NEW AMERICA
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Policy Backgrounder

Unlicensed Broadband Device Technologies: "White Space Device" Operations on the TV Band and the Myth of Harmful Interference

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Synopsis

White spaces devices use the unassigned frequencies between broadcast TV channels to offer a range of wireless services to the public. Access to the vacant TV channels in each market has been the subject of intense lobbying, yet far too many of the arguments against white space devices rely upon misinformation about the technologies and the FCC process that will ensure that harmful interference TV broadcasts and other incumbent services does not occur. Much of the analysis that underlies anti-white space device lobbying does not equip policymakers with the information they need to make decisions in the public interest. We believe that policymakers deserve better than the torrent of misinformation that has characterized the debate over white spaces devices. Therefore, this paper is an effort to help policymakers strike the appropriate balance between protecting existing services from interference while making the benefits of mobile broadband services available and affordable for all consumers. This policy backgrounder contains an analysis of the impact of white spaces devices from the New America Foundation, an independent think tank that has published numerous independent studies on this issue over the past five years. The paper contains links to primary sourcing to support its claims and aid in the critical analysis of the counterclaims currently being made about these new technologies. Our goal is to provide decision-makers and interested parties with: 1) a brief historical background to the current FCC proceedings; 2) a description of White Space Device (WSD) technologies; 3) a point-counterpoint "Myths vs. Facts" section on some of the key concerns raised about WSDs; 4) an overview of the public benefits of WSDs; and 5) a concise summary of where we are in the multi-phase process of adopting WSD technologies for consumer use.

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Executive Summary

Today we are living through a critical juncture in telecommunications history akin to the advent of the telephone, radio, or television. **Computers and other digital technologies have enabled an entirely new communications medium – distributed, portable, "device as infrastructure" networks. Within these networks, end-user devices are "smart" and are capable of adapting to changing environments and maximizing efficient use of available spectrum to deliver mobile, affordable broadband connectivity.** Today, a coalition of consumer and other public interest groups, along with a number of high-tech companies, actively support the widespread adoption of these innovative new technologies. The primary obstacle to this boost for mobile broadband deployment and wireless innovation is gaining access to unused portions of the public airwaves.

"White space devices" (WSDs) can utilize the *unoccupied* frequencies in the TV bands for digital communications—including broadband networks—forming the foundation for a new communications era that incorporates advances in miniaturization and transceiver technologies to better meet the needs of consumers. Opponents of WSDs have lobbied to prevent the widespread deployment of WSDs and have launched a massive public relations effort to spread uncertainty about the viability of WSD technology. This paper documents that the arguments of the opponents of WSDs are without merit in a "Myths vs. Realities" section that shows, among other findings, that:

1. WSDs will adequately sense channels occupied by licensed TV broadcasters;
2. WSD transmissions will not cause harmful interference to TV broadcasts on immediately adjacent channels;
3. There are now more than adequate data demonstrating the feasibility of WSDs to support the issuance of technical specifications;
4. Mobile WSDs can detect and protect wireless microphones currently using the band;
5. WSD prototypes can sense occupied TV channels at or below -114 dBm – a signal level roughly 1/1,000th the power that a TV set needs to display an image;
6. WSDs are critical to meeting new consumer needs; and,
7. WSD manufacturers and public interest groups have powerful incentives to act so as to protect the quality of over-the-air television reception.

While our work demonstrates that the conclusions of WSD opponents are unfounded, it also shows that the public benefits of these devices are clear. This paper therefore concludes by providing details on how **WSDs will advance: (1) rural broadband deployment; (2) auxiliary public safety communications; (3) educational and enterprise video conferencing; (4) personal consumer applications; (5) mesh and ad-hoc networks; (6) security applications; (7) municipal broadband access; (8) enhanced local coverage and communications; and, (9) enterprise networking.**

The process being followed by the FCC includes three phases: first, feasibility testing is conducted to document the viability of the technology; second, technical standards are set to ensure that white space devices co-exist with one another and existing broadcast uses; and, third, consumer WSDs are certified to ensure that they conform to established technical standards. **The FCC's multi-step process should be supported and will help ensure that WSDs will not cause harmful interference to existing licensed broadcasters and will be widely available to consumers.**

Historical Overview

In May 2004, the Federal Communications Commission (FCC) issued 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 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 PDAs) could also use these empty airwaves without causing "harmful interference" to the dwindling number of over-the-air TV viewers.[3]

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 broadband connectivity, home and community networking. The remaining challenge for the FCC is to define explicit operating rules for WSDs so that high-tech industries can embark on the research and development necessary to bring compliant consumer devices to market.

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

White spaces are vacant frequency bands between occupied (licensed) broadcast channels or broadcast auxiliary services like wireless microphones. 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.[4] 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[5] wants to open up access to these unoccupied bands for everyone by allowing wireless devices certified by the FCC to operate on vacant frequencies, in much the same way that tens of millions of Wi-Fi devices successfully share a smaller, less desirable band of unlicensed spectrum today with millions of cordless phones and other unlicensed consumer devices.

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 inefficiently used or entirely unoccupied. Opponents of WSDs have launched a misinformation campaign in an attempt to prevent more widespread access to TV bands. Their arguments focus on the claimed inability of WSDs to sense and avoid occupied TV channels and, when they do, to operate without causing harmful interference to licensed broadcasts on neighboring channels. However, recent laboratory testing conducted by the FCC's Office of Engineering and Technology (OET) document that the "Prototype B"

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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.

[3] Roughly 13 percent of TV households rely primarily on over-the-air reception, while 87 percent subscribe to cable or satellite TV services.

[4] The share of the DTV band (channels 2-to-51) that will be vacant after the February 2009 turnoff of analog transmission ranges from 30 percent in the most congested, coastal markets (e.g., Trenton N.J.) to 80 percent or more in small town and rural markets (e.g., Fargo N.D.) For more information and a survey mapping available white space in a representative number of 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.

[5] Coalition members supporting unlicensed access to TV white space 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.

WSD submitted by Philips Electronics reliably detects and avoids DTV signals at extremely low power levels (-114 dBm[6]), a signal level far below the threshold needed for a television to display a broadcast. In addition, engineers 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 on adjacent channels.

The next section summarizes some of the myths and facts surrounding WSDs. The FCC's tests demonstrated conclusively the feasibility of the technology, despite the fact that one of the prototypes tested ("Prototype A") malfunctioned. While the broadcast industry lobby has attempted to convince newcomers to the discussion that WSDs *cannot* work, these WSD detractors have systematically ignored data showing that WSDs work perfectly and at their intended design specifications. One particularly deceptive tactic has been to "move the goal posts" by claiming that prototype WSDs should detect very weak and/or distant out-of-market TV signals at threshold levels they were not designed to detect.

The National Association of Broadcasters worldview – white space devices do not accurately detect TV broadcasts (at -116 dBm), which is a far more sensitive level than is necessary or anticipated by the prototypes submitted to FCC for testing earlier this year (FCC report Figure 3-4):

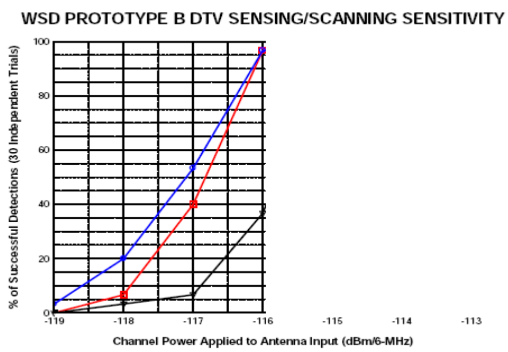

Figure 3-4. Baseline Detection Threshold Results for Prototype B.

The full picture – at -115 dBm the WSD Prototype B that was tested by the FCC worked perfectly, even though this is also more sensitive than the -114 dBm design specification (FCC report Figure 3-4):

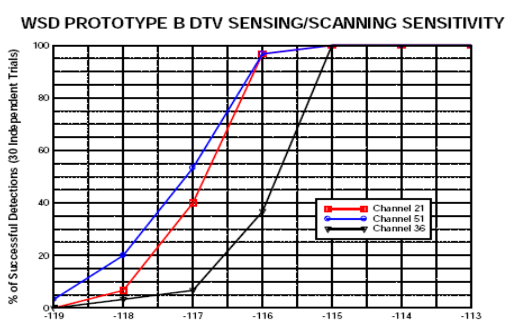

Figure 3-4. Baseline Detection Threshold Results for Prototype B.

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[6] dBm is a power measurement for electromagnetic transmissions. 0 dBm is equal to 1mW (1/1000th of a Watt). 3 dBm is roughly equal to a doubling of power (i.e., 3 dBm is about 2mW) and -3 dBm is roughly equal to a halving of power (i.e., -3 dBm is roughly 0.5mW). By comparison, a typical cell phone transmitter operates at 27 dBm or roughly 500mW; BlueTooth tends to operate at roughly 20 dBm (100mW). -114 dBm 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. In fact, WSDs can measure broadcast signals at levels that are 1/1000th the power level needed for a television to actually display a picture. During the OET testing, the Philips prototype had a 100% success rate of detecting occupied television stations down to -115 dbm (which was outside the device's technical specification of -114 dBm reception sensitivity).

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-

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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

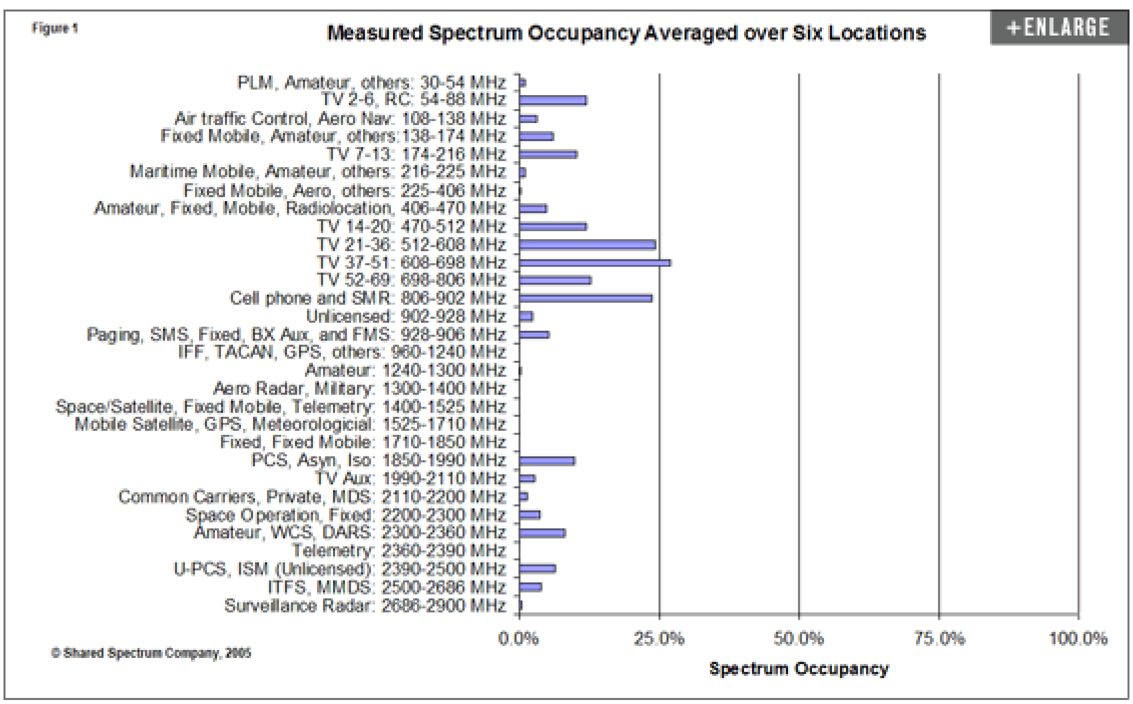
[11] These findings are summarized in New America, et al., Reply Comments on OET Unlicensed Device Testing, ET Docket 04-186 (Sept. 5, 2007), at http://www.newamerica.net/publications/resources/2007/reply_comments_oet_unlicensed_device_testing

[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]



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[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.

[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.

Public Benefits of White Space Devices:

Almost all community and municipal wireless networks – commercial (e.g., Wireless ISPs), municipal and community nonprofits, public-private partnerships, etc. – use unlicensed spectrum to transmit data. While existing use of unlicensed spectrum has driven a remarkable amount of innovation, opening more low-frequency spectrum for WSDs is the "rocket fuel" needed to facilitate and scale up home, business, and regional wireless networks.

TV frequencies are a valuable data networking tool for the same reasons they are desirable for television broadcasts – they easily penetrate obstacles such as buildings and trees and can reach longer distances than the higher frequencies currently utilized by unlicensed Wi-Fi devices. Every region in America has a large quantity of low-frequency spectrum that is unoccupied at any given time. Although the particular empty channels vary in each local market, in most parts of the nation *a majority* of local TV frequencies are not being used, but could be, for affordable broadband access. Below are some of the benefits to consumers and the U.S. economy:

1. Rural Broadband Deployment

The highly favorable propagation characteristics of the TV broadcast spectrum (as compared to the 2.4 or 5 GHz bands) allow for wireless broadband deployment with greater range of operation (including the ability to pass through buildings, weather, and foliage) at lower power levels. Thus, the TV white spaces could be used to provide better broadband service in less densely populated areas, to provide ubiquitous coverage for municipal wireless networks, as a first broadband service in many underserved areas, including rural and other remote areas. This is a critical need considering the 15 percent "broadband gap" between rural and urban/suburban areas, according to the Pew Internet Project. Today more than 3,000 wireless ISPs (WISPs) and rural telephone cooperatives already rely on the current "junk" bands of unlicensed spectrum to provide broadband to remote customers, mostly in rural areas. This is why the Wireless Internet Service Provider Association (WISPA) and the National Telecom Cooperative Association (NCTA) have been advocates of opening the TV white spaces for unlicensed access, as this will greatly reduce the cost and improve the quality of rural broadband deployment.

2. Public Safety Communications

An increasing number of cities and counties across the nation – such as Pratt, Kansas and Corpus Christi, Texas – have already begun to supplement their voice communication networks with wireless broadband data networks operating over unlicensed spectrum—most notably the 2.4 GHz "Wi-Fi" band. These cutting-edge, mobile, high-speed data networks complement voice systems and serve as a cost-effective means to deliver applications such as: streaming video for surveillance and disaster response, fast downloads of suspect mug shots or building blueprints, and access to public safety databases. By providing first responders with more resources in the field – and reducing the time they need to spend in the office – these wireless data networks act as a "force multiplier," improving overall public safety.[18] These public agencies argue that access to more and better spectrum in the TV band will improve the capacity and quality of their networks, as well as facilitate their expanded use for e-government and consumer services. In emergencies, the TV white spaces can also provide auxiliary services to augment public safety communications. For example, rescue efforts could be enhanced by placing remote video cameras at a disaster site to relay images to a command center, or first responders using portable "helmet cams" could provide real-time, first person visual information.

[18] See Lakshimipathy, "Wireless Public Safety Data Networks Operating on Unlicensed Spectrum," New America Foundation, Policy Backgrounder (April 2007), available online at http://www.newamerica.net/publications/policy/wireless_public_safety_data_networks_operating_on_unlicensed_airwaves.

3. Education and Enterprise Video Conferencing

The TV white spaces could be used to give local high schools and middle-schools the same multimedia capabilities available to major university campuses: mobile, high-speed Internet access for every student and teacher with a laptop or portable wireless device. WSDs also can be used to increase the reliability and decrease the cost of video conferencing on college and commercial campuses. Such video conferencing could help enable distance learning for students in remote locations for whom traditional classroom-based learning is impractical. The "e-rate" has succeeded in bringing a wired Internet connection to almost every classroom and library – but providing the wireless capacity and penetration to allow every student in a school to access the Internet at high speeds and from any location, as our great universities do today, will require more and better spectrum access. This is why EDUCAUSE, which represents the nation's colleges and universities on technology issues, is a leading advocate of opening the TV white space for unlicensed use.

4. Personal Consumer Applications

WSDs could be used to provide new services and applications to consumers by taking advantage of the improved signal reliability, capacity, and range of the TV broadcast spectrum. Wireless local area networks using low power and battery operated devices could enable new communications technologies that bring safety, convenience, and comfort to consumers in their homes. For example, WSDs could provide improved energy efficiency through intelligent home automation and power monitoring or home security with robust low power wireless video feeds.

5. Mesh and Ad-Hoc Networks

The TV white spaces could be used to enhance mesh networking. Self-configuring, ad-hoc mesh wireless networks avoid disruption or failure by re-routing around node failures or congestion areas, thereby enabling more robust and reliable communications. Through use of mesh networks, unserved or underserved communities could readily and cost-effectively create their own network extensions as an alternative means of Internet connectivity. In addition, because mesh networks can be easily deployed, they offer a means of communications if existing networks telecommunications infrastructures fail.

6. Security Applications

The favorable propagation and bandwidth characteristics of the TV broadcast spectrum could enable enhanced video security applications for commercial, residential, and government purposes. Some examples of security applications using the WSDs include perimeter video surveillance, robust wireless secure area monitoring, and childcare monitoring in the home or in childcare facilities.

7. Municipal Broadband Access

Hundreds of municipalities and counties across the nation are already deploying first generation wireless local area networks to provide broadband access to their residents and to make local government services more productive and efficient. Use of the TV white spaces for such municipal broadband networks could increase the quality of service and decrease the deployment costs for these networks. For example, Corpus Christi, Texas, which has already deployed an advanced public safety wireless network citywide on current unlicensed spectrum, has been an advocate of unlicensed access to the TV band to improve capacity and quality of service.

8. Enhanced Local Coverage and Communications

Local communities could use WSDs to enable mobile video and audio services and citizen journalism. These services could provide information of special interest to the local community (e.g., a town hall meeting), coverage of local sporting events (e.g., the high school football game), and new methods for local advertisers to reach customers in a more targeted and valued manner. As WSD technologies are integrated into next generation wireless microphones and other media equipment, these systems will be substantially less prone to interference than today's “dumb” equipment (which is often incapable of sensing whether other devices are transmitting on the channel they intend to use). In the same way that digital media equipment has spurred a new wave of consumer-generated media, the ad-hoc and distributed information dissemination networks that WSDs make possible will encourage the sharing of local content and user-generated content.

9. Enterprise Networking

From a base of essentially zero in 2000, an estimated 60 percent of U.S. corporations now provide some type of wireless networking using unlicensed spectrum last year.[19] On May 25, 2006, in testimony before the Senate Commerce Committee, Roger Cochetti, federal policy director of the Computing Technology Industry Association (CompTIA[20]), stated that reallocating the TV white spaces for unlicensed use “will be used by small business to improve their productivity, not least of which will be access to new wireless broadband services.”[21] As Cochetti testified:

> The use of radio spectrum for data services is an absolutely essential part of our industry today... “White space” frequencies represent prime, largely unused wireless “real estate.” With their excellent signal propagation characteristics, low-cost broadband deployment using this spectrum should be readily achieved, jumpstarting significant new business opportunities and improvements in the productivity and competitiveness of small businesses, urban and rural. Such wireless broadband services will enable small businesses to more easily and cost-effectively employ and network IT, especially in sparsely populated, underserved areas where the economics of broadband deployment sometimes make it impractical for providers to serve. In doing so, “white space” technology will give America’s small businesses a better foot up in the globally competitive environment.[22]

The Take-Home Message:

We have completed a critical phase of the process needed to bring WSDs to consumers. Extensive feasibility testing has been conducted and extensively documented and this testing has demonstrated that WSDs can and do work. A new round of feasibility testing is currently underway and will add further support for the viability of WSD technologies. The next step will be for the FCC to issue the necessary technical specifications for WSDs based upon the empirical data collected during feasibility testing and regulatory precedent. The FCC will then be able to certify consumer devices, ensuring that those devices meet required technical standards. Only after all three phases of this process are completed will consumer WSDs be made available to the general public. Taken together, this multi-step process will ensure that WSDs co-exist with current license holders without causing harmful interference and that manufacturers and implementers will have the flexibility to develop new features and innovative uses for WSDs. Public interest groups have been vocal in their support of rigorous testing and also have remained committed to the end goal of certifying useful new wireless technologies that operate within TV bands without causing harmful interference to licensed users.

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[19] Telecommunications Industry Association, 2006 Telecommunications Market Review and Forecast, p. 188. For a larger estimate, see In-Stat, “In-Depth Analysis: Wireless Data in the Enterprise: The Hockey Stick Arrives,” December 2006. See also ABI Research, “Enterprise IP Telephony,” 2006.

[20] CompTIA’s 20,000 members are predominantly among the nation’s 32,000 value-added resellers, a $43 billion industry that deploys IT networks for small- to medium-sized businesses and professional offices across the country.

[21] Roger J. Cochetti, CompTIA Testimony before the Senate Committee on Commerce, Science and Transportation, May 25, 2006.

[22] Ibid.