Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
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Additional Spectrum for Unlicensed Devices Below 900MHz and in the 3GHz Band	)	ET Docket No. 02-380
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Reply Comments of

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Introduction

Rather than confer full liability for interference mitigation solely to unlicensed devices, at least partial responsibility should be placed on television broadcasters. One helpful step toward this goal would be to require broadcasters to provide a robust, auxiliary geolocation system in fulfillment of their public-service obligations.

Numerous Commenters[1] filed in support of and in dissent of the proposal to use GPS-backed license databases to ameliorate the interference caused by unlicensed devices. Instead of considering that monolithic option, a much simpler, dynamic, and area-specific solution is within reach and is presented here.

Seeing a Forest for the Trees: A Technical Solution to the GPS/Database Issue

The discussion of problems related to storing licensed spectrum user coordinate databases in handheld devices is blinded by the same legacy "one size fits all" mentality that dominates spectrum management. Storing an immutable database of every spectrum licensee in read-only memory or even flash memory makes little sense, particularly since a given user might only ever roam within range of a minor fraction of that database's transmitters.

Rather than require each device manufacturer to store a copy of the Universal Licensing System or the Media Bureau CDBS database in every unlicensed wireless device, storing an area-local subset of licensed transmitter coordinates at each broadcast tower shifts the economic burden away from consumers, and towards a one-time capital investment by television

[1] See: Comments of Williams, Johansen, The Wi-Fi Alliance, IEEE 802.18 RR-TAG, The Software Defined Radio Forum, Intel Corporation, and Intersil and Symbol Technologies, Inc., In the Matter of Additional Spectrum for Unlicensed Devices Below 900MHz and in the 3GHz Band, ET Docket No. 02-380.

broadcasters. Placing this responsibility on broadcasters has the added benefit of greatly simplifying device design, which reduces the eventual end-user cost.

Since a significant fraction of television transmitters still have not made the transition to digital, it is possible that the NTSC Vertical Blanking Interval (VBI) could be used to transmit a low data rate ancillary geolocation signal[2]. Such a signal could contain a number of useful details about the broadcast tower, for instance: its GPS coordinates, center frequency, bandwidth, antenna EIRP, and a GPS-synchronized time signal.

By building a signal reference into television broadcast towers, precise geolocation becomes highly feasible for any terrestrial receiver. Since the television spectrum is better at permeating through foliage and other obstacles than the GPS spectrum, the addition of a geographic reference signal has excellent implications for any and all terrestrial users. The benefits to public safety officials, law enforcement, hobbyists, hikers, urban users, and others offer innumerable reasons to create such a service.

To add redundancy and robustness, a neighborhood-aware antenna system could be constructed in which television broadcasters within an area would be required to transmit the GPS coordinates of other known licensed transmitters within their vicinity. A major benefit to this approach would be the rapid, dynamic sensing of the RF environment upon system start. Each time a device powers up, it could detect licensed broadcasters within the immediate vicinity, as well as, potentially, the broadcasters one hop further. In other words, a device would be cognizant of the broadcast antennas whose signals it directly detected, *and* the antennas within an extended neighborhood. Having location information available will effectively "sectorize" swaths of the frequency landscape allowing for much higher resolution area-specific spectrum management. This boost in precision would help dismantle the Urban/Rural differentiation problem caused by the present Part 15 rules.

Geolocation tied to fixed transmitters also adds some measure of plausibility to the concept of an "interference temperature". Rather than spend vast resources on a national system for measuring interference, dynamic frequency management is more plausible in an environment where devices are automatically aware of their geographic coordinates and those of licensed spectrum users. Such awareness would help devices automatically scale output power to acceptable levels. In other words, devices that know they are in the countryside, far from any television tower reference signals, could then boost their output power. Those devices that power up in the middle of an urban area, with multiple licensed users nearby, would know to scale output power downward.

Aside from the cellular communications system, where spatial intelligence is built into the network, no other widespread geolocation system is currently in operation among other terrestrial operators. In order to facilitate the palatable deployment of more and higher-powered unlicensed transceivers, geolocation and spectral neighborhood awareness capabilities should be made a priority requirement. Building intelligence into the broadcast television system will ultimately assist in the deployment of unlicensed devices among

[2] The technology used for broadcasting data in the VBI is field-proven and has been in deployment since 1988. Groups such as the PBS-subsidiary National Datacast Inc. have readily demonstrated the feasibility of transmitting data using this method. (National Datacast, Inc. website, http://www.pbsnationaldatacast.com/WhoWeAre.htm)

empty channels. Spatial intelligence is a key factor in congestion and interference mitigation, as evidenced by the success of mobile telephony frequency reuse. An infrastructure for robust geolocation should be considered an important step toward further citizen access to underutilized spectrum.

As an augmentation of the GPS system, a television-band geolocation system is a good thing. Since television frequencies are much lower than GPS, the price and power requirements of an RF frontend for TV-band geolocation decoders would follow commensurately. Direct-downconversion RF frontends built on standard silicon CMOS processes could be commercially available at lower cost than present SiGe-based GPS ASICs.

Same Bird, Different Stone

Economically, since the Vertical Blanking Interval is a vestige of analog technology, and since the equipment used to add data to a broadcast signal does not come cost-free, requiring the remaining analog stations to add a geolocation signal to their equipment before their next license-renewal might spur more operators towards making the conversion to digital television.

Digital television stations should be subject to the same provisions to broadcast an ancillary geolocation signal. A novel solution for digital broadcasters, similar in nature to this proposal, is technology developed by the Rosum group (www.rosum.com). Using the Field Synchronization Segment of the ATSC standard, the Rosum terrestrial location technology allows for meter-precise user triangulation.

Because it piggybacks on a higher-powered signal with excellent Non-Line-of-Sight propagation characteristics, the addition of terrestrial positioning information to each and every broadcast television signal would enable indoor positioning an order of magnitude better than that of GPS.

Reciprocity

Another benefit of using digital signals to geolocate users and broadcasters is the fact that it creates a definite method by which signal quality might be measured. For instance, measuring the amount of usable-to-unusable geolocation data might yield a decent reference for channel utilization. In instances where the percentage of usable data falls below a certain threshold, the channel could be considered free for unlicensed use. Knowing the EIRP and receiver distance from an analog broadcast would give a better sense of channel attenuation.

A definitive digital geolocation signal with measurable degradation sidesteps the problems of quantitatively defining analog “interference”. Where fuzzy analog television picture may be due to natural signal attenuation or man-made interference, and may or may not be acceptable to the end user, a digital location signal would be hit-or-miss. Therefore, if the end user is out of the range of a usable digital geolocation signal, they would then have the option of using the spectrum for other purposes. However, this option may be quite generous to current television broadcasters, since digitally encoded signals are more robust at analog broadcast power levels.

Finally, the addition of geolocation signals to both digital and analog television broadcasts might benefit the development of listen-before-talk (LBT) transceivers. Since current-generation LBT systems already contain

enough intelligence to know when an analog channel is occupied, it wouldn't hurt to give them something useful to listen to. By offering a normative digital signal that would positively identify channel occupancy, LBT-based systems could more easily exclude themselves from utilized channels.

Conclusion

Certainly, incumbent broadcasters can leave signal detection and listen-before-talk dynamic frequency selection entirely up to unlicensed device designers. But such an approach is akin to dancing in sandals: eventually your toes *will* get stepped on. This is what broadcasters use as their primary argument, the notion that unruly unlicensed users will step on their toes more often than not. Without taking any of the responsibility for mitigating interference upon their own shoulders, however, broadcasters should not be granted *carte blanche* to complain, if an unlicensed user occasionally strays into their channels. For broadcasters to say to unlicensed users, in effect, "We're not going to help you find us, but you have to know we're here," places too many responsibilities on the wrong side of the table. Part of the culpability should fall on the broadcasters as it already does on the users.

Some responsibility for demarcating their licensed service contours should be explicit on the part of broadcasters. It should not be defensible for a licensee to simply claim spectrum in broad strokes within a geographic region while taking no proactive measures and forcing users to accept full responsibility for mitigating interference. A distributed system for broadcast tower geolocation would shift to the broadcasters some of the responsibility for defending their spectrum claims.

However, it must also be understood that adding geolocation data to a television signal does not enhance or further cement the rights of broadcast spectrum licensees. It would also not relieve broadcasters of their responsibility to convert to digital by 2007. The purpose of adding such a signal would simply be to benefit the public interest and facilitate movement towards more localized, efficient spectrum management and *sharing*.

It is within the public interest goals of the FCC to facilitate new and novel utilization of spectrum resources. Requiring all new unlicensed devices to contain complete license databases places a superfluous burden on innovative electronics designers. Similar in lineage to the requisite station identification, Emergency Broadcast, and public service announcements, it should be within the statutory public interest obligations of broadcasters to offer a minor fraction (a currently *unutilized* fraction) of their licensed transmissions for geolocation purposes.

Respectfully Submitted,

s/Max Vilimpoc
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Max Vilimpoc is a Research Associate at the New America Foundation ("NAF") in Washington, DC. These comments represent the views of the author only and may not necessarily represent the views of the Foundation. For the official position of NAF, et al., See: Comments of the New America Foundation, et al., in ET Docket No. 02-380.