

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of)	
)	
Amendment of Part 15 of the)	ET Docket No. 14-165
Commission's Rules for Unlicensed)	
Operations in the Television Bands,)	RM-11840
Repurposed 600 MHz Band, 600 MHz)	
Guard bands and Duplex Gap, and)	
Channel 37)	

**Comments of Adaptrum, Inc.
In Support of Microsoft's Petition for Rulemaking**

Adaptrum, Inc. supports the Petition for Rulemaking submitted recently by Microsoft, Inc. (RM-11840) requesting that the Commission adopt a set of improvements to the rules for unlicensed devices that operate in the TV white spaces (TVWS). As supplier of communications equipment that utilizes TV White Spaces (TVWS), Adaptrum has many years of on-the-ground experience with TV white space deployments. To support operators deploying TVWS, Adaptrum has continually innovated to improve our TVWS equipment in order to eliminate barriers to adoptions. Initially available commercial equipment successfully demonstrated the ability of TVWS to provide long-range coverage in rural, remote, and non-line-of-sight conditions, but saw limited adoption due to high deployment costs and limited capacity.

To reduce TVWS equipment cost and allow commercial-scale adoption, Adaptrum has focused on developing a standards based TVWS ASIC as well as management software and network and device features to improve scalability and ease-of-use, allowing TVWS networks to scale to thousands of end users. Adaptrum's TVWS ASIC supports leading TVWS standards with advanced carrier aggregation, MIMO and network synchronization capabilities and peak throughput up to 500 Mbps (when using carrier aggregation with full-channel bandwidth). With the initial chip-based devices expected by end of 2019, the ASIC reduces the cost of equipment for fixed wireless broadband and also enables new low-cost, small-size form factors, including embeddable options to enable IoT over TVWS applications. Additionally, over the past couple of years, Adaptrum has released carrier-grade management software and scalability features including the recent release of our cloud-based network management software, which simplifies monitoring and configuring all TVWS devices in an operators network to reduce the complexity and expense of running large networks.

To improve system throughput and capacity and meet the broadband definition and beyond, Adaptrum developed a set of radio technologies including channel expansion, channel

aggregation, and MIMO, which are realized on the Adaptrum ASIC and next generation systems. Combined, these throughput enhancement features will allow TVWS networks to deliver over 100Mbps (up to 500Mbps peak) while still maintaining the same long-range, non-line-of-sight coverage and still driving down deployment costs.

With our experience with operators and our own advancements with TVWS technology in mind, we believe that the changes proposed by Microsoft will provide enhanced opportunities for providing service with TVWS devices and thereby have a direct impact in both improving the quality of life of rural Americans and strengthening the rural economy. These improvements can be implemented without increasing the potential for interference to licensed services that use the TV and 600 MHz wireless bands.

Microsoft's proposals are focused on modifications to the rules that will increase industry's ability to deliver high quality services to unserved and underserved regions of the country. Adaptrum submits these comments on specific provisions of Microsoft's petition:

- **Permit Higher Radiated Power Limits in Less Congested Areas**

Adaptrum's feedback from rural operators we have engaged is consistent with that of Microsoft's in that a modest increase in effective radiated power through an additional 2 dB of antenna gain to 12dB would improve the ability of TVWS devices to provide service to users in rural areas, thereby improving the economics of deploying TVWS in these currently underserved locations.

With regards to implementation, it is both practical and feasible to implement compliant devices that utilize the increased power limit in rural areas. The highest gain antennas available today, and likely in the future given practical size limitations, support a gain of 11-12dBi. Such antenna performance is consistent with the proposed combination of allowing a maximum EIRP of 42dBm and maximum conducted power of 30dBm requested by Microsoft. Current generation Adaptrum base station radios deliver a maximum conducted output power of 26dBm. With no significant change in cost, it would be feasible to increase the conducted power to 30dBm while still meeting all applicable emission and database requirements. This would allow networks to benefit from the increased coverage of an EIRP of 42dBm. In areas and channels where EIRP is limited to 40dBm, 36dBm, or lower, Adaptrum devices will reduce power to or below the levels received from the WSDB. We believe that allowing EIRP up to 42 dBm with a combination of 30dBm capable devices and 12dB of antenna gain could be implemented through an appropriate increase in the separation requirements to protect broadcasters and other licensed users.

- **Authorizing Higher Power WSD Operations on First-Adjacent Channels**

Adaptrum supports Microsoft's proposal asking the Commission explore options for allowing fixed WSD to operate at higher powers closer to broadcast television stations on adjacent channels. As Microsoft suggests, TV receivers supporting the more efficient ATSC 3.0 standard

will have better ability to reject adjacent channel signals. In addition, it may now be possible to better predict where TV signals are sufficiently strong that they will not receive adjacent channel interference from TVWS devices.

An additional consideration for allowing increased power on first-adjacent channels is that TVWS devices today are better able to utilize available spectrum. Therefore rules that allow more channels to be utilized will have a direct impact on broadband service. A frequent critique of TVWS has been that the performance, *i.e.* throughput, is poor relative to higher frequency technologies. There is also a misunderstanding that there is some inherent performance limitation when operating in a lower frequency band. In reality, the only limitation is channel size. Higher band systems, operating in say the 5.8GHz ISM band, have channels with widths starting at 20MHz and the possibility of systems operating across 160MHz. Relative to this, the performance of a TVWS system operating in a single 6MHz channel is substantially less. Early TVWS systems operated only in a single channel with no advanced multi-antenna processing (*i.e.* MIMO) capabilities. However, systems available today boast a number of capabilities that make it possible to better utilize available spectrum to deliver broadband capabilities more in line with high-band systems. These include channel aggregation, channel expansion, and MIMO. In this context, while historically the quantity of channels in an area didn't directly impact the service that could be delivered, now it does. Allowing higher power in adjacent channels will directly increase channel availability and thereby delivered performance. Channel aggregation allows multiple non-adjacent channels to be used by a single device. By allowing operation at higher power in channels adjacent to broadcasts, channel aggregation would make it possible to utilize a single unused channel sandwiched between two TV stations as part of a multi-channel system. Similarly, in other portions of the band, the proposed change would increase the likelihood of more and wider blocks of available channels. This would allow channel expansion, which enables systems to operate across multiple adjacent channels. When combined with MIMO, which increases the throughput regardless of quantity of spectrum, systems will be able to maximally take advantage of the fragmented nature of the TVWS band to deliver over 100Mbps when sufficient channels are available. As such, consideration for allowing increased power operation in adjacent channel will have a material impact on meeting broadband targets in areas that are dependent on TVWS.

- **Operation at Average Terrain of Up to 500 Meters**

In working with rural operators, we have also observed that some rural communities in hilly and mountainous regions are impeded from economically deploying TVWS systems due to the restrictive Height Above Average Terrain (HAAT) limitations currently in place. For instance, a community in Southern Virginia was exploring use of TVWS systems, but many of the sites targeted were not viable due to the HAAT limit. These sites were identified because they offered existing tower infrastructure as well as being located in areas that would maximize coverage around the surrounding area. Finding locations that did not exceed the current HAAT limits added significant cost to deploying systems while also severely limiting the coverage that could be achieved in these hilly areas.

While we recognize that concerns for interference to incumbents due to propagation from elevated terrain must be accounted for, the current 250 meter hard limit on HAAT can preclude any operation regardless of the proximity of the nearest incumbent service. Allowing the database to calculate availability at higher HAAT in line with the appropriate highly protective separation distances would give much needed visibility into whether TVWS could be used in currently excluded areas. As a precursor to a decision on this topic, it could be useful for a TVWS database operator to examine channel availability under the Microsoft's newly proposed separation distances for locations currently impeded.

- **Allow White Space database ("WSDB") administrators to use the Longley-Rice propagation model**

One of the principal concerns in the Commission's approach in protecting licensed operations from TVWS devices has been the model used to predict the availability of broadcast signals. In particular, the FCC curves model does not consider local terrain factors that can limit the reception of broadcast signals. Microsoft proposes using a terrain based propagation predictor such as the Longley-Rice model that would account for local signal availability factors to improve predictions. That could significantly open up to TVWS operations additional locations where currently broadcast service is assumed to present but where there is actual service present. This could be especially helpful on opening up opportunities for increased power for adjacent channel operations. Such a change could equally decrease the uncertainty related to propagation calculations when considering Microsoft's proposals to both increase the overall radiated power level to 42dBm and increase the maximum HAAT to 500m. As Microsoft points out, modern computing capabilities may now provide the ability to make Longley-Rice or other computationally intensive location model predictions on a timely and cost-effective basis. Thus the practical concerns underlying use of the FCC-curves may no longer be valid. Use of a more sophisticated model that provides more accurate predictions could also be made optional for white space database operators. For these reasons Adaptrum also urges the Commission to re-visit the propagation model used to predict broadcast signal strength in determinations of TVWS channel availability to consider use of a more accurate model.

- **Support the Use of White Space Channels for Narrowband IoT**

Microsoft's petition also includes a provision that would increase the ability to better utilize the TV White Spaces to deliver Internet of Things (IoT) services; Adaptrum supports that effort.

As publicly disclosed previously, Adaptrum is developing a system on a chip (SoC) intended to support operation in the TVWS bands.¹ A key part of the functionality of this chip will be support for features beyond the 802.11af standard for wireless networking by TVWS devices.

¹ See Letter from Robert M. McDowell, Counsel to Microsoft Corporation, to Marlene Dortch, Secretary, Federal Communications Commission, ET Docket Nos. 16-56, 14-165 (filed Feb. 16, 2018).

This includes baseband support for narrowband operation. Microsoft's proposal to add rules for a "narrowband WSD" device would enable systems built around the chip to both utilize more of the available spectrum for IoT services as well as achieve better performance (range & throughput) by allowing higher power operation. This would in turn unlock the favorable propagation characteristics of VHF & UHF TVWS spectrum for IoT projects such as Microsoft "Farmbeats" and other IoT application including smart agriculture and smart utilities to achieve.

In conclusion, Adaptrum fully support of Microsoft's request to launch a Further Notice of Proposed Rulemaking to make a set of improvements to its White Space device ("WSD") rules, and it is our hope that the FCC will give the proposal its full consideration and approval.

Sincerely,
Haiyun Tang
CEO
Adaptrum, Inc.