## White Space Technology and 'Interference': Myths vs. Facts

**MYTH: WSDs could disrupt the Digital TV transition.**

**FACT: The DTV transition will be over before any personal/portable WSD is permitted to operate in the band. The FCC's First Order and Further NPRM in October, 2006, specifically prohibits the marketing or sale of WSDs until after the February 2009 transition deadline.** Moreover, assuming the FCC issues its Final Order in early 2008, it will take time for manufacturers to build – and for the FCC to test and certify – consumer-grade devices. After the transition, since personal/portable WSDs that rely on spectrum sensing will continuously scan the band for TV and wireless microphone signals, both full-power and low-power TV licensees will be detected and avoided even if they change channel assignments in the future. Indeed, an advantage of WSDs with sensing capability is that they will immediately detect and avoid a DTV signal, or wireless microphone system, operating on a previously vacant channel.

**MYTH: WSDs will not adequately sense channels occupied by licensed TV broadcasters.**

**FACT: The FCC's Office of Engineering and Technology report, documents that the Philips "Prototype B" was 100% successful at sensing occupied TV bands at the weakest signal level within the device's technical specifications (-114 dBm).**[7] The FCC also measured how well the device operated at even weaker, out-of-spec measurements of -116 dBm, -117 dBm, -118 dBm, and -119 dBm. Opponents of WSDs only reported the results at -116 dBm, choosing to ignore the perfect performance of "Prototype B" at -114 dBm.[8] However, requiring detection and avoidance of a TV station even at -114 dBm is arguably too strict, since this level is far weaker than a DTV receiver needs to actually display a picture – DTV receivers need a signal power level that is 1,000 times more powerful (roughly -85 dBm) to actually display a picture. As a policy matter, it is important to consider that requiring an overly strict sensitivity level (i.e., a level weaker than -114 dBm) will result in far less white space being available while adding very little in the way of additional interference protection for the tiny percent of households with very expensive rooftop antennas capable of pulling in distant over-the-air TV signals.

**MYTH: Feasibility testing this year by OET is the same as FCC device certification.**

**FACT: The prototype testing recently conducted by the OET focused on determining whether WSD technologies were *feasible* for personal/portable uses, and on determining the appropriate operating parameters for such devices. Devices sold to consumers must first undergo a rigorous FCC certification process to confirm that they will operate pursuant to the actual technical specifications for interference avoidance.** The testing results for Prototype B, which overwhelmingly performed according to the manufacturer's specifications, proved the viability of the technology. Despite this, opponents of WSDs have suggested that the failure of one of the prototypes tested by the FCC is indicative of the performance of certified consumer equipment. Obviously, the goal of prototype testing is to evaluate particular technologies – the idea that all prototypes need to work flawlessly to conclude that a technology is viable is ludicrous. Prototypes being developed by other companies (such as Motorola and Adaptrum) incorporate a number of different interference-

[7] "Initial Evaluation of the Performance of Prototype TV-Band White Space Devices," available online at http://fjallfoss.fcc.gov/edocs_public/attachmatch/DOC-275666A1.pdf You can see the results in Figure 3-4 (page 14) and Figure 3-8 (page 18).

[8] See, for example, the statement from NAB Executive Vice President Dennis Wharton, "FCC testing results confirm what NAB, MSTV and others have long contended: that the portable, unlicensed devices proposed by high-tech firms can't make the transition from theory to actuality without compromising interference-free television reception." Available online at: http://www.nab.org/AM/Template.cfm?Section=Position_Statements1&CONTENTID=9976&TEMPLATE=/CM/ContentDisplay.cfm

avoidance technologies and sensing algorithms and will be assessed in a new round of OET testing. The take-home message, in terms of testing the *feasibility* of WSD technologies, is that the OET tests were a marked success.

**MYTH: WSD transmissions will cause harmful interference to TV broadcasts on immediately adjacent channels.**

**FACT: The Public Interest Spectrum Coalition worked with researchers at the University of Kansas Information and Telecommunication Technology Center (ITTC) to study the feasibility of building WSD transmitters that would not cause harmful interference, even to neighboring channels. On January 31, 2007, ITTC released a study commissioned by the New America Foundation[9] that created and tested WSD transmissions and concluded that by combining a number of basic interference-reducing features, WSD transmitters operating at under 100 milliwatts did not cause harmful interference to TV broadcasts on neighboring channels.** Wireless experts from across the country reviewed these test results and agreed with the study's findings, filing comments in support of this research with the Commission.[10] Subsequent measurements at Kansas University's ITTC labs show how a properly designed WSD "transmission mask" can operate at low power on the channel immediately adjacent to an occupied channel, just as two high-power DTV stations operate today without interference on immediately adjacent channels in Lawrence, Kansas.[11]

**MYTH: More time is needed to study the viability of these technologies before technical specifications are created since these are completely new technologies.**

**FACT: Spectrum sensing is proven and well-understood technology. The Pentagon has approved unlicensed sharing of military radar spectrum in the 5 GHz band by unlicensed devices using detect-and-avoid "smart" radio technologies.** In addition, in the FM radio bands, unlicensed transmitters have been in use for years – products like the iTrip allow anyone to broadcast from their iPod to their car or home radio over vacant FM channels.[12] This proceeding has been pending since 2002 (when the FCC published an initial Notice of Inquiry, seeking comment on the feasibility of productively using the TV white space). In June 2006, the Senate Commerce Committee adopted "The Advanced Telecommunications and Opportunity Reform Act" which (in Title VI) would have required the FCC to allow unlicensed devices to utilize all unused spectrum in the TV Band, subject to interference protections for licensed incumbents.

**MYTH: Unlicensed devices will harm existing TV broadcasts.**

**FACT: The vast majority of wireless microphones are themselves unlicensed devices and have been using vacant TV channels for many years (most of them illegally) yet without complaints of interference.** As noted above, today's "smart" radio technologies already are proven, and can be used to sense and avoid both high-power broadcasters and relatively low-power wireless microphone systems (such as those used at major concerts and sports stadiums). "Listen before talk" sensing is a well-established radio technology already operating to the Pentagon's satisfaction in the 5 GHz band – allowing "smart" Wi-Fi devices to share the band with military radar. The technology is also central to

[9] Technical Report ITTC-FY2007-44910-01, "Quantifying the Impact of Unlicensed Devices on Digital TV Receivers," online at http://www.newamerica.net/files/NAF%20Spectrum%20Technical%20Report%20_FINALSUBMITTED_o.pdf

[10] Available online at: http://fjallfoss.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6518724361

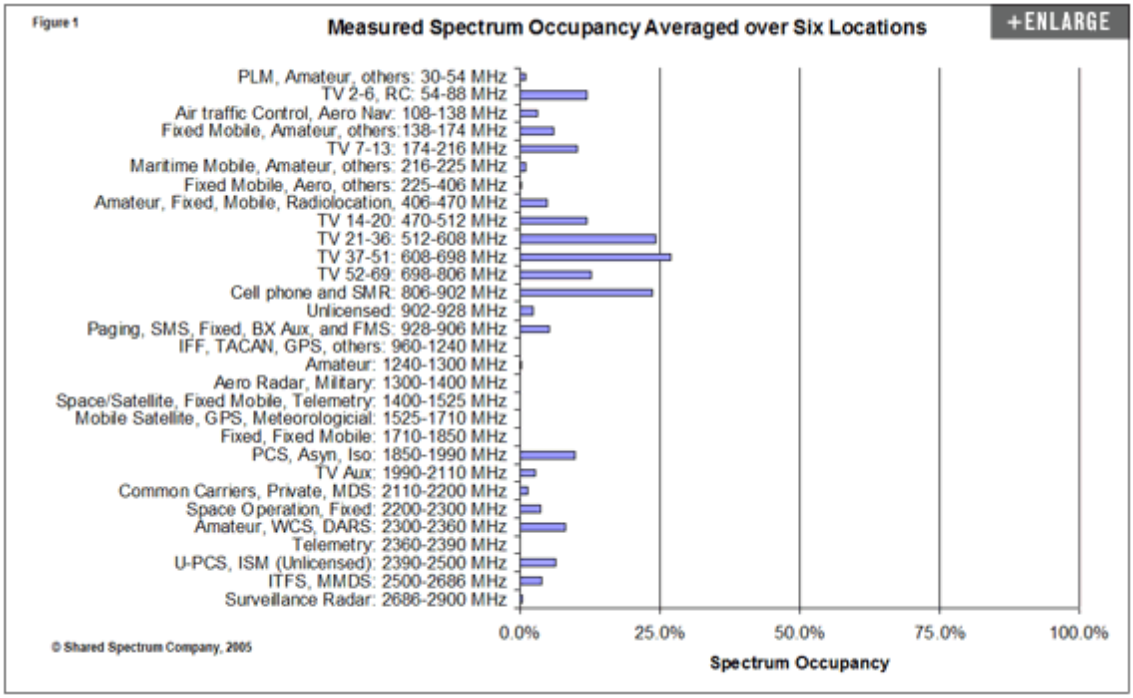
[11] These findings are summarized in New America, et al., Reply Comments on OET Unlicensed Device Testing, ET Docket 04-186 (Sept. 5, 2007), at http://www.newamerica.net/publications/resources/2007/reply_comments_oet_unlicensed_device_testing

[12] More information available online at: http://en.wikipedia.org/wiki/iTrip

the military's DARPA/X-G initiative, which has shown "smart" radios can identify and share spectrum white space across wide ranges of frequencies anywhere in the world. Although the broadcast and wireless microphone lobby has emphasized that one of the prototypes tested by the FCC failed to detect weak signals, the success of the Philips "Prototype B" was sufficient to prove the feasibility of the technology. The Microsoft "Prototype A" failed to perform well because it was broken. In fact, a second, identical Microsoft device in OET's possession was never tested, but subsequent testing demonstrated that when the device was not broken, it was able to detect incumbent TV operations using the proposed detection threshold of -114 dBm.[13]

**MYTH: Current uses of TV bands are efficient.**

**FACT: The University of Kansas Center for Research conducted a series of tests of actual spectrum use as a part of its study, "Spectrum Occupancy Measurements and Pre-Selector Development National Radio Research Testbed (NRNRT)."[14] This research documented the massive inefficiencies in today's uses of the public airwaves.** Researchers measured spectrum use in Great Falls, VA; Tysons Corner, VA; Arlington, VA; New York City, NY; Greenbank, WV; and Vienna, VA. The results from these tests document that the vast majority of spectrum remains unused. Even within the TV Bands a vast majority of the spectrum remains unused (see figure below). A New America study found that after full-power TV stations switch to digital-only broadcasting in February 2009, the vacancy rate among the 49 channels reserved nationally for DTV will range from 20-to-40 percent in congested, coastal markets like Trenton N.J., to 80 percent or more in rural markets.[15]




[13] See especially Figure 1 on page 6 and Figure 1 [sic] on page 7 of the *ex parte* filing in ET Docket 04-186 that includes these results is available at: http://fjallfoss.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6519610797

[14] National Science Foundation (NSF) Award Number: ANI-0335272

[15] For survey mapping available white space in selected TV markets, see *Measuring the TV "White Space" Available for Unlicensed Wireless Broadband*, New America Foundation and Free Press, January 2006, available at http://www.newamerica.net/publications/policy/measuring_tv_white_space_available_for_unlicensed_wireless_broadband

**MYTH: There is no way to prevent mobile unlicensed WSDs from broadcasting in unassigned TV channels used by wireless microphones (e.g., at a Broadway show or National Football League game).**

**FACT: Many options are available to venues that want to ensure that WSDs are not operating on specific frequencies being used by wireless microphones.** First, automated sensing of frequencies utilized by wireless microphones is being integrated into prototype white space devices themselves and can prevent harmful interference. Second, the FCC's original 2004 NPRM stated that venues can require patrons to turn off their cell phones and other wireless devices, much like theaters, airlines and other venues specifically request today. However, it should also be noted that licensed microphone systems operate at considerably higher power than WSDs (up to 250mW, compared to the proposed 100mW maximum power for white space devices), and so a WSD would, in most scenarios, need to be quite close to a microphone receiver to interfere. Third, the FCC could allow licensed microphone operators to protect themselves by using an inexpensive beacon device to broadcast a signal at the DTV pilot tone frequency (which is what WSD sensors are listening for), which would cause WSDs within range to avoid those channels during the event. Finally, other innovative solutions are available; for example, the United Kingdom has set aside specific frequencies for wireless microphone users to use during the DTV transition and if wireless microphone manufacturers need more spectrum, they can lease or buy extra service bands, like any other industry.

**MYTH: WSDs need to be able to sense at or below -116 dBm to ensure that harmful interference does not occur to television broadcasts.**

**FACT: Public interest groups and independent engineers believe that a sensitivity level in the range of -110 to -115 dBm will be more than adequate to protect TV receivers given a transmit power cap of 100 mW for personal/portable devices. This assessment is predicated upon research findings published by the New America Foundation that show this range to be adequate for receiver protection.[16]** The IEEE 802.22 is considering a sensing threshold of -116 dBm for fixed-location broadband equipment (such as access points) that will generally be transmitting at higher power levels than personal/portable devices and from locations well above ground level (e.g., on towers, rooftops or lamp posts), where they are more likely to interfere with DTV antennae. The White Spaces Coalition, which is composed of numerous high tech firms, including the companies who built the first two prototypes tested by the FCC, has proposed a somewhat less sensitive detection threshold of -114 dBm for very low-power personal/portable devices. It's important to note that even the -114 dBm threshold proposed by the high-tech companies is more than 30 dB less than the broadcast industry's ASTC A/7430 recommendation for DTV receiver sensitivity (based on the signal strength needed to actually display a DTV picture) of -83 dBm with no external noise and no propagation degradation, which, in practice, decreases sensitivity a few dB[17]. The final choice of DFS sensitivity number depends on many factors, particularly including the maximum allowed transmit power, emission mask, and treatment of adjacent channel issues. Creating overly protective WSD reception sensitivity standards harms the public interest by creating situations where WSDs cannot use frequencies where the TV signals are too weak for a television to display (e.g., where the weak signal detected is from a distant market). Even a -114 threshold would be so protective of distant TV signals (receivable only by a handful of viewers with expensive, roof-mounted directional antennas) that large quantities of spectrum would remain unusable.

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[16] Mark A. Sturza and Farzad Ghazvinian, "White Space Technical Study: Can Cognitive Radio Operating in the TV White Spaces Completely Protect Licensed TV Broadcasting?" New America Foundation Working Paper, January 29, 2007, available online at: http://www.newamerica.net/publications/policy/can_cognitive_radio_operating_in_the_tv_white_spaces_completely_protect_licensed_tv_broadcasting.

[17] The 30 dB difference between TV set and WSD reception sensitivity means that a TV set needs a signal that is 1000 times stronger than a WSD can detect to show a picture (one order of magnitude for each 10 dB).

**MYTH: Licensing white space spectrum could generate substantial auction revenue.**

**FACT: TV white space is ill-suited for licensed services and would raise only a small fraction of the revenue that is expected from unencumbered spectrum (such as the 700 MHz spectrum TV channels 52-69). TV white space is "swiss cheese" spectrum – each of the nation's 210 TV markets has a different set of channels in use, thus there are no nation-wide clear channels.** In addition, WSDs – whether licensed or unlicensed – would need to operate at very low power and operate on a secondary basis to DTV and wireless microphone licensees. This lack of priority, coupled with the lack of geographic scope and very low power levels, creates a novel set of constraints that would *dramatically* lower the profitability (and thus pricing) of each channel compared to other licensed spectrum. These constraints do not fit the existing business models of companies willing to bid billions, or even tens of millions, for licenses that guarantee quality of service over a national or at least regional service area. Indeed, to protect DTV, the license areas will be smallest and most encumbered in and around the most densely populated metro markets, where the most desirable customers are concentrated. The precedent set by Wi-Fi, on the other hand, demonstrates that unlicensed allocation of seemingly less than desirable spectrum can generate enormous economic activity, ultimately raising far more funding for our public coffers (through sales taxes, increased manufacturing jobs, cost savings to municipal entities, etc.) than licensing.

**MYTH: Stationary wireless deployments are sufficient to meet consumer needs.**

**FACT: Cell phones, PDAs, laptop computers, music players and small home electronics are all personal/portable devices in wide use today. The benefits end users gain by having access to the Internet on a diversity of mobile devices is substantial; adding white space connectivity will generate entirely new services, applications, and innovations in communications technology and "smart" electronics.** Fixed wireless (e.g., towers, customer premises equipment) is no substitute for mobility. As more and more consumers come to rely upon portable wireless devices for their day-to-day communications, the need for spectrum supporting "personal portable" technologies has likewise grown. Accessing the white space between occupied TV broadcast frequencies is an efficient and effective strategy to support the future growth of mobile communications technologies.

**MYTH: Device manufacturers and proponents of white space devices do not care about the quality of over-the-air television reception.**

**FACT: Leading advocates of expanding unlicensed spectrum access for broadband and services – such as Consumers Unions and the Leadership Council on Civil Rights – have fought for consumer rights for decades, particularly among low-income households who tend to be more dependent on over-the-air reception, and are 100% committed to maintaining the quality of over-the-air television. Likewise, the high-tech firms advocating WSDs on white space have a self-interest in avoiding equipment recalls and bad publicity from consumer complaints about TV interference.** In fact, "Prototype B" – the WSD that detected DTV signals with 100% accuracy in FCC/OET tests – was submitted by Philips Electronics, a leading manufacturer of DTV sets. In fact, several companies that support white space devices are considering integrating over-the-air television receivers into personal, portable devices. As a result, unlicensed broadband connectivity and DTV reception could one day be integrated side-by-side within the same device. Philips and other device manufacturers thus have a tremendous financial incentive to ensure that the two devices do not interfere with one another. The claim that public interest groups like the National Hispanic Media Coalition and the Leadership Council on Civil Rights would advocate changes that directly harm the constituents they serve – or that hardware manufacturers like Philips would support technologies that would harm their TV sales – is absurd on the face of it.