use of existing technologies, reduces their utility and unnecessarily precludes white spaces applications from reaching their full potential.

We propose that the Commission adopt an approach similar to the one proposed by Ofcom[4] and being considered by Industry Canada[5] .In doing so the utility of white space technology will be greatly improved while causing no additional interference to incumbent license holders. With this in mind Spectrum Bridge proposes the following rules modifications to enable a more robust ecosystem.

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[1] Second Memorandum Opinion and Order In the Matter of Unlicensed Operation in the TV Broadcast Bands (10-174) September 23, 2010

[2] WiFi Alliance Petition For Reconsideration (04-186) November 29, 2010

[3] Motorola Solutions Inc. Petition For Reconsideration (04-186) January 5, 2011

[4] Ofcom, Implementing Geo-Location and Summary of Next Steps, September 1, 2011

[5] Industry Canada, Consultation on a Policy and Technical Framework for the Use of Non-Broadcasting Applications in the Television Broadcasting Bands Below 698 MHz, SMSE-012-11, August 2011

Proposed rule changes

1. §15.709(a)(5)(i). Allow a maximum PSD of 18.2 dbm/100 KHz. A path loss model is proposed that defines the necessary separation distances as a function of TX PSD and antenna height AGL. This approach yields the same level of protection currently afforded by the combination of fixed separation distances and antenna height limits defined by the current rules. These protections can be applied dynamically and facilitate the use of existing and more cost effective technologies, as well as the potential to extend performance in rural areas.
2. §15.709(c)(1), (2). Establish the adjacent channel OOBE (out of band emissions) limit as an absolute threshold for fixed devices: 12.2 dbm/100 kHz – 55 db = -42.8 dbm/100 kHz.
3. Allow flexible TVBD adjacent channel OOBE limits (per authorization), requiring the database to enforce a variable separation distance between fixed TVBDs and adjacent channel protected entities based on the proximity of protected entities.

The analysis supporting the above propose rule changes are contained in Appendix A attached.

Spectrum Bridge is convinced that if these rule changes are implemented white space technology and cognitive radio technology innovation will be stimulated with the attendant benefits flowing to the American public and economy.

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Appendix A Background and Supporting Analysis

1) The separation distances defined in 47 CFR § 15.712 can be derived by applying a Hata Okumura path loss model. This model is referenced in FCC 08-260, paragraph 181 and is used in support of the values in the following table.

Antenna Height of Unlicensed Device	Required Separation (kilometers) From Digital or Analog TV (Full Service or Low Power) Protected Contour	
	Co-channel	Adjacent Channel
Less than 3 meters	6.0 km	0.1 km
3 – Less than 10 meters	8.0 km	0.1 km
10 – 30 meters	14.4 km	0.74 km

After extensive evaluation and modeling, Spectrum Bridge has determined that the values in the above table can be closely replicated by using a combination of the Hata-Suburban and Hata-Open path loss models. It is therefore recommended that a path loss model, such as the one proposed below, be applied to allow some flexibility in allowing a modest increase in the conducted transmit PSD limit for fixed devices. The recommended approach is to maintain a minimum co-channel separation distance of 6 km and maximum transmit conducted PSD of 18.2 dbm/100 KHz and applying the Hata-Hybrid model defined below to determine co-channel separation distances as a function of transmit PSD. The maximum allowable PSD limit of 18.2 dbm/100 KHz was selected for the following reasons:

- The 1 W EIRP limit can be achieved while leaving margin at the band edge for the filter implementation necessary to comply with OOBE limits.
- Yields reasonable separation distances (22km at 470 MHz and antenna height 30' AGL).
- Prohibits narrowband, high power operations.

The values in the following graph were derived using these formulae and assumptions:

Hata Suburban Path Loss:

$$L_{su} = L_u - 2(\log f/28)^2 - 5.4$$

where,

L_{su} = path loss in suburban areas (dB)
L_u = path loss in urban areas (dB)
f = frequency of transmission (MHz)

Hata Open Path Loss:

$$L_o = L_u - 4.78(\log f)^2 + 18.33\log f - 40.94$$

where,

L_o = path loss in open areas (dB)
L_u = path loss in urban areas (dB)
f = frequency of transmission (MHz)

Hata Hybrid Path Loss:

$$L_h = (L_{su} + L_o)/2$$

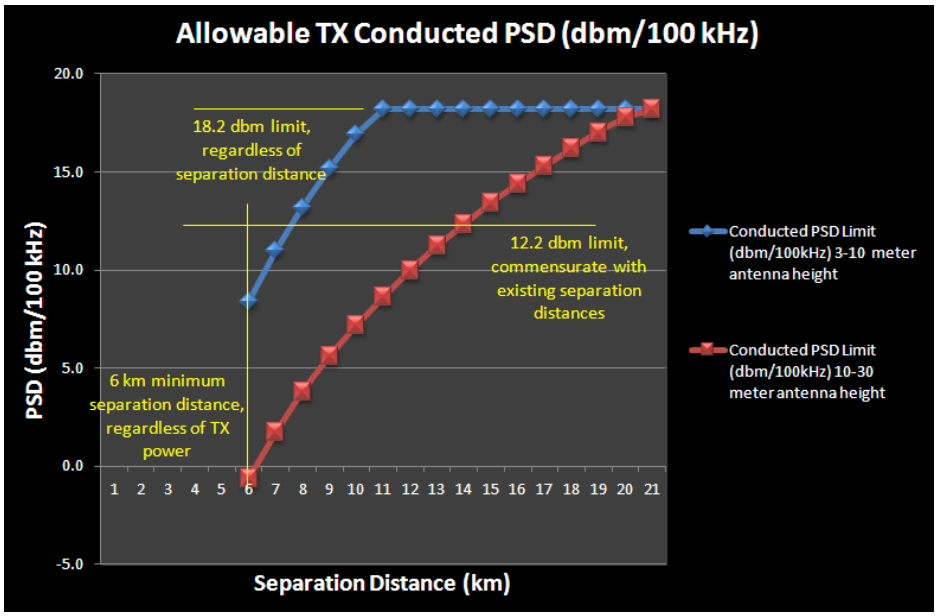
Maximum TVBD Allowable EIRP:

EIRP = 41 dbuV (DTV Noise-Limited Service for UHF) - 115.8 (free space electric field intensity to power density conversion) – 23 db (co-channel D/U ratio, DTV) – Hata Hybrid Path Loss (db)

Converting EIRP to a conducted PSD limit:

Maximum Allowable PSD (RBW 100KHz) = EIRP – 6db Antenna Gain - 10log(6MHz/100KHz)

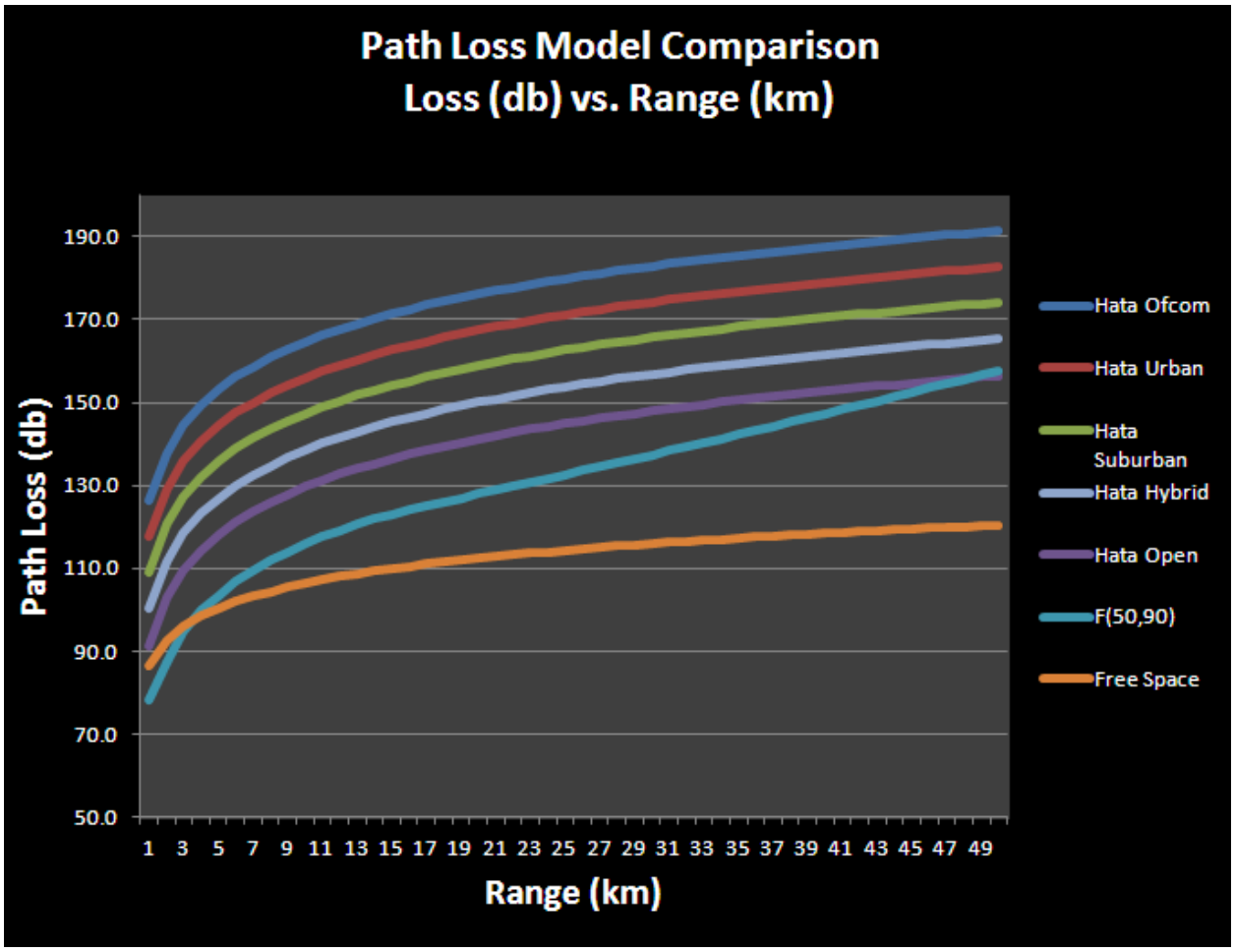
Although the separation distance cannot be solved directly due to the transcendental nature of the path loss equations, separation distances can be easily computed using iterative computational techniques.



The FCC has stated "*A table of minimum required separation distances between TV station contours and TV white spaces devices would similarly be easier to implement than D/U ratios and provide certainty as to whether a particular TV band device is far enough away from TV stations' service areas to avoid causing interference. Accordingly, we are adopting this alternative approach for ensuring that fixed TV band devices do not cause interference to TV service. The table of separation distances we are specifying in the rules will provide protection that is functionally equivalent to that which would be provided under the D/U ratio approach*." [6] However, Spectrum Bridge has determined that the facilities required to implement a dynamically variable allocation methodology, in real time, are no more complex than the current method and entails no additional technical risk. Furthermore, the proposed method is similar to that proposed by Ofcom in their most recent consultation on the use of white spaces.

[6] Second Report and Order and Memorandum Opinion and Order In the Matter of Unlicensed Operation in the TV Broadcast Bands, (08-260) November 4, 2010

A graph depicting the difference between path loss models referenced in white space proceedings is also provided for comparison and reference:



This analysis does not attempt to quantify the benefit of additional isolation derived through the polarization difference between television and TVWS systems.

2) The second issue requiring clarification or modification is related to the emissions limits for fixed TVBDs specified in § 15.709. The current specification, "*In the television channels immediately adjacent to the channel in which a TVBD is operating, emissions from the TVBD shall be at least 72.8 dB below the highest average power in the TV channel in which the device is operating*," is unnecessarily restrictive for fixed devices. This limit should be specified as an absolute threshold with respect to the interference threshold of the protected entity(s), not with respect to the TVBD waveform:

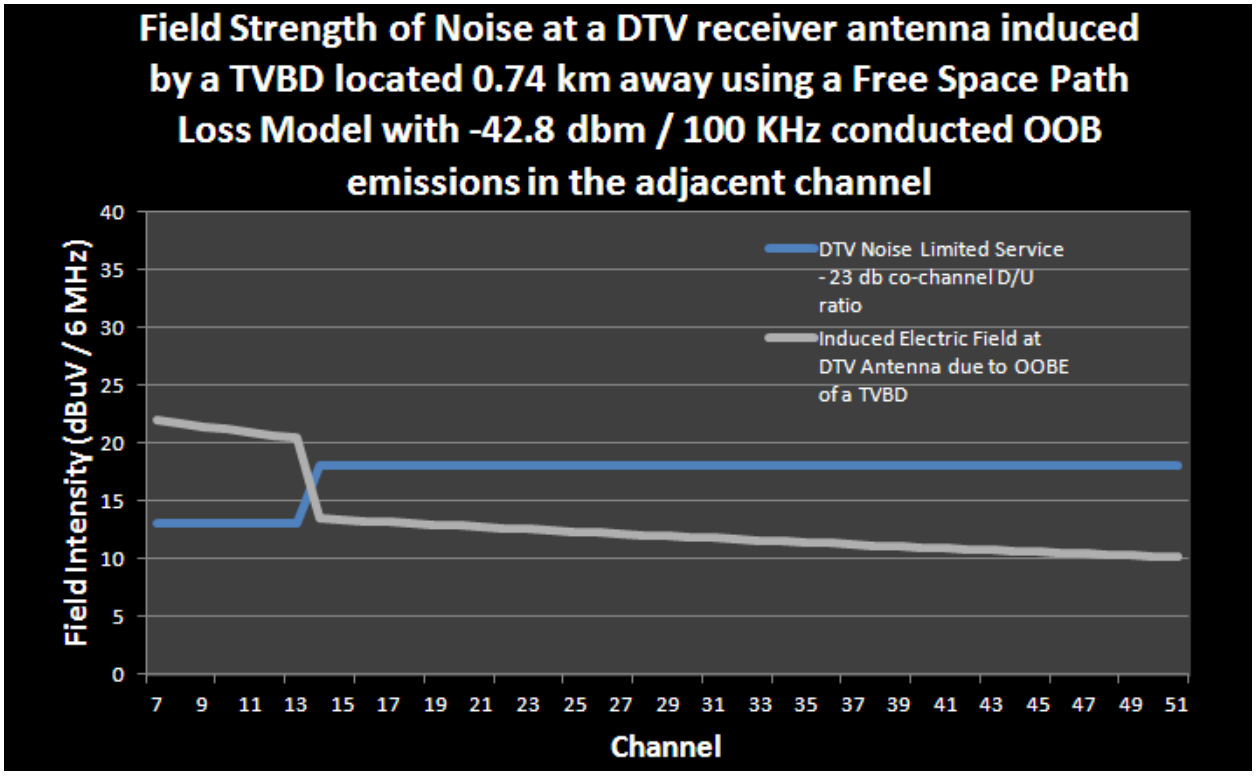
30 dbm (conducted TX power) – 55 db (ACLR*) – 10log(6 MHz/100 KHz) = -42.8 dbm/100 KHz

*ACLR = Adjacent Channel Leakage Ratio

The absolute limit of -42.8 dbm/100 KHz has already been considered as sufficient in mitigating the effects of adjacent channel interference and permissible by virtue of the existing rules. However, it is hardly practical and not cost effective to achieve. For example, any attempt to filter or reduce bandwidth in the frequency domain to comply with the emissions limit at the bandedge, is further penalized by lowering the OOBE limit. This is caused by the relative nature of the requirement (i.e. *reducing the highest average power the emissions limit is referenced to*).

It should also be noted that the radiated emission limits specified in § 15.209 that apply to OOBE beyond the adjacent channel are specified as absolute (not relative) values.

3) The chart below depicts the relationship between OOBEs induced upon a DTV receiver by a TVBD when -42.8 dbm / 100 KHz conducted emissions are present in an adjacent channel. The maximum tolerable undesired emissions required for successful DTV operation is also illustrated.

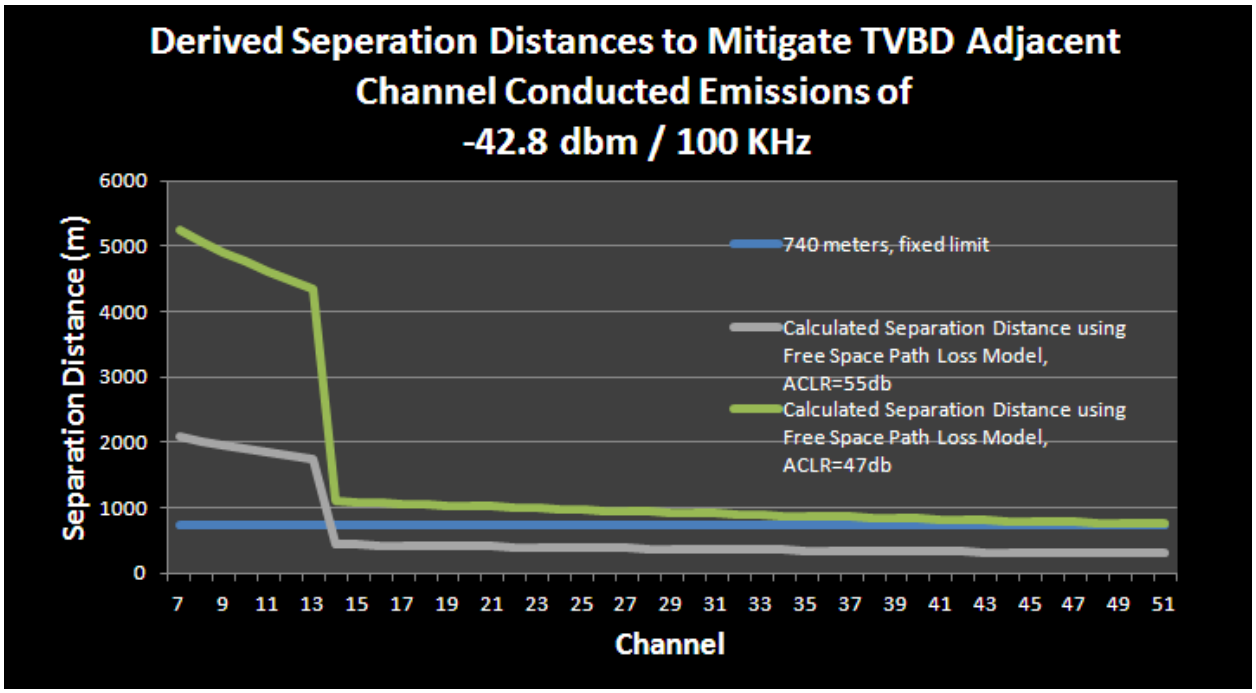


Induced Electric Field Strength due to OOBE by a TVBD = -42.8 dbm (conducted OOBE limit, 100 KHz RBW) + 6 dbi antenna gain + 10log(6 MHz / 100 KHz) db – free space path loss db + 115.8 (free space power spectral density, dbm/m^2 to electric field intensity conversion, dbuV/m^2)

The analysis shows adequate protection in the UHF bands and marginal protection in the upper VHF band.

Spectrum Bridge proposes a more effective solution for fixed devices by applying an appropriate path loss model via the database to ensure an adequate separation distance between TVBDs and protected entities. Allowing a variable OOBE profile (per authorization) also adds additional flexibility. Default or worst case OOBE limits can be designated to maintain the WS ecosystem integrity (e.g. -42 dbm / 100 KHz). In this way, protected entities can be assured adequate and appropriate protections are being applied, while a diversity of new and existing technologies can be employed.

An illustration of derived separation distances obtained using a free space path model as a function of frequency and maximum tolerable field strength is shown below:



This analysis does not attempt to quantify the benefit of additional isolation derived through the polarization difference between television and TVWS systems.

The proposed methodology is similar to those being proposed in other regulatory domains in Europe and specifically by Ofcom in the UK.

