6Harmonics Inc.
Suite 10
21 Concourse Gate
Ottawa
K2E 7S4
10 June 2019

Re: ET Docket No. 14-165, RM-11840 - Microsoft Request to amend Part 15 of the Commission's Rules for Unlicensed Operations in the Television Bands, Repurposed 600 MHz Band, 600 MHz Guard Bands and Duplex Gap, and Channel 37. Submitted to FCC 3rd May 2019.

COMMENTS OF 6HARMONICS SUPPORTING MICROSOFT'S SUBMISSION TO:

- Permit fixed WSDs to operate at greater than 40 mW on the first-adjacent channel.
- Permit fixed WSDs to operate at heights above average terrain of up to 500 meters.
- Foster the development of narrowband WSDs that can support IoT applications by modifying existing technical and operational rules.
- Permit geofenced operation of fixed WSDs on mobile platforms.

We support the proposals above with the additional comments as follows:

I. THE COMMISSION SHOULD PERMIT HIGHER RADIATED POWER LIMITS IN LESS CONGESTED AREAS TO SUPPORT BROADBAND EXPANSION IN RURAL AMERICA.

The proposal is based on an increase of 2dB in EIRP by increasing antenna gain only.
We have found that to improve the economics of deployment, keeping down the cost of the client station installation is key. By allowing an increase in antenna gain, the conducted power required to close the link is reduced as is the cost. This also leads to an improvement of receive sensitivity delivering a potential 4dB improvement in link budget. Practically speaking, directional Log Periodic Dipole Array (LPDA) antennas can be obtained with gain up to 14dBi. We have tested such

antennas in both UK and Canada and found the performance benefits of using these higher gain antennas to be material. This is key as radio technology improves and next generation radios begin to utilize higher coding levels such as 1024QAM in order to increase throughput.

In order to sustain links with 1024QAM, higher SNR is required and an extra 2dB can make a material difference to link throughput-and more importantly the aggregate throughput and spectral efficiency of a network. We stress that this allowance is particularly relevant at the client installation - and is practical as many rural residences already use high gain LPDA /Yagi style antennas to receive broadcast TV signals.

In addition to allowing an increase in antenna gain we propose that the conducted Adjacent Channel Leakage Ratio (ACLR) and Power Spectral Density (PSD)/100kHz limits remain the same as currently assumed for an EIRP limit of 40dBm/6MHz in less-congested areas.

II. THE COMMISSION SHOULD EXAMINE THE POSSIBILITY OF AUTHORIZING HIGHERPOWER WSD OPERATIONS ON FIRST-ADJACENT CHANNELS TO BROADCASTERS, WITH APPROPRIATE SAFEGUARDS.

While we support Microsoft's proposal, we also recognize that the key requirement needed is to identify appropriate safeguards that find a reasonable balance between protecting the primary users in the 470-698MHz band and allowing practical and economically viable TVWS deployments for rural broadband and other applications.

As Microsoft proposes, we support the proposal to allow database providers to optionally utilize the Longley-Rice (L-R) model. We would point out that FCC has already accepted that the Longley-Rice model as the most accurate and appropriate methodology to determine propagation and therefore interference risk in this band.

Specifically, in the "STATEMENT OF INTENT BETWEEN THE FEDERAL COMMUNICATIONS COMMISSION OF THE UNITED STATES OF AMERICA AND THE DEPARTMENT OF INDUSTRY OF CANADA RELATED TO THE RECONFIGURATION OF SPECTRUM USE IN THE UHF BAND FOR OVER-THE-AIR TELEVISION BROADCASTING AND MOBILE BROADBAND SERVICES"[1] signed by representatives of

[1] https://transition.fcc.gov//ib/sand/agree/files/PASIIC.pdf & https://transition.fcc.gov/ib/sand/agree/files/PASIIC.pdf

Industry Canada and FCC August 2015, the detailed methodology to determine TV signal strength contours using L-R is provided in Appendix 1 of this Statement of Intent. The purpose of this agreement was to ensure no interference between USA and Canadian TV stations. Given this agreement, it is therefore inconsistent that TV signal strength contours determined to protect TV broadcasts should use any other methodology than L-R.

Moreover, not only should the adoption of L-R be considered to determine TV broadcast contours that need protection from secondary devices, but also TVWS device transmission signal strengths should also use L-R.

We believe that Microsoft's proposal to allow the database provider the option to calculate signal strength from a transmitting TVWS device using L-R is entirely reasonable given that FCC has already accepted L-R as the correct methodology for propagation analysis in this band.

Furthermore, the methodology in the FCC-Industry Canada agreement uses a generic directional receive antenna configuration of 10m AGL, Horizontal polarization, up to 10dB receive gain, up to 14dB front to back isolation, parameters which are generically close to a TVWS client station antenna.

We believe FCC should re-consider the inclusion of directional antennas at client installations if, and only if, the database provider can include in their calculations (i) a generic directional antenna as above (ii) a known azimuth provided by the client station antenna as part of the database query process. We believe the optional addition of reporting the azimuth of the directional client station antenna to the database is now viable and realistic as FCC has now mandated that all TVWS radios must have GPS. Therefore, a simple calculation based on the location of the base station and the client station can yield an accurate antenna azimuth for the client station. When combined with (i) an assumed generic directional antenna as above and (ii) a L-R propagation model, reporting the client station antenna azimuth should provide a much more accurate and realistic approach to determine the risk of interference with primary users in the band. We believe continuing to assume a base station antenna is omnidirectional is reasonable.

III. THE COMMISSION SHOULD PERMIT FIXED WSD OPERATIONS AT UP TO 500 METERS HEIGHT ABOVE AVERAGE TERRAIN TO IMPROVE RURAL COVERAGE, UNDER CERTAIN CONDITIONS.

We agree with Microsoft's proposal to increase the HAAT limit to at least 500m. Given the discussion in the preceding section it can be argued that the adoption of L-R will eliminate the need for any HAAT limit at all. An increase to 500m seems a reasonable first step and should be seen as a complementary measure that aligns with the previous decision of FCC to allow an increase of antenna AGL height to 100m. Since the HAAT limit includes the antenna AGL, unless the HAAT limit is also increased then in some locations the increase of antenna AGL from 30m to 100m is useless. It is important to realize that in some of the mountainous areas of the USA HAAT is preventing the deployment of TVWS to provide rural broadband solutions. Often, a rural wireless internet service provider will have limited options to locate a TVWS base station, an argument recognized by FCC when increasing the antenna AGL. However, HAAT must also be addressed to ensure deployment is practical.

IV. THE COMMISSION SHOULD ADJUST ITS RULES TO SUPPORT THE USE OF WHITE SPACE CHANNELS FOR NARROWBAND IOT.

We support the proposal of Microsoft to establish a set of rules for IoT TVWS narrowband device restricted to (i) a listen before talk protocol (ii) no transmissions within 250kHz of the channel edge (iii) the same channel plan EIRP/conducted power limits provided by the database (iv) the same antenna limits as for fixed devices.

6Harmonics already uses a listen before talk protocol and such an approach with the appropriate CSMA[2] settings can ensure IOT sensors communicate effectively in either a point-to-multipoint or mesh mode.

As it stands the primary issue with the current framework is in the interpretation of the certification procedures. KDB 416721 D01 White Space Test Procedures v03 December 2015 is restricted to a single 6MHz channel test procedure. A test procedure for multiple contiguous channel operation is not specifically defined, and as Microsoft correctly points out, equally no

[2] Carrier sense multiple access with collision avoidance.

procedure is defined for operation that is narrower than the assumed 5.5MHz out of the DTT channel width of 6MHz.

With respect to point (iv) above, in reality, it is the database that provides the limits of conducted power per 6MHz, conducted PSD per 100kHz and ACLR. If, for example, the occupied bandwidth was 1MHz with 12.6dBm/100kHz then the total allowed conducted power would be:

$$10 \times 12.6\text{dBm} = 10 \times 18.2\text{mW} = 182\text{mW} = 22.6\text{dBm}.$$

If the database determined that the allowed conducted power is 30dBm/6MHz then both the conducted power and the PSD/100kHz limit will not be exceeded. The only remaining parameter that needs to be evaluated to ensure no interference risk with primary users is the conducted ACLR in dBm/100kHz at N+1 & N-1. The relevant value is -42.8dBm/100kHz in any part of the N+1 or N-1 channels, as this is the maximum conducted ACLR emission assumed by the database to determine risk of interference. If there is a higher conducted ACLR in dBm/100kHz than this value, then there is the risk of interference. If, during the test procedure a manufacturer was able to show the conducted ACLR requirement was met, irrespective of the exact center frequency of 1MHz transmission[3] within the 6MHz channel, then the protection requirements for primary users will also have been fulfilled.

With clarity on the testing procedure for narrowband TVWS devices we do not believe it necessary to restrict operation to 10 seconds per hour or 100kHz bandwidth.

It should also be noted that OFCOM requires the database to provide a PSD/100kHz limit and that that the TVWS device should not operate at a total channel power that allows the PSD/100kHz limit and either / or the EIRP/channel limit to be exceeded. Therefore, operation of narrowband TVWS devices has implicitly been captured by OFCOM.

[3] Assuming the transmission is >250kHz from the channel edge.

V. THE COMMISSION SHOULD PERMIT GEOFENCED FIXED WSD OPERATIONS AND FIXED WSD OPERATIONS ON MOVABLE PLATFORMS WITHIN GEOFENCED AREAS.

We support Microsoft's proposal to allow movable whitespace devices within geofenced areas.

In the examples cited by Microsoft, in effect, movable platforms as client stations are implicitly geofenced as the base stations are fixed. Even with omnidirectional antennas on the movable stations the propagation limits are readily predictable and therefore a geofence calculation can be implemented.

Because movable platforms must be mobile, the antenna is physically restricted to 5m or less AGL. This practical reduction in the mobile station antenna height effectively ensures that the geofence is determined by the fixed base station (up to 100m AGL) not the mobile client stations (5m AGL or less). OFCOM specifically allows a TVWSD to identify as mobile in the database query and it is then assumed that the antenna height for the mobile station is 5m AGL. The database calculation is then performed to determine channel availability. Under OFCOM because the antenna AGL is restricted for mobile stations, higher allowed EIRP from the database is allowed for mobile stations versus fixed stations.

With a 60 second channel availability check any additional risk of interference is unlikely. 6Harmonics has tested a database update with a periodicity as short as 3 seconds and has shown no issues.

Under EN 301.598v2.1.1 the TVWS device must check the database if the radio moves more than 50m. 6Harmonics has demonstrated such capability, which in effect allows mobile operation up to approximately 80kph without any problems.

Signed 

Dr Michael Davies
VP, Business Development
6Harmonics Inc.
Email: mike@6harmonics.com
Tel: 613-761-2586