To the Federal Communications Commission in regards to:

Comments Supporting National Association of
Broadcasters Emergency Motion for the Suspension
of the operation of the White Space Databases
(Section 47 C.F.R. 15.711(b) and 47 C.F.R 15.717)

Changes to Certain Rules for Unlicensed
Operations in the Television Bands, 600 MHz Guard
Bands, Duplex Gap and Channel 37

Reply Comments in Support of the Above Petition For Rulemaking

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Introduction

I would like to take this opportunity to reply to comments filed regarding FCC RM-11745, the *Emergency Motion for Suspension of Operations* of the TV White Space Database (WSDB). Comments were filed both in support and opposition to this rulemaking and I believe reality is found somewhere between the polar opposite filings submitted by both sides. The Commission found itself in the difficult position of trying to allow Part 15 users to share "unused"[1] TV spectrum while protecting incumbent broadcast, wireless mic and other licensed users from interference by created by Part 15 users. The Commission's novel solution to this problem was the creation of a database of protected users that the Part 15 devices are required to reference before operating; theoretically allowing both licensed and unlicensed users to operate without causing interference between each other.

This database is seen as the "future of spectrum management" and shows some promise in allowing seemingly incompatible users to co-exist in the same spectrum. While auditing the operation of the WSDB system, the National Association of Broadcasters (NAB) identified several apparent problems with the database and filed a petition to suspend operations of the database until the design flaws NAB identified were corrected. While some of the database problems identified by NAB appear to be related to syncing problems between the multiple White Space Databases (WSDB) as well as factory test data by TV Band Device (TVBD) manufacturers, I believe there are still a lot issues that need to be dealt with before the WSDB is ready for "prime time". I further believe this is the perfect time to make these tweaks in the database system before the universe of white space devices expands beyond the approximately 600 devices that can be found in the database.

The bottom line is many of the "little" issues with the WSDB can be attributed to "bugs" that any software project has to deal with. However, there are still some serious flaws in the WSDB concepts and "little issues" combine with the serious ones to make protected users wonder if they are truly being protected from interference or if the spectrum protected users rely on will essentially be reallocated by interference to exclusive Part 15 use – very much like 2.4 GHz WiFi users have made the 2.4 GHz ENG bands unusable[2] by licensed broadcast and public safety users in Phoenix and other cities.

1. ***Lack of "Reported Interference"***

   Almost every party in opposition to this Rulemaking said NAB's concerns were invalid due to the "Lack of Reported Interference", so much so that it appears this was one of the "talking points" distributed to all opposing parties. While it may be true that there has not been any reported interference from WSD, this does not mean interference doesn't exist. There are many reasons

[1] So called "white space" spectrum in not laying fallow just because there are no TV stations using that channel. There are an untold number of wireless mic, intercom, broadcast point to point links and other users using this spectrum. Additionally, there will be even less spectrum available for the above licensed users once the 600 MHz auction and channel repacking is completed.

[2] In Phoenix, the licensed use of the 2.4 GHz Electronic News Gathering (ENG) band (2450-2483 MHz) has been deemed unusable for High Definition (HD) ENG due to unlicensed WiFi users interfering with ENG receivers. Before news went to HD video, Phoenix broadcast users would regularly chase interfering Part 15 WiFi users off mountain top ENG receive sites to allow licensed News operations to use 2.4 GHz frequencies without interference from unlicensed WiFi devices. The Phoenix broadcast community has essentially abandoned the licensed 2.4 GHz bands due to the complex modulation schemes needed to pass HD video, the sheer number of WiFi users and the amount of time needed to chase down the interfering Part 15 users – effectively reallocating this spectrum in Phoenix from shared licensed/unlicensed use to unlicensed use. I believe other markets have also given up on this spectrum for the same reason.

why interference to TV viewers and wireless mics are not reported. These can include, but are not limited to:

a. improper receive antenna and antenna systems[3]
b. lack of understanding on how digital TV (DTV) receivers works[4]
c. The "cliff effect" of DTV.[5]
d. Improper location and adjustment of receive antenna[6]
e. the viewer or wireless mic users simply "gives up" and either turns the TV or wireless mic off or changes to another channel
f. the viewer assumes the TV station is off-air

Any of these issues can cause the viewer or wireless mic user to have problems receiving a signal. However, none of these problems are things that would typically cause the user to contact the FCC and file a complaint.

Finally, let's assume the person is being interfered with by a WSD. Most users do not know what is causing the problem or have the ability to identify an unknown signal that is causing their problem. Even fewer, including broadcasters, know about or would even consider the existence of a TVBD causing the problem. If they don't know about TVBD, then they certainly won't know how to use the WSDB. But even if they magically identified the problem as a TVBD and could find their way through a WSDB, it appears there is no way to find out what channel a potentially interfering TVBD is operating on[7]. Combine all these issues and we find it's very unlikely the person being interfered with is going know what the problem actually is, so the complaint filed with the FCC would probably be classified as a TV reception problem. Assuming they did file a complaint, the

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[3] Most people are unaware that the FCC's DTV Planning Factors assumed all viewers had an outdoor TV antenna 30' above the ground and therefore an outdoor antenna was factored into DTV channel allocations and transmitter power. Due to marketing of "DTV" antennae, many viewers use amplified indoor "DTV" antenna or have replaced their traditional log-periodic outdoor antenna with a "DTV" antenna. For whatever reason, most "DTV" antennae are designed for UHF use and have poor performance at VHF Hi band and essentially no response at VHF Lo band frequencies. Additionally, many "DTV" antennae have internal pre-amplifiers, probably due to the poor response at VHF frequencies, low antenna gain and the incorrect assumption that "more signal is always better".

[4] One of the 1st things a viewer does then they have a reception problem is to add a pre-amplifier to "boost" the received signal. Unfortunately, most viewers don't realize it is possible to get too much signal into a DTV receiver, and the symptoms of too much signal are identical to that of too little signal. This is because the "signal meter" on most DTV tuners shows signal *quality* and not signal *quantity.* Too much signal results in non-linear operation in the RF stages – degrading the signal *quality*. I can't tell you how many RF attenuators I have sent to viewers that have had problems receiving KAET's VHF signal.

[5] Due to the error correction inserted into DTV signals, many viewers get excellent reception while receiving a marginal signal. If the signal further degrades for any reason, the additional errors can exceed the ability of the error correction circuits and the viewer's DTV falls off the edge of the "digital cliff" – losing their DTV signal.

[6] Many buildings in Phoenix use "stucco" construction. Stucco uses chicken wire as the base that cement/plaster is applied to. This creates for all practical purposes a faraday cage containing the DTV, which severely attenuates the DTV signal received in the house. Unlike analog TV, where the viewer could adjust the rods on indoor rabbit-ear type antenna and see when they have the antenna adjusted, in most cases the viewer cannot see any effect when adjusting the antenna; especially after the viewer's receiver has fallen off the "digital cliff"

[7] Most users, including broadcasters and professional wireless mic users, have no idea that TVBD even exist, much less know how to look them up in the database. In addition, I'm unaware of any method of finding out what channel a TVBD is actually operating on. This makes it difficult to identify TVBD interference – even by professional broadcasters and wireless mic users that probably have access to a spectrum analyzer. A typical TV antenna installer would probably have even more problems identifying TVBD interference as they typically don't carry spectrum analyzers.

FCC would most likely ignore it as they have more important things to do than deal with apparent TV reception or wireless mic issues[8].

Because there are simply too many things that could cause a viewer to have problems receiving a TV signal, I unfortunately suspect FCC complaints would not significantly rise even if the number of TVBD being deployed would somehow jump to a huge number similar to WiFi – but the WSD interference potential certainly would certainly rise – possibly resulting in the unintended backdoor reallocation of licensed spectrum to Part 15 spectrum much like 2.4 GHz WiFi.

2. Professional Installation and improper entry of location information

Many comments, both pro and con, were made about improper data being entered into a fixed WSD which can cause the wrong list of available TV channels to be sent to the WSD. In addition to a simple typo when doing data entry, I can not only see how a user can unknowingly circumvent the WSDB but it has actually happened to me. Let's explore 2 examples, one real and one theoretical.

In November of 2013, I evaluated a Meld MT-300 TVBD as a possible emergency replacement exciter for a translator should the exciter fail. When I unpacked the device, there was a note in the box that said the device has already been entered into the WSDB and there was no need to enter it again. When I turned it on, I found it came up on an active full power DTV channel – certainly not what I expected. So I looked up the device in the WSDB and found it was not located in downtown Phoenix like I expected, but the WSDB had it located somewhere out in Kansas – far from any TV transmitters. Since this was an evaluation unit, I didn't see this as anything malicious, but something the sales vendor would do so they could send an evaluation unit anywhere and it would work. This is exactly what NAB was concerned could happen if a TVBD user wanted to use a device in an area where there are no channels available to a TVBD.

The theoretical example would be a user that buys and correctly installs a TVBD in a rural area, just like they are intended. It works great and the user is happy. At some point, the TVBD user moves to a location near a protected location, i.e. a church using wireless mics, and again correctly reinstalls it into the WSDB at its new location. The church only activates its protected status on Sundays when they have services, so every Sunday the TVBD user finds his device turning off – just like it's supposed to because the church activated it's protection for its Sunday services. However, the TVBD user doesn't understand the TVBD is operating exactly as designed and assumes his device is broken. A simple internet search comes up with a "fix" for his "broken" TVBD – change the location of the WSD to the cornfield in Kansas. Voila, the TVBD is now "fixed", at least to the TVBD user – while causing interference to the church operating its wireless mics during its Sunday services.

I suggest a possible solution – make the installing user enter both the physical address as well as the Latitude/Longitude (Lat/Lon) of the TVBD location. The WSDB can easily geolocate the address and compare it to the Lat/Lon entered in the device. This would be a quick and easy verification that the Lat/Lon was entered correctly, i.e. the installer didn't transpose numbers.

[8] Adaptrum notes in its comments "*FCC spectrum management processes are operating near overload at present, e.g. FCC's inability to resolve 100+ cases of interference from FM broadcast stations to 700 MHz LTE base stations…*"

While a truly "malicious user" could easily circumvent this simple test, it would easily catch the inadvertent typo when doing data entry.

3. *White Space Database Concerns*

Much was made of the problems found in NAB's audit of the various WSDB. The comments opposing NAB explained away many of these issues as "test data" used when doing factory quality control and the lack of standards in the expiration of TVBD data. There were several suggestions on methods of identifying test data so it can easily be filtered out. I think this is a great idea and should be implemented. The same concept should also be implemented to identify all test data, including MVPD, wireless mic locations, broadcast links, etc. when doing WSDB testing and verification. I have entered data into the WSDB with an extremely short duration so I can verify the system works correctly. Unfortunately, test data must be entered into the live database to verify the data is properly synced from one database to another. Data identified as "test data" can be filtered so that active devices do not act on the test entries as well as make it easier to do database verification by easily filtering out test data. While I do my best to enter test data so that it will not affect live users, I would love to be able to identify this data as test so it doesn't affect any TVBD that may be in operation.

I have problems understanding the "lack of standards in expiring data" as a valid reason. I see this as being a symptom of serious problems syncing data. I don't understand why each database makes its own decisions on expiring data. A solution to this issue would be to make the database the data was entered into the "master" database that owns that record. Any changes to that record would be done by the owner/master database for that record and those changes, including deletions, would be synced to the other databases. Databases can only make changes to records they own and those changes would be synced to the other databases. In order for the WSDB concept to work properly, ALL databases MUST be absolutely synced. When protected users find their data in some databases but not others, the database concept takes a serious hit in reliability.

I've identified additional problems syncing data between databases[9] where data (MVPD and licensed wireless mic location) is entered into one database but does not appear in others. Please note I am only looking at issues that affect my stations operations. I would bet there are problems that others simply have not found yet as they have not spent any time with a WSDB. Over the years, I have sent many emails to WSDB admins reporting issues and have usually received quick responses and the issues have either been fixed or explained away to my satisfaction. However, I have not received a direct response on the latest MVPD issue nor has it been fixed. So I entered the information into another WSDB in an attempt to be sure my operations are protected. The inability to rely on data being properly synced and having to do workarounds like this are one of the many things that gives the entire system a black eye.

I have to clarify one statement[10] I made in my original comments where I said it is not possible to find the contact info for a TVBD that may be causing interference. What I should have said was it is apparently not possible to get the contact info using the WEB GUI most users use to access the WSDB. I found it is possible to get this information by downloading the entire WSDB, import it

[9] Comments of Karl Voss to RM-11745

[10] Comments of Karl Voss to RM-11745 at the bottom of page 3 and top of page 4. "*The contact information for the offending TVBD user simply does not appear to be available to protected users or Frequency Coordinators using the publically available WSDB.*"

into Excel or another database and query the database that way. I believe this is beyond the abilities of many standard users – especially when they have a current interference issue to track down.

I hoped to be able to identify the TV channel in use by a TVBD by downloading the entire WSBD. Unfortunately, this does not seem to be the case. At one time I could find TVBD channel info in the iConectiv WSDB WEB GUI, but that appears to have been removed. Maybe this information is hidden somewhere and I'm missing it, but based on the amount of time I've been testing and using the WSDB, I suspect if I can't find it then most standard users won't be able to find it either.

4. Fixed TVBD Geolocation

Adding GPS capability to fixed TVBD was universally opposed by comments from entities against the NAB filing. The majority of comments regarding GPS were similar to "too expensive", "unnecessary", "wouldn't work inside buildings" and "professional installation in all that's needed". I find it interesting that cell phones can work inside buildings without external antennae and adding GPS or other geolocation ability to a cell phone certainly didn't add $50[11] to the cost of a cell phone – at least I don't think so based on the current costs of most cell phones. I do understand the costs that would be incurred by the TVBD manufacturers in adding geolocation to devices that currently don't have GPS capability, but I feel that meeting FCC Rules would simply be a cost of doing business. Adding automatic geolocation to fixed devices simply makes sense – especially based on the examples I described in section 2 of this document.

Google[12] and Microsoft[13] both state in their comments that all personal/portable TVBD automatically include geolocation. While this is true for Mode 2 Personal/Portable devices, Mode 1 devices do not have geolocation abilities and receives its channel availability list from either a fixed or Mode 2 device. A Mode 1 device can operate as long as it can talk to its Fixed or Mode 2 controlling device. If the Fixed device has the incorrect location, the Mode 1 device will get the channel list that is available where the WSDB thinks the fixed device is. Adding geolocation to fixed devices will fix this problem.

Additionally, because a Mode 1 personal/portable WSD is not location aware, it can accidently wander into a protected area as long as it can continue to contact its controlling device. Since neither the controlling device nor the Mode 1 WSD knows it wandered into a protected location, the Mode 1 WSD would continue to transmit – possibly interfering with a licensed device in the protected area.

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[11] $50-$100 per unit is the estimated cost per WSD to add geolocation to fixed WSD as noted on page 3 of the White Space Manufacturers comments

[12] Comments of Google to RM-11745 on page 6. "*In focusing primarily on the registration of fixed devices, NAB's petition fails to note that the Commission requires personal/portable devices to rely on an automated geolocation capability. This approach makes sense for consumer devices that are likely to be sold on the mass market and operated in a variety of locations.*"

[13] Comments of Microsoft to RM-11745 on page 2. "*…All other personal/portable TV white space devices determine and report their locations to the database automatically, eliminating the possibility of human error in any part of the process that could affect interference protection…*"

Microsoft[14] appears to think "professional installers" are unlikely to commit inadvertent errors so geolocation is not needed. I know I had my share of typos when I created this document, I'm not sure why Microsoft thinks that typos would never get manually entered into a fixed TVBD. Double checking the Lat/Lon entered into the TVBD against the address that is also entered into the TVBD would solve this issue.

Summary

I believe using an automated spectrum management database is the future of spectrum management and can be a solution for allowing incompatible users to share spectrum. However, I believe both NAB and I have identified several serious problems with the current implementation of the TV Band White Space Databases. I think NAB ultimately did the White Space Industry, the pool of protected incumbents and the FCC a service in getting this discussion going. Many of the commenters, even those opposed to the NAB filing, said the WSDB system is a not a perfect process and there is still work to be done. In addition, they noted that this is a perfect opportunity to fine tune the database process and make it better.

As I noted in my introduction, I don't believe the doomsday notion that database is beyond salvaging and I certainly don't agree with the rose colored glasses view of the White Space world as described by opponents. I think reality is somewhere between both extremes and am willing to roll up my sleeves and work on making white space spectrum available to unlicensed users – as long as licensed and therefore protected incumbent users truly get the interference protection they deserve and the FCC Part 15 Rules require. I'm not sure that protection exists within the White Space Database system as it is currently operating.

I hope this starts the discussion and the process of fixing these problems…

Respectfully Submitted,

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[14] Comments of Microsoft to RM-11745 on page 2. "*…eliminating the possibility of human error—or by professional installers, who will be especially unlikely to commit inadvertent errors…"*