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Reclaiming the Vast Wasteland

WHY UNLICENSED USE OF THE WHITE SPACE IN THE TV BANDS WILL NOT CAUSE INTERFERENCE TO DTV VIEWERS

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On May 13, 2004, the Federal Communications Commission approved a Notice of Proposed Rulemaking (NPRM) proposing to allow a new generation of wireless devices to utilize vacant television channel frequencies in each market. This so-called TV band “white space” consists of frequencies that are allocated for television broadcasting but are not actually in use in a given area.¹ The FCC’s proposed rulemaking is pending but currently inactive.

The proposed rules are intended to make way for technologies that utilize unlicensed spectrum, such as Wi-Fi, to utilize the prime TV band spectrum to offer wireless broadband services. Wi-Fi technology has become very popular at higher frequencies, and has had a positive impact on the growth of broadband services. However, the bands used for Wi-Fi do not have appropriate radio propagation characteristics to serve low population densities. Lower-frequency spectrum, such as that used for TV broadcasting, is capable of traveling longer distances at a given power level, and can better penetrate obstacles such as buildings and trees.

The FCC’s proposal would promote both spectrum efficiency and wireless broadband deployment. The TV band has been called a “vast wasteland” of underutilized spectrum. Even after the completion of the DTV transition – and the reallocation of TV channels 52-to-69 – an average of only seven full-power DTV stations will be operating on channels 2-to-51 in the nation’s 210 local TV markets. Only a fraction of the 294 MHz of prime spectrum allocated to DTV services will actually be utilized in most markets.

Thus, the proposed use of “white space” TV channels could have a particularly great impact on the growth of

information services in rural areas, where such empty channels are readily available. In urban areas, where less “white space” is available, this spectrum would also be useful because of the great demand for wireless broadband services and because of the ability of the TV band spectrum to penetrate buildings and objects within buildings better than the higher bands.

The FCC was clear in this NPRM that any devices certified to operate in the TV white spaces would be required to use new “*smart radio*” technology that would not interfere with television reception. Nevertheless, the National Association of Broadcasters (NAB) and other broadcast industry representatives, in comments filed at the FCC and in communications with Congress, have objected to the FCC’s proposal, claiming that unlicensed devices operating on vacant channels in the TV band would cause harmful interference to television broadcasts and other uses of licensed TV band channels.

This Issue Brief responds to the broadcast industry’s allegations, addressing each of the industry’s concerns about interference. The paper concludes that interference-free unlicensed use of the white space *is* practical with today’s technology. While some of the issues raised here are novel, the FCC as an “expert agency” should be able to handle them as it handles other cutting-edge spectrum problems. Indeed, the FCC is required by statute to avoid harmful interference with licensed TV broadcasts – and its NPRM describes several different ways to protect the dwindling number of over-the-air TV viewers from interference, as described below.

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Unlicensed Devices: 350 Million and Booming

Unlicensed devices have been authorized by the FCC since 1938. A Consumer Electronics Association study quoted by the FCC estimates that there are over 350 million unlicensed devices in the US and that annual hardware sales are in the multibillion dollar range.² The earliest unlicensed devices were remote controls for radio receivers. Today's unlicensed devices range from the ubiquitous cordless telephone to garage door openers to home security systems to Wi-Fi wireless local area networks.

All of these systems comply with general rules established by the FCC to ensure that they do not cause interference to licensed systems and Federal Government systems.³ Some unlicensed devices operate at very low power so they can coexist with higher power licensed users in the same band,⁴ while others (e.g., Wi-Fi) operate in bands that are largely devoid of licensed users.⁵ Before a new model of unlicensed device can be sold, it must be authorized—that is, it must be tested by a third party and shown to comply with technical standards established in FCC Rules.⁶ The FCC enforces its technical rules for unlicensed devices through both this equipment authorization program and through its statutory jurisdiction over the marketing of devices “capable of emitting radio frequency energy...in a sufficient degree to cause harmful interference to radio communications.”⁷

The FCC's technical rules have been primarily focused on preventing interference with licensed users. Unlike some other governments, the FCC has not attempted to steer the market by mandating specific services or technologies. This light-handed regulation has enabled a dynamic market for unlicensed devices to develop, as innovators bring to market new devices for new applications. Perhaps the best known example of this dynamic innovation on unlicensed bands is the explosive growth of Wi-Fi technology. The Telecommunications Industry Association estimates that sales of Wi-Fi equipment in 2004 reached \$4.35 billion, and predicts spending on Wi-Fi infrastructure equipment will increase to \$7 billion in 2008, a 12.6 percent annual increase.⁸ The development and popularization of Wi-Fi technology was built on a 1985 FCC decision⁹ to allow unlicensed devices in three bands--then best known for being the “home” of microwave ovens--provided they used “spread spectrum” technology to minimize interference.

The FCC Proposal for Unlicensed Sharing of TV Spectrum Without Harmful Interference

The Commission's May 2004 NPRM proposed to allow unlicensed devices to operate on unused TV channels, often called “white spaces.” As the FCC noted in its NPRM, this spectrum would be ideal for unlicensed broadband because it has better radio propagation characteristics than the present Wi-Fi bands and can tolerate higher power devices without causing interference. These characteristics allow wireless broadband providers to achieve better-quality coverage of larger areas using less infrastructure,

significantly reducing the cost of broadband deployment. A recent study by Intel confirms this, showing that the capital costs of covering a rural area with wireless broadband service in the TV band would be one-fourth those needed to achieve the same coverage using licensed MMDS spectrum in the 2.5 GHz band (which sits adjacent to the current unlicensed “Wi-Fi band” at 2.4 GHz).¹⁰

The FCC's NPRM proposes unlicensed operation under one of three alternative schemes intended to prevent interference to television reception:

I. “Listen-Before-Talk” (LBT): Sensing the presence of TV signals by the unlicensed device in order to select channels not in use. This concept, also described as dynamic frequency selection (DFS), has already been adopted by the International Telecommunications Union (ITU) and the FCC for sharing of the 5 GHz spectrum between unlicensed systems and military radar.¹¹ Technical protocols to avoid interference have been negotiated between industry and the military.

II. “Geolocation/Database”: Location sensing and consultation with a database of broadcast license assignments. In this scheme, an unlicensed device would contain location-sensing technology, such as a Global Positioning System (GPS) receiver. The device would cross-check its own location with an internal database of TV transmitter locations in order to verify that it was a minimum distance from a TV transmitter.

III. “Local Beacon”: Reception of a locally transmitted signal that identifies which TV channels may be used in the local area for unlicensed use. In this scheme, low power local signals, possibly controlled by local broadcasters, would indicate directly which channels were free for use.

The Commission's NPRM proposes possible use of any of these methods as acceptable ways of avoiding interference to licensed broadcast users, and recognizes that the final rules might only allow for one or two of these independent alternatives. The remainder of this Issue Brief will discuss basic technical issues that have been raised in the FCC proceeding and then specific points made by the broadcast industry lobby in recent communications with Congress and the FCC.

I. Broadcaster Interference Concerns are Unfounded or Readily Avoidable with Established Technologies

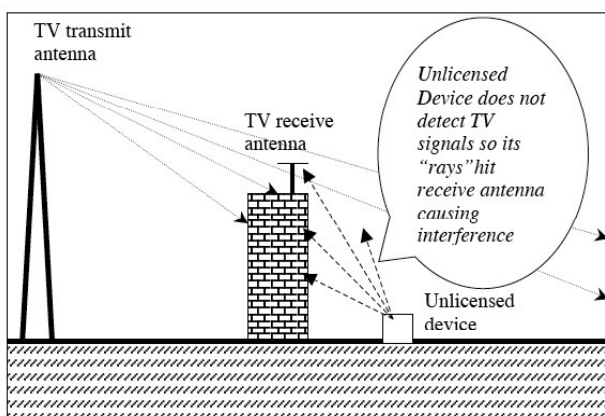
This section will address basic technical issues associated with the three alternatives. The proponents of this NPRM, including academics and equipment manufacturers, have shown in their comments that any of the three alternatives may be both effective and practical. While the original FCC proposal might not have been flawless, the remaining issues can be resolved through the normal rulemaking process at the FCC. Indeed, this is why Congress adopted the

Administrative Procedures Act¹² in order to have a give-and-take between regulators and concerned parties before rules are adopted reflecting the overall public interest.

A. Listen-Before-Talk (LBT) Alternative: Avoiding the “Hidden Node” Problem

The broadcast interests have focused much of their concern about the NPRM on alleged vulnerabilities in the *LBT* alternative (Alternative I above), in which unlicensed devices must first “listen” and sense the presence of TV signals in the area before transmitting. They point out that, as shown in Figure 1, an unlicensed device could be in the shadow of a building and be shielded from the TV signals, while a TV antenna at the top of the building might get a good signal.¹³ This is known in the technical literature as the “hidden node” problem. Indeed, studies have shown that in both urban and rural areas, where buildings and terrain serve as obstacles to TV signal penetration, there exist many “shadow” spots in which TV signals may be weakened or totally diminished.

Figure 1 - The “Hidden Node” Problem



Therefore, the broadcast interests claim that unlicensed devices using this alternative are likely to miss detecting TV signals due to shadowing, and thus will cause interference to nearby TV receivers that have adequate signal strength.

The comments of the broadcast industry (and even the FCC’s NPRM) assume that the detector part of the unlicensed devices in the *LBT* alternative would be about as sensitive to radio-frequency emissions as are normal TV receivers. But this need not be the case. Research presented at a February 2003 FCC-sponsored seminar demonstrated that a detector optimized for a specific class of signals (e.g., TV signals) can be orders of magnitude more sensitive than a normal receiver.¹⁴ The Commission had previously taken note of this research in its NPRM on cognitive radio,¹⁵ but inexplicably did not address it in this unlicensed NPRM. Similarly, the reply comments of the broadcast community have steadfastly ignored the applicability of this technology, which was mentioned repeatedly by various parties in the comment phase of the FCC rulemaking.¹⁶

It has also been pointed out in the comments that cooperative sensing of TV spectrum by multiple unlicensed devices could, in effect, improve sensitivity of TV signal detection significantly. Such cooperative sensing can be used in conjunction with very sensitive detectors for even more sensitivity gain.¹⁷

The use of very sensitive receivers could solve the hidden node problem. **The FCC could simply set a sensitivity value for detectors that would give a high confidence that usable TV signals would not be missed**, and then verify during the equipment authorization process for each model of unlicensed device whether that sensitivity level was met.

B. Geolocation/Database Alternative: Need to Keep FCC Data Up to Date

The broadcast interests also raise concerns about a second alternative means to avoid interference with TV reception on nearby channels: Geolocation and automated checking against a database of frequency assignments (Alternative II). Broadcasters have pointed out that geolocation systems such as GPS do not generally work indoors and hence could not reliably determine location. They also point out that the FCC databases on broadcast stations are not 100% accurate and are sometimes slow in catching up to transmitter frequency location changes – a more common problem now during the DTV transition.

We acknowledge the validity of these comments, but note that all of these concerns can be addressed with minor modifications to the proposed rules. The final rules should require that unlicensed devices must make iterative geolocation checks within a specified time interval in order to continue transmitting on a given frequency.

With respect to the broadcaster claims about the reliability of geolocation technologies, it is important to note that there are advanced GPS technologies used in some cellular telephone systems that actually *do* work indoors.¹⁸ Furthermore, once the DTV transition is complete, it will become technologically feasible to conduct indoor geolocation using multiple DTV signals, instead of the satellite technology used in current GPS systems. Indeed, geolocation could even become a new product for broadcasters.

In regards to the accuracy of FCC transmitter databases, it is true that the FCC’s internal database technology is outdated, allowing manual data entry problems to compromise the accuracy of transmitter location information. We call upon Congress and the FCC to recognize that such technology issues limit the potential of the multibillion dollar industries the FCC regulates and upgrade FCC databases so that they can be viewed as highly reliable. Regardless, if Congress mandates a “hard date” for the end of the DTV transition as it is expected to do, spectrum use will become more stable and the problems of updating the present FCC systems will become manageable.

C. Local Beacon Alternative: Control Signal Rules Can Avoid False Positives

With respect to the *Local Beacon* alternative (Alternative III above), the broadcast interests point out that the NPRM did not specifically propose what type of short-range radio signals should be used to broadcast channel availability information. Absent specific rules, a long-range transmitter might indicate availability of a certain channel and be received in an area far away, where that channel is not really available. For example, a signal transmitted in the AM broadcast band could have a range of hundreds of miles at night, and would be inappropriate for carrying information about which empty TV channels could be used in a given area. We agree with the broadcast interests on this point, but the problem could be simply resolved by rules specifying that the radio channel used to convey TV channel availability information must have a range comparable with the geographic validity of the channel availability information.¹⁹

D. Channel Availability

Some broadcast interests have questioned whether there will be significant channel availability for unlicensed use in major urban areas during the DTV transition. This concern is unwarranted. Even in urban areas, where there are fewer unused channels, there is likely to be substantial channel availability during the transition. Also, as Intel has argued, just because a particular channel may not be available throughout an urban region, doesn't mean it won't be available in *parts* of an urban area. Furthermore, the issue of channel availability during the DTV transition is likely to be short-lived. It now seems likely that the DTV transition will be ended by a date certain in the not too distant future – and the transition issue will simply go away.

Most importantly, there is no doubt that in rural areas—where unlicensed access to the TV band white space would make the most difference for affordable broadband deployment—there *is* spectrum available now and there will be for the foreseeable future. The proponents of this proposal do not seek a guarantee on how much spectrum will be available in a given location at a given time, and are willing to take their risks with the basic FCC proposal and their own analysis.

II. Other Concerns Expressed by Broadcast Community and Responses from NAF *et al.*

The broadcast industry has vehemently opposed the NPRM with multiple allegations that the proposals would cause serious harm to broadcast reception, cable television (CATV) reception, and to wireless microphones used in broadcast program production.²⁰ These allegations are addressed in turn below. The order of discussion here follows that of the April 8, 2005 letter sent by a broadcast industry consortium, the Coalition for Spectrum Integrity, to Senate Commerce Committee Chair Ted Stevens (R-AK).²¹

After the discussion of these points, we address the issues raised in a recent web-based video from the broadcast lobby.

A. “Interference to 73 Million TV Sets”

The FCC has previously noted that only a steadily declining minority of households with televisions are actually dependent on over-the-air signal reception, and that more than 85% of American households with televisions subscribe to cable or satellite services,²² and thus could not possibly be affected by interference from nearby unlicensed devices.²³ Nonetheless, the broadcast lobby asserts that permitting unlicensed broadband devices to operate on vacant TV band frequencies will cause a range of interference problems. The industry commissioned a Canadian laboratory study to corroborate these claims.²⁴ However, the results produced by the study were created under unrealistic conditions, such as certain combinations of channels and antennas pointing directly at each other. (This study also implicitly introduces the broadcast lobby's trick of using ultrawideband transmitters, permitted by a loophole in the original FCC proposal, to simulate the proposed unlicensed devices. This tactic forms the basis of a lobbying video released by the broadcast industry, discussed in Section I, below.)

B. DTV Disruption Issue

Broadcasters have claimed that implementation of the proposals would create consumer confusion and delay the penetration of DTV receivers needed to reach the 85% consumer take-up threshold mandated in current law before broadcasters would be required to cease analog transmissions. There is no evidence for this assertion. Concerns have also been raised that uncertainty about this rulemaking might make small local stations delay making final channel selections and converting to DTV. However, it now appears likely that the DTV transition end-date will be mandated, rendering this issue moot. Congress is expected to pass legislation this year that will end the DTV transition by a date certain, as well as to subsidize digital-to-analog converters and an education campaign aimed principally at the 15% of households still relying on over-the-air reception.

The broadcast community's statement that unlicensed devices may cause “interference to newly purchased DTV receivers, which may cause consumers to return their new TV sets,” similarly lacks a factual basis. Today's DTVs are far more capable of handling and rejecting any potential interference than older analog sets, which are susceptible to a variety of signal impairments that pass through directly to viewers in the form of ghosts, snow, and interference patterns in the video display. To suggest that new DTVs are somehow more susceptible to potential interference than other TVs is questionable logic.

C. Public Safety Interference

The *Geolocation/Database* and *Local Beacon* alternatives in the FCC proposal use local information, such as location and databases of facilities, in deciding what channel to use. Thus unlicensed systems using these techniques could readily avoid channels 14-to-20 in the handful of markets in which they are used for public safety. The *LBT* alternative requires more complexity to avoid public safety use of channels 14-to-20 since lower power, intermittent public safety communications are harder to detect than high power, full time TV broadcasting. However, technology already exists that allows unlicensed devices to detect and avoid military radar – which is a far harder task than detecting public safety communications. The FCC can solve this problem simply by requiring a long listening period on public safety channels before they can be declared vacant.²⁵ Similarly, the FCC can decide to require that unlicensed devices operating on certain frequencies include the ability to recognize a priority-in-use signal transmitted by public safety systems.

D. Newsgathering and Sports Programming Production

Although not generally known, broadcasters and certain other entities are allowed to use vacant TV channels for “low power auxiliary stations” (e.g., wireless microphones) with nominal licensing under the provisions of federal regulation.²⁶ While this use is officially licensed, this spectrum has not been auctioned and it bears many similarities to unlicensed use except that it is reserved for a narrow group of eligible devices. These devices are used at studios, but are sometimes used at sports events and other outdoor news events.

The broadcast interests raise concerns that the wireless microphones used by broadcasters on vacant TV channels might receive interference from unlicensed devices using the *LBT* alternative. While the FCC minimized this problem in the NPRM,²⁷ it is a difficult problem to solve in a manner that is transparent to existing users of such wireless microphones because the microphones operate at a lower power, do not necessarily have signal formats enumerated by regulations, and do not have a formal channel plan.

But it is not at all clear that such devices should continue to have exclusive access to this spectrum. The continued exclusive access of this small group of devices to large blocks of valuable spectrum for very occasional use, independent of marketplace forces, is anachronistic and inconsistent with spectrum policies enacted by Congress and implemented by the FCC in the past two decades. The FCC should perhaps revisit why broadcasters and the narrow group of eligible entities specified in FCC regulations are granted *sole access* to the “white space” spectrum in the TV band for a use that does not involve broadcasting directly to the public. When these policies were adopted decades ago, there was no other alternative to allow use of this “white space” except manual coordination

among a small group of broadcast licensees. However, today’s technology has increased the demand for this type of spectrum and permits cognitive radio alternatives such as those in the NPRM. Why should wireless microphones not be treated as unlicensed devices?

Even if this anachronistic use of the white spaces is continued, however, the *Local Beacon* scheme would protect wireless microphones, as local broadcasters would control the signals indicating which channels were available in a given area at a given time. There are also compromises available that could protect users of such microphones and allow the proposed unlicensed use: the FCC could, for example, adopt a transition plan that exempts unlicensed devices from certain TV channels for a transition period. Following this period, it could then grant full interference protection to eligible wireless microphone users that transmit a low power beacon signal in the vicinity of an operating wireless microphone, and having a comparable coverage area to that microphone, indicating which TV channel the microphone was using.²⁸ In this way, the broadcasters would have preferential (but not sole) access to the TV band.

In the past, traditional land mobile radio technology (i.e., walkie-talkies) did not provide the audio quality required for broadcasting. Now, however, high-speed 3G cellular technology could offer broadcast-quality audio for program production with a minor variant of standard technology—that is, *if* the broadcasters were willing to pay for such a service.²⁹ However, the present availability of “free” spectrum for this limited group of eligible entities discourages cellular firms from developing such 3G offerings. Shouldn’t the broadcasters’ use of this spectrum for auxiliary purposes be subject to the same marketplace forces that apply to other spectrum users in order to ensure the highest and best use of limited spectrum resources?

E. Interference with “Theaters, Churches, and School Events”

Broadcast interests have also raised the concern that unlicensed use of the TV band might interfere with spectrum use at theaters, churches, and social events. However, they have failed to explain why these entities are even using this band, as theaters, churches and schools are not permitted to use the TV band spectrum. It appears that wireless microphone vendors have been selling their products to customers who cannot lawfully use them – and some now want to rely on those unlawful sales to prevent use of the spectrum for wireless broadband. Mass-market wireless microphones are capable of operating on the adjacent low-power Private Land Mobile Radio band, in which theaters, churches and schools *are* eligible to obtain licenses. Instead of using the TV bands, these users should use the lawful adjacent band. The equipment vendors who created this confusion should be required to help clear it up.

F. Will the Proposal “Permanently Chill Investment” in Spectrum?

The FCC proposal focuses on unlicensed sharing of channels 2-to-51 of the TV band spectrum, which has and will continue to have plentiful white space. The proponents of this rulemaking do not seek to expand this proposal to cover unlicensed sharing of the spectrum covering channels 52-to-69, which is to be licensed for non-broadcast use.

The broadcast community suggests that any regulatory change allowing unlicensed access to empty TV channels would deter investment in spectrum. Proponents of the proceeding would counter that unlicensed sharing of the TV band below channel 52 would in fact have precisely the opposite effect. By providing access to frequencies favorable for cost-effective rural coverage on an unlicensed basis, the proceeding would increase the economic incentive for deploying broadband wireless service in areas currently unserved or underserved by existing licensed wireless and wired broadband providers.

The statement of broadcast interests that “once unlicensed devices are permitted in a licensed band, there is no way to remove them” is overly dramatic and does not reflect contemporary technology. PC users routinely update their operating systems and other software to get the latest version. Demonstration versions of software with fixed expirations are common. The FCC should require that the internal software used by unlicensed devices to share the TV band white space be capable of being updated at a specified interval, so that the FCC will be able to modify the operating criteria of these systems based on experience, and even turn them all off if it so chooses. While this approach may be difficult for some types of transmitters, the transmitters in this proposal are expected to be connected to the Internet on a regular basis, and thus could check for software updates without requiring user intervention.

G. Interference to Cable Services

The allegations of the broadcast interests here fit into two sub-issues dealing with cable headends and in-home wiring. Translator stations, which pick up and rebroadcast signals in remote areas to extend a station’s coverage area, raise similar issues as cable headends. Although translator stations are not specifically brought up in the broadcast industry’s allegations, they are included in this discussion because of their relevance.

1. Cable Headend and Translators

Cable television systems (CATV) usually use over-the-air reception of TV signals to collect the signals for redistribution to their subscribers. The Commission’s “must-carry” rules³⁰ result in obligations to carry certain signals that in some cases are quite weak. Thus some cable headends in rural areas have high antennas on mountaintops aimed at distant stations in order to receive these very weak

signals. Some TV translators in rural areas have similar receiving systems.

Indeed, a wireless ISP using solely the *LBT* alternative with an antenna on a hillside close to a cable system headend or translator antenna might fail to notice a weak TV signal and thus cause interference to a CATV headend or translator. This type of interference could be prevented by requiring WISPs, at least in rural areas, to use options other than the *LBT* alternative for detecting vacant channels. While an end user of an unlicensed consumer device operating in the TV band might also cause interference for the same reason, this is very unlikely, because rural CATV headends and translators are explicitly located to give them a line of sight that avoids nearby populated areas in order to ensure good reception. Also, headend and translator antennas are often highly directional—that is, they are optimized to receive signals from certain angles so as to acquire as much of the distant signals as possible. This directionality desensitizes the headend receiver to any off-axis interference generated locally by a portable consumer device operating within proximity.

At present, there is no reliable database that contains the sites of rural headends or translators or the channels they receive. As was suggested by the National Translator Association,³¹ there are benefits here and in other applications to encouraging formal registration of cable headends and translators in order to improve spectrum management in general. Similar optional registration of CATV headend satellite receivers has been in place for more than 20 years to ensure that they do not face interference from other spectrum users.³²

The final rules should require that wireless ISPs at high elevations in rural areas must check the database of headend and translator input locations and avoid any use of frequencies used by headends and translators in their area. Translators and headends that choose not to register would receive no guaranteed protection.

2. Wiring Issue

The Canadian laboratory study used by the broadcast interests to demonstrate unlicensed devices interfering with over-the-air TV signals (see Section A above) concluded that even CATV users might face interference due to unlicensed signals entering “leaky” cables in their wall.³³ In order to demonstrate this, the laboratory had to aim a directional antenna at a cable at a distance of one meter. Furthermore, the cable used was of a type that is not used by the CATV industry and is not even sold by the largest US electronics retailers. Finally, in order to get this result, it was necessary that all the unused cable connections in the house had to be left “unterminated”—that is, without either a TV connected to it or an inexpensive, thimble-sized “terminator” device. These unrealistic test conditions render the findings of the study extremely unreliable at best.

H. “Eglin AFB Incident”

In its letter to Sen. Stevens and in filings at the FCC, the broadcast interests have repeatedly quoted a news story from *USA Today* reporting unlicensed device interference to military radars at Eglin Air Force Base in Florida in early 2005.³⁴ The FCC, with the concurrence of NTIA and DoD, adopted rules in 2003 to require unlicensed devices operating in the 5.250-5.350 GHz band to employ dynamic frequency selection (DFS) to ensure protection of military radar systems.³⁵ This DFS technology is related to the cognitive radio technology that would be used for unlicensed use of the TV band, but the technological problems associated with reliably detecting a single radar pulse of less than a millionth of a second duration versus detecting a TV signal, which is on continuously, are very different.

Furthermore, these DFS systems are not even available yet because FCC, NTIA, DoD, and interested parties are still negotiating the details of the testing to verify compliance.³⁶ Thus, DFS-equipped unlicensed devices could not have caused the problem at Eglin AFB because they are not yet available. The delay in developing consensus for testing methods mentioned by the broadcast interests is not a problem; rather, it is a sign that the spectrum policy-making system is behaving responsibly in delaying final implementation until a consensus is reached on the difficult issues.

It is puzzling why the broadcast interests also included in their letter to Sen. Stevens a copy of the FCC’s February 15, 2005 public notice dealing with garage door openers possibly receiving interference near military bases.³⁷ While garage door openers and military communications systems share the same frequency, the priority is very clear and is given for all unlicensed devices in federal regulations: unlicensed devices can not cause interference to licensed systems and must accept any interference caused by licensed systems. Potential unlicensed devices operating in the TV band would be subject to the same requirement. The likelihood of interference is very different in the case of military systems--which are not designed to avoid problems with garage door openers--and the proposed unlicensed devices in the TV band, which are specifically designed to use all available technology to avoid creating interference.

III. “Your Neighbor’s Static”

In August 2005, the Association for Maximum Service Television (MSTV), an arm of the broadcast lobby, released a video on its website alleging to show the interference that would be caused by unlicensed devices operating in the TV band.³⁸ Ignoring standard scientific methodology, MSTV did not include any details to show how an independent observer could reproduce its results; it stated simply that the device demonstrated was “an FCC-compliant unlicensed device,” and could cause interference to DTV sets at distances up to 78 feet and to analog TV sets up to 452.7 feet “even through multiple walls.”

Informal discussions with an individual involved with the production of the video reveal that the simulated unlicensed device exploited a longstanding loophole in FCC Rules that has never caused a problem using real transmitters in the field.³⁹ The device demonstrated is reported to be a 54-MHz-wide noise generator (covering the bandwidth of nine TV channels) – essentially an ultrawideband transmitter. This device would normally be forbidden by existing and proposed FCC Rules, but the loophole permits it to be used in existing unlicensed bands in conjunction with a more powerful signal limited to 6 MHz.

The present FCC rules were written two decades ago when test instrumentation was less advanced than it is today. As broadcasters well know, the FCC’s rulemaking contemplates new rules and device certification requirements that will be designed specifically to avoid interference with broadcast reception. This loophole in the Part 15 unlicensed rules, which would theoretically permit ultrawideband emissions in TV spectrum, can be closed once and for all if the FCC includes in its Report and Order in this proceeding an additional easily-measured total limit on power in the TV bands for out-of-band emissions.⁴⁰

Conclusions

The FCC made a reasonable and important proposal in May 2004 to give unlicensed access to under-utilized TV band frequencies to devices that meet rigid technical specifications. The FCC has proposed several alternative means to ensure there would be no harmful interference to television reception or to public safety operations, as required by law. The ability of “smart radio” technologies to avoid interference is well-established, and technology industries have suggested additional improvements. A comprehensive record has been established at the FCC. Legislation that mandates an end to the DTV transition will have the side effect of removing a major uncertainty affecting this proposal. The other concerns about interference raised by the broadcast interests in this proceeding can be easily resolved through normal rulemaking.

Endnotes

¹ FCC Notice of Proposed Rulemaking in Docket 04-186, http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-04-113A1.pdf

² “Unlicensed and Unshackled: A Joint OSP-OET White Paper on Unlicensed Devices and Their Regulatory Issues” OSP Working Paper Series, Federal Communications Commission, http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-234741A1.pdf

³ The FCC has agreed with the National Telecommunications and Information Administration (NTIA), which regulates Federal

Government use of spectrum pursuant to 47 USC §305, that it will coordinate with NTIA all rule changes that might cause interference to Federal Government radio systems. See http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-230835A2.pdf

⁴ See 47 CFR §§15.205,209

⁵ See 47 CFR §15.247

⁶ For most types of equipment, this authorization is done by a Telecommunications Certification Body accredited by the FCC or a foreign counterpart of the FCC pursuant to a mutual recognition agreement. However, for new classes of equipment FCC usually insists on retaining “hands on” control of final approval of new models until there is a consensus with industry on how the testing is to be done and interpreted. See <http://www.fcc.gov/oet/ea/-sec0>

⁷ 47 USC §302(a),(b) FCC issued \$350,000 in fines in 2004 for equipment marketing violations. See <http://www.fcc.gov/eb/reports/Jan2005.pdf>

⁸ “Wi-Fi and WiMAX Key Drivers of Wireless Equipment Spending, with Market Reaching \$29.3 Billion by 2008”, Telecommunications Industry Association press release, 4/21/05, http://www.tiaonline.org/media/press_releases/index.cfm?pareleas=e-05-24

⁹ See Report and Order, Docket 81-413, 1985

¹⁰ Kibria, Masud and Chris Knudsen, “Capital Expenditure Implications of Spectrum Assets in Semi-rural Environments,” Intel Corporation, August 23, 2005, p3.

¹¹ See 47 CFR §15.407(h)

¹² See 5 USC §553

¹³ At the frequencies used for TV broadcasting, radio signals do not act like rays of light with clear shadows. But obstacles such as buildings and terrain do result in some shadowing and signal decrease.

¹⁴ The presentation given by Dr. John Betz of MITRE Corp. is available at <http://www.fcc.gov/realaudio/presentations/2003/021203/featuredetection.pdf> One illustration of lower threshold for detection versus good reception can be found in tuning an analog TV set with over-the-air reception. One can notice which channels have distant and weak signals by seeing rolling snowy signals that can not be viewed as local signals can.

¹⁵ The Commission had previously taken note of this research in its NPRM on cognitive radio The Commission stated, “there are techniques that can be used to increase the ability of a sensing receiver to reliably detect other signals in a band which rely on the fact that it is not necessary to decode the information in a signal to determine whether a signal is present. ... For example, sensing can be made more sensitive by using bandwidths much smaller than a 6 MHz TV channel and/or can look for specific features of the TV signal such as the visual and audio carriers.” *Notice of Proposed Rule Making and Order* in ET Docket No. 03-108, 18 FCC Rcd 26859 (2003). At ¶20 and fn. 35. Available at: http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-03-322A1.pdf

¹⁶ See Comments of Michael Marcus, Sc.D. http://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6516482949 and Shared Spectrum Company

http://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6516982986

¹⁷ Comments of Adaptrum, Docket 04-186, at ¶17-19 http://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6516482775

¹⁸ An example is Qualcomm’s SnapTrack technology which is used in cellular E-911 systems. See <http://www.snaptrack.com/impact/index.jsp>

¹⁹ Radio propagation is generally has a large random component due to the same reflections that cause “ghosts” in analog TV reception. Therefore, the fix to this problem must state that the statistical confidence limit in the coverage area of the beacon signal must match the validity of the channel availability data to a high confidence limit such as 99%.

²⁰ Examples of the comments filed by broadcast TV interests are : http://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6517610710, http://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6517587197, and http://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6516983613

²¹ This letter is on file at FCC. Available at: http://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6517610710

²² FCC has reported that in 2003 66.1% of US TV households had cable service and 19.1% had DBS service. See http://www.fcc.gov/Reports/fcc2006budget_main.pdf at p. 12. Independently, a Consumer Electronics Association study this summer disputed the NAB’s number of 73 million affected sets finding only 33.6 million sets with over-the-air reception. http://www.ce.org/press_room/press_release_detail.asp?id=10764) See also “Speeding the DTV Transition: Facts and Policy Options,” New America Foundation Policy Brief, May 2005, at p. 1. Available at: http://www.newamerica.net/Download_Docs/pdfs/Doc_File_2389_1.pdf

²³ However, there is a separate issue of preventing interference to certain rural cable TV headend receivers which will be discussed later in this paper.

²⁴ The study is quoted, in part, in the November 30, 2004 Comments of NAB and MSTV but has never been published in enough detail that its results could be reproduced. See http://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6516883657

²⁵ TV channels are used continuously for all or most of the day. Public safety channels are more intermittent. There are 120 pairs of 25 kHz channels in a 6 MHz TV channel. These generally have a high transmitter (repeater) on each pair. If none of these 120 pairs have any detectable signal after a monitoring period of, say 1 hour, one can be certain one is not in an area where the channel is used for public safety.

²⁶ See 47 CFR §74.832(a),(c),(d)

²⁷ See ¶38 of NPRM

²⁸ A possible format for this beacons signal would be to have it imitate the narrow band pilot tone that is an integral part of DTV signals and thus would be looked for by devices searching for the presence of DTV signals. The beacon should be limited to having a comparable coverage area to the microphones in use.

²⁹ In rural areas there may not 3G availability for several years. But there is little wireless microphone use by broadcasters in such areas and they could either use microphones based on the unlicensed systems in this proceeding or microphones using Private Land Mobile spectrum for which they are eligible.

³⁰ See 47 CFR §§76.51-76.65

³¹ See

http://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6516883675

³² See 47 CFR §25.131 Only satellite receivers which have an optional license receive protection against C band terrestrial users.

³³ *Supra* Note 24

³⁴ Sen. Stevens letter at p. 4. Article referenced is “High Speed Net, Wi-Fi Interfering with Military Radar”, *USA Today*, Jan. 28,2005.

³⁵ See 5 GHz U-NII Report and Order, ET Dkt No. 03-122, 18 FCC Rcd 24484 (2003).

³⁶ See FCC Public Notice, OET Clarifies Equipment Authorization Policy for Unlicensed National Information Infrastructure (U-NII) Devices Operating in the 5 GHz Band, January 26, 2005, http://hraunfoss.fcc.gov/edocs_public/attachmatch/DA-05-175A1.pdf

³⁷ FCC Public Notice, Consumers May Experience Interference To Their Garage Door Opener Controls Near Military Bases, February 15, 2005 Available at:

http://hraunfoss.fcc.gov/edocs_public/attachmatch/DA-05-424A1.pdf

³⁸ Video available at:

<http://www.tvtechnology.com/dlrf/one.php?id=986>

³⁹ The NPRM stated that the out-of-band emissions of the proposed new unlicensed devices must comply with longstanding §15.209(a) of the FCC Rules. This is the same limit that applies to a variety of other unlicensed devices and which for 25 years has also applied to millions of home computers. (The computer limits in §15.109(a) are the same as this limit in the UHF TV band.) While many unlicensed devices are subject to a peak power limit in §15.37(b), the wording of the proposal implicitly exempted the proposed devices from the peak power limit that would have prevented the effect shown in the video.

⁴⁰ TV receivers are uniquely subject to this ultrawideband interference and the ultrawideband rules (§15.501,525) forbid UWB in TV bands. TV receivers have a very wide tuning range to accommodate all channels and try to achieve high sensitivity (which equivalent to low “noise figure”) using modestly priced components. There is a basic tradeoff between sensitivity and rejection of undesired signals in the same band and consumer-grade TV receivers, as demonstrated in the video, have a susceptibility to ultrawideband signals which do not occur in real environments outside the laboratory.