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Policy Brief

The Feasibility of Unlicensed Broadband Devices to Operate on TV Band 'White Space' Without Causing Harmful Interference: Myths & Facts

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Overview

In May 2004, the Federal Communications Commission (FCC) approved a Notice of Proposed Rulemaking (NPRM) to allow a new generation of wireless devices to use vacant TV frequencies (so-called "white spaces") on an unlicensed basis and thereby promote more effective use of the public airwaves.[2] In October 2006, under bipartisan pressure from Congress, the FCC adopted a First Order and Further NPRM that approved unlicensed use of vacant TV channels for "fixed" broadband deployments, but called for further study on the question of whether "personal" and "portable" low-power devices (such as laptops and iPhone-type PDAs) could also use these empty airwaves without causing "harmful interference" to the dwindling number of over-the-air TV viewers (roughly 13 percent of TV households use over-air reception the rest subscribe to cable or satellite TV services).

These white space devices (WSDs) present new opportunities for consumers to efficiently use currently unused spectrum and for America's technology sector to promote ubiquitous, more affordable broadband deployment – particularly in underserved rural areas – as well as stimulate new innovations in consumer products, services, and applications. With the growing use of Wi-Fi and other unlicensed devices in everything from laptops to next-generation PDAs and cell phones, WSDs provide much-needed additional capacity for everything from broadband connectivity to home and community networking. The remaining challenge for the FCC is to define explicit operating rules to govern device certification, so that high-tech industries can embark on the R&D necessary to bring compliant consumer devices to market.

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[2] FCC, *Noticed of Proposed Rulemaking in the Matter of Unlicensed Operation in the TV Broadcast Bands*, 13 May 2004. Available at http://fjallfoss.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6516214773.

What are TV Band 'White Spaces' and White Space Devices?

White spaces are vacant frequency bands between occupied (licensed) broadcast channels. In fact, after the completion of the DTV transition in February 2009, the amount of white space in most of the nation's 210 local TV markets will greatly exceed the amount of occupied spectrum, even in most major cities.[3] The same propagation characteristics that make TV broadcast frequencies so sought-after are also useful for expanding affordable, high-capacity, wireless broadband. The Public Interest Spectrum Coalition[4] wants to open up access to these unused bands for everyone by allowing wireless devices certified by the FCC to operate on vacant frequencies just like tens of millions of WiFi devices – and hundreds of millions of cordless phones, baby monitors and other devices that share a smaller, less desirable band of unlicensed spectrum today.

WSDs take advantage of wireless innovations of the past 15-to-20 years and automatically detect occupied TV frequencies – allowing the public to use spectrum that would otherwise be entirely fallow. In recent laboratory testing by the FCC's Office of Engineering and Technology (OET), the Philips "Prototype B" WSD was found to be 100 percent reliable in detecting and avoiding DTV signals at extremely low power levels (-114 dBm[5]), a signal level far too weak for a television to display. In addition, researchers at the University of Kansas (KU) have built and tested a prototype WSD transmitter and successfully demonstrated how WSD transmissions can be structured to avoid causing harmful interference to licensed broadcasts.

Opponents of WSDs have launched a misinformation campaign in an attempt to prevent more widespread access to TV bands. Their arguments focus on two key assumptions: first, that WSDs cannot sense occupied TV channels; second, that WSDs will cause harmful interference to licensed broadcasts. However, the OET and KU studies demonstrate that the two key facets needed to create unlicensed WSDs (reception sensing and transmission) are viable technologies and should be actively pursued. The next page summarizes the myths and facts surrounding WSDs and provides primary sourcing documenting the viability of WSD technologies.

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

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

FACT: The FCC's Office of Engineering and Technology report, "Initial Evaluation of the Performance of Prototype TV-Band White Space Devices"[6] documents that the Philips "Prototype B" was 100% successful at sensing occupied TV bands at the lowest level within the device's technical specifications, -114dBm. The FCC also measured how well the device operated at even weaker, out-of-spec measurements of -116dBm, -117dBm, -118dBm, and -119dBm. Opponents

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[3] Examples include Honolulu, HI; Charleston, WV; and Portland, OR. For more information see *Measuring the TV "White Space" Available for Unlicensed Wireless Broadband*. 05 January 2006, available at http://www.newamerica.net/publications/policy/measuring_tv_white_space_available_for_unlicensed_wireless_broadband.

[4] Coalition members supporting unlicensed access to TV white space for both fixed and personal/portable WSDs include Consumer Federation of America, Consumers Union, EDUCAUSE, Free Press, the Leadership Council on Civil Rights, the National Hispanic Media Coalition, Media Access Project, New America Foundation, Public Knowledge and others.

[5] dBm is a power measurement for electromagnetic transmissions. 0 dBm is equal to 1mW (1/1000th of a Watt). 3dBm is roughly equal to a doubling of power (i.e., 3dBm is about 2mW) and -3dBm is roughly equal to a halving of power (i.e., -3dBm is roughly 0.5mW). By comparison, a typical cell phone transmitter operates at 27dBm or roughly 500mW; BlueTooth tends to operate at roughly 20dBm (100mW). -114dBm is a bit less than .005pW or roughly 0.00000000000005 of a Watt. The "Prototype B" White Space Devices are able to measure signal strengths of this strength 100% of the time.

[6] 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).

of WSDs only reported the results at -116dBm, choosing to ignore the perfect performance of "Prototype B" at -114dBm. 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 -85dBm) to actually display a picture.

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.[7] This study 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 (see Appendix A of the report, pages 13-24). 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.[8] 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.[9]

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

FACT: 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. As noted above, the Pentagon has approved unlicensed sharing of military radar spectrum in the 5 GHz band based on the same detect-and-avoid "smart" radio technologies. In the FM radio bands, unlicensed transmitters have been in use for years – products like the iTrip allow any one to broadcast from their iPod to their car or home radio.[10]

MYTH: Unlicensed devices have never been allowed on the TV bands and represent a formidable new technology that could harm existing TV broadcasts.

FACT: The vast majority of wireless microphones are themselves unlicensed devices and have been using vacant TV channels illegally, yet without complaints of interference for years. The FCC should offer them no further protection than the Public Interest Spectrum Coalition's proposal to allow sports, theater, concert and other venues to bar, or require patrons to turn off, mobile

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

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

[9] 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

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

broadband devices during their events. There is absolutely no doubt about the *feasibility* of today's "smart" radio technologies to sense and avoid both high-power broadcasters and relatively low-power wireless microphone systems (such as those used at major concerts and sports stadia). "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 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 worked flawlessly at -114dBm.[11]

[11] 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