Testimony of

Michael Calabrese
Director, Wireless Future Project
Open Technology Initiative
New America Foundation

On behalf of the
Wireless Innovation Alliance and
Public Interest Spectrum Coalition

"Legislative Hearing to Address Spectrum and Public Safety Issues"

Before the

Committee on Energy and Commerce
Subcommittee on Communications and Technology
United States House of Representatives

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Thank you, Chairman Walden, Ranking Member Eshoo and members of the Committee, for this opportunity to testify today on the critical issue of how best to reallocate the nation's public spectrum resource to promote mobile broadband, while promoting public safety communication and preserving the public benefits of over-the-air broadcasting.

My name is Michael Calabrese, Director of the Wireless Future Project at the New America Foundation's Open Technology Initiative. New America is a nonpartisan public policy institute based here in Washington, DC. On issues concerning spectrum and wireless broadband policy, New America is part of the Public Interest Spectrum Coalition (PISC), which represents national consumer and advocacy groups including Consumers Union, Consumer Federation of America, Free Press, Public Knowledge and other nonprofits. New America is also a member of the broader Wireless Innovation Alliance (WIA), which includes most of PISC as well as high-tech companies both large (e.g., Dell, Microsoft, Google) and small (e.g., Shared Spectrum, Adaptrum).

My testimony will focus on the importance of designing TV band incentive auctions in a way that preserves the current access to unlicensed spectrum (the co-called "TV White Spaces") in every local market and nationwide for "Super WiFi" and other new technologies and services. At the end I also comment on the Spectrum Relocation Improvement Act of 2009, H.S. 3019. I will make the following main points:

- The voluntary incentive auctions described in the Discussion Draft appear to strike a reasonable balance with respect to reallocating and repacking broadcast station licensees in order to reassign a portion of the band to meet the surging demand for wireless broadband services.
- While local broadcasting should be protected, it is likewise essential that any incentive auction authority also give the FCC the ability and obligation to preserve substantial access to unlicensed spectrum in every local TV market.
- We have serious concerns with the Draft's provision (Section 104) requiring that the "Allocation of Spectrum for Unlicensed Use" must be done only subject to competitive bidding through a system where the highest bidders – rather than the expert agency – determine whether the service rules for a particular band in a particular area will be exclusively licensed or unlicensed.
- This provision, requiring auctions for unlicensed spectrum, is unstudied, untested, unworkable, and virtually certain to ensure that no new unlicensed spectrum is actually allocated.
- It will effectively preclude the FCC from repacking the TV band in a manner that maintains access in every market to the unlicensed TV White Space channels, the "Super Wi-Fi" service that industry is in the process of deploying after unanimous approval by both a Republican-led and a Democrat-led FCC.
- The FCC economists who hypothesized the Draft's proposed auction mechanism for unlicensed spectrum also made it clear why problems with "free riders," bid aggregation, collusion and the need for spectrum caps and other eligibility limitations likely make this idea unworkable in the real world.
- Putting service rules up for auction creates tremendous uncertainty about how much of a band will end up licensed or unlicensed, undermining the revenue-raising potential of the auctions to a degree that will undoubtedly lower the score that CBO can put on what would be an unpredictably contingent auction.
- Unlicensed technologies, pioneered in America, are increasingly so complementary and critical to the mobile broadband ecosystem that Congress can best optimize TV band spectrum for broadband deployment, job creation and

economic growth by ensuring continued unlicensed access to substantial amounts of TV White Space spectrum in every local market and nationwide.

- Concerning H.R. 3019, many Federal bands are particularly well-suited for increased sharing with the private sector, but this will require not just streamlining the CSEA's Spectrum Relocation Fund process but also broadening eligibility so that agencies have the resources to upgrade systems to share capacity on a far greater number of bands.

Introduction

While most of the debate concerning incentive auction authority and a repacking of TV band spectrum has focused on protecting local broadcasters and auctioning licenses to wireless carriers, another critical public interest in the TV bands need to be safeguarded as well: unlicensed use of TV White Space channels. At present the majority of TV channels in each of the nation's 210 media markets is not used for TV broadcasting, but has been reallocated by the Federal Communication Commission for unlicensed use. Under the Report & Order adopted unanimously by the Commission in November 2008,[1] both fixed and mobile broadband devices will be allowed to operate on an unlicensed basis on unused DTV channels ("white space") provided that the devices have GPS and the capability to periodically check an online database of available TV channel frequencies in that discrete geographic location. TV band white space devices are required to query one of nine competing databases, operated by private companies, already approved by the FCC to determine available channels at their current location before transmit capabilities are engaged.

The initial proposal to open the White Space channels for unlicensed use was put forward FCC Chairman Michael Powell, who remains a supporter today. When the proceeding stalled at the FCC, bipartisan legislation introduced by senior Republicans and Democrats on the House and Senate Commerce Committees would have required the FCC to

[1] Unlicensed Operation in the TV Broadcast Bands, *Second Report and Order and Memorandum Opinion and Order*, ET Docket No. 04-186, ET Docket No. 02-380, FCC 08-260 (released November 14, 2008) ("*TVWS Order*").

complete the reallocation within six months, prompting the FCC to adopt an Order in November, 2008. After nearly eight years of study and debate, last September a unanimous Commission voted 5-0 for a second time to give final approval to unlicensed use of the unassigned TV channels in all 210 local TV markets, facilitating new wireless technologies that have been dubbed "Super Wi-Fi." As described further below, investment and trial deployments of a wide range of innovative devices and services is already well underway on this new unlicensed band. The U.S. invented Wi-Fi and leads the world in unlicensed technologies, already a multi-billion industry. We believe it is essential that any incentive auction authority also give the FCC the ability and obligation to preserve substantial access to unlicensed spectrum in every local TV market.

Discussion Draft: The Spectrum Innovation Act of 2011

The voluntary incentive auctions described in the Discussion Draft appear to strike a reasonable balance with respect to reallocating and repacking broadcast station licensees to reassign a portion of the band for *licensed* use on an exclusive basis. However, we have serious concerns with the Draft's provision requiring that the "Allocation of Spectrum for Unlicensed Use" must be subject to competitive bidding. Section 104 (pp. 25-27) provides that unlicensed spectrum be assigned only by auction in an untested manner that is unworkable for a variety of reasons. This provision is virtually certain to ensure that no new unlicensed spectrum is actually allocated. It will effectively preclude the FCC from repacking the TV band in a manner that maintains access in every market to the unlicensed TV White Space channels, the "Super Wi-Fi" service that industry is preparing to deploy after unanimous approval by both a Republican-led and a Democrat-led FCC. Indeed, had this provision been in place before the FCC designated the 2.4 GHz band for unlicensed sharing, America's invention of today's multi-billion dollar Wi-Fi industry, with all its benefits, would never have occurred.

Section 104: Auctioning Unlicensed Spectrum

The temptation to try to raise some additional federal revenue by auctioning not only licenses for exclusive use of public spectrum, but also the spectrum bands set aside for

unlicensed use is understandable. After all, spectrum is a valuable public resource, whether it's assigned for exclusive use by a single company (licensing) or for open access by any individual, company, entrepreneur or institution that abides by the low power limits and other "rules of the road" governing its use. The reality is that auctioning "unlicensed" spectrum – such as the Wi-Fi band (at 2.4 GHz) or the new Super Wi-Fi spectrum (TV White Spaces) – is impractical as a revenue raiser *and* could even reduce the net revenue from auctions for exclusive licenses by creating enormous uncertainty about whether a band of frequencies would end up a patch quilt of licensed and unlicensed, subject to different technical rules and with no ability to later create a nationwide or possibly even a regional service. It would also undermine the nation's longer term economic interest in ensuring opportunistic use of wireless broadband and the emergence of increasingly interconnected "smart" radio devices.

There is no practical way to auction 'unlicensed' spectrum while preserving the unique benefits of enabling anyone to use the band. The U.S. economy and society would continue to benefit most from a balanced and complementary mix of licensed *and* unlicensed – with access to both in frequency ranges with diverse propagation characteristics. Further below I describe some of these unique and proven benefits, which include the efficient offload of at least 20% of carrier mobile data traffic, rural and remote broadband by thousands of small WISPs and RLECs, the ability of tens of millions of homes and businesses to wirelessly share a single wired Internet connection, and tremendous innovation that would not occur in a licensed-only world. The TV White Spaces represent the last opportunity to obtain unlicensed spectrum below 1 GHz and without it many user scenarios will not emerge for the foreseeable future.

Putting aside the unique benefits of unlicensed spectrum, nobody has come up with a practical way to auction unlicensed spectrum. The Discussion Draft requires the FCC to auction the option to designate a band for unlicensed use – an unprecedented, unstudied auction concept described in a single 2008 paper by two FCC staff economists.[2] The

[2] Bykowsky, M., Sharkey, W., and Olson, M., "A Market-based Approach to Establishing Licensing Rules: licensed Versus Unlicensed Use of spectrum," FCC, OSP Working Paper Series, No. 43 (2008). Bykowsky and Sharkey are FCC staff economists; Olson is a professor at George Mason University. OSP working papers do not necessarily reflect FCC policy.

staff economists hypothesized a new type of "clock auction," where both carriers and a broad range of other companies could bid for spectrum at auction, specifying whether they wanted the band for licensed or unlicensed use. The high bid for each block would determine how much spectrum in the auction would be licensed or unlicensed. The FCC economists explained that, in theory, this should reveal the value that various firms attach to access to licensed versus unlicensed spectrum. However, they go on to identify the following challenges and fatal flaws with this approach in the real world:

Free Rider Problem: Because unlicensed spectrum is a "public good" available to anyone, even the largest among the many thousands of companies and nonprofit institutions that rely on unlicensed have an incentive to hold back and let others pay the government. As the FCC economists explain, "although it is in every … firm's interest to have spectrum designated to unlicensed use, any individual [] firm has an incentive to'free ride' off the bids of other bidders in an attempt to maximize their own profits."[3] Winning bidders must shoulder the cost of a common resource that benefits not only competitors, but many thousands of other firms, tens of millions of households and the entire economy. The FCC economists analogize this to a fundraising telethon – but unlike a charitable cause, it seems unlikely that for-profit companies that can internalize only a small fraction of the value of unlicensed operations will agree to subsidize other users. And although the economists suggest that coordination ("collusion") among bidders might get over this, they conclude the paper by warning that "[i]f a significant number of [users] that wish to see spectrum designated to unlicensed operations free ride on the bids made by other[s] … then the efficient designation of spectrum to licensed and unlicensed operations may not occur."

Collective Action Problem – Aggregating Bids: Another challenge identified by the FCC economists is that "the value that society obtains from … unlicensed operations, given their unfettered open access nature, is equal to the summation of the valuations that [users] place on having such a designation."[4] Incumbent carriers would always outbid even large firms and institutions that use unlicensed, unless the users can coordinate and

[3] *Ibid* at p. 15.
[4] *Id.* at p. 7.

aggregate their bids. The Discussion Draft anticipates this, providing that a band in a geographical area would be unlicensed if "the bids for unlicensed use, in the aggregate, exceed the highest bid for such license." However, this presents a *collective action problem*: how do you aggregate the bids for unlicensed spectrum? Bidders potentially include thousands of high-tech companies and device manufacturers, tens of thousands of other firms (e.g., hotel and retail chains, hospitals, schools), and tens of millions of employers and households whose bids should be aggregated since they benefit most (in aggregate) from unregulated access. Most unlicensed operators, such as the nation's 2,500 small business WISPs, will be unable to raise the capital to bid on shared, non-exclusive use.

The Draft also leaves critical implementation issues unanswered. Must bids be proportionate to future use? Will be FCC register, convene and coordinate what could be thousands of bidders with extremely diverse use cases in mind? If not, who will? There will also be companies that decide to deliver products and services years after the allocation and that would not participate in the auction.

Auctioning Unlicensed Requires Collusion and thus Exclusion: Because of the first two challenges, the FCC economists conclude that non-carriers must be allowed to collude in their bidding strategies.[5] Although a small number of companies and/or carriers could collude – forming a consortium to bid – they could only profit by limiting use of the spectrum to their own customers. For example, if Verizon were to combine with Google to 'own' unlicensed spectrum, they could (and rationally would) exclude customers of other carriers and Internet companies. The spectrum would then be *licensed* – and millions of other firms and individuals would be excluded in a way they are not from *unlicensed* bands. Since much of the most valuable wireless innovation has come from start-ups and small companies on the unlicensed bands. Moreover, this hypothesized collusion is both unrealistic (see below) and, even if the FCC waives the strict anti-collusion rules that applied to every previous auction, possibly violates antitrust laws. The FCC economists' proposal would not permit the winning bidders to exclude others or change the FCC's Part 15 rules. The Discussion Draft is ambivalent on this point,

[5] *Id.*

although without the ability to set the rules and exclude others, there would be little profit motive for any firm other than a spectrum speculator who hopes to change the rules later.

Spectrum Caps and/or Bidding Discounts Required: The FCC economists also observe that an auction of unlicensed may "fail" if wireless carriers (such as Verizon and AT&T) are allowed to participate. "[I]f the value that [carriers] place on spectrum is driven largely by the profits they would earn from not having the spectrum in the hands of a competitor, an auction … to guide the licensing rule determination [between licensed and unlicensed] may not lead to the efficient outcome."[6] As a remedy, the FCC economists propose either "a spectrum cap" or "discounting the [carrier's] bid by an amount equal to the value … [of] owning the asset for purely anticompetitive reasons."[7] Although the Discussion Draft describes the FCC economists' hypothetical auction model, the very next section of the Draft contradicts this essential regulatory precondition. Section 105 of the Discussion Draft adds a paragraph (18)(B) that prohibits the Commission from limiting participation in an auction for licensed or unlicensed spectrum based on "the total amount of spectrum licenses held by a person." While New America and PISC believe that the Commission should retain its authority to promote competition by imposing "spectrum caps" or other limits on allocations and auctions where appropriate (a policy the FCC successfully employed in the 1990s to ensure at least 5 competing cell phone providers in each market), the Draft's ban has the effect of allowing the largest incumbent carriers to foreclose entry, competition and innovation simply by outbidding the undefined aggregation of future unlicensed users who might be inclined to bid.

The insurmountable problems above, identified in the FCC's own theoretical paper, are minor compared to the policy downsides inherent in this approach. Among our most serious additional concerns are the following:

The auction model will increase uncertainty and reduce government revenue: We believe that putting the service rules up for auction – thereby creating uncertainty about how much of a band will end up licensed or unlicensed – will undermine the revenue-

[6] *Id.* at p. 15, note 23.
[7] *Id.*

raising potential of the auctions. This will undoubtedly lower the score that CBO can put on what would be unpredictably contingent auction. CBO could not know in advance what spectrum the FCC will decide to make available for licensed versus unlicensed bidding. The FCC would need to develop dual service rules, since neither the agency nor any bidder would know whether at the end of the auction how much of the spectrum would end up licensed (exclusive, flexible, high-power) or unlicensed (shared, subject to FCC database control, low-power).

The Discussion Draft encourages the FCC to auction smaller geographic licenses, which will compound the uncertainty. Since presumably some local areas will end up licensed and some unlicensed, with winners operating under widely varying service rules, these frequency bands could never again be aggregated nationwide or possibly even regionally. And if instead the legislation requires all such spectrum to be auctioned only on a national basis – or even by regional aggregation (as the C Block was in the 700 MHz auction of 2008), then like the C Block the only likely winners of any auction would be the two dominant carriers, leaving their small, rural and regional carriers and WISPs effectively excluded. Since to date every auction has been conducted on the basis of certainty concerning both service rules and the types of services that will be operating in adjacent areas and frequencies, carriers expected to be the highest bidders for this contested spectrum would necessarily need to lower their bids to account for all the various uncertainties introduced by a contested licensed vs. unlicensed auction.

Auctioning unlicensed ignores the biggest beneficiaries of unlicensed: The FCC economist paper refers only to "firms" bidding to decide if a given block of spectrum should be licensed or unlicensed. However, this ignores both the origins of unlicensed spectrum and its primary beneficiaries: which are currently nearly every American home, individual, small business and nonprofit institution. The cumulative benefit to all these homes, businesses and community anchor institutions – for Wi-Fi alone – is in the tens of billions of dollars each year, generating hundreds or thousands of jobs and boosting both Internet use and overall productivity. Before Wi-Fi boomed, the unlicensed Industrial, Scientific and Medical (ISM) bands were called "junk bands" because the FCC had left

the band open as a very easy, low-cost way for individual consumers and device makers to market and operate low-power, off-the-shelf items including cordless phones, baby monitors and microwave ovens – all of which are certified under the Commission's Part 15 (unlicensed device) rules. Many hundreds of millions of these devices continue to operate in unlicensed bands, along with a rapidly growing number of machine-to-machine chips that facilitate applications including RFID, remote irrigation control for farmers/ranchers, and remote monitoring of a myriad of industrial, weather and other systems (even some dental office drill bits now send an email when they need to be replaced). Unlicensed access to the TV White Space channels will magnify the utility of all these uses, particularly for rural and industrial (machine-to-machine) uses.

Non-carrier firms say they have no incentive to 'own' unlicensed bands: Even if we assume away the "free rider" and coordination problems noted above, manufacturers, software firms, big-box retailers, universities, hospitals and others that clearly benefit from unlicensed are not in the business of managing and selling wireless ISP subscriptions. No one firm (or even several) could internalize enough profit to cover the cost to outbid carriers, unless they excluded others and charged subscription fees. They do not sell wireless Internet access–it's neither their business nor expertise. They are only indirect beneficiaries – as trucking companies are with respect to interstate highways, or as shipping companies are with respect to the open access to oceans and other waterways.

Spectrum speculators are the most likely purchasers of 'unlicensed' bands: As it has in the past, the FCC seems most likely to auction for potential unlicensed use the bands that are *least* attractive to wireless carriers and other purchasers of exclusive licenses. That is the history of the TV White Spaces (TVWS), for example, which for decades were unoccupied guard band channels that could only be used, if at all, at extremely low power levels to protect television reception (40 milliwatts on a first adjacent channel under the TVWS Order adopted in 2008). Going forward, some of the Federal bands mandated for auction in Section 101 of the Discussion Draft represent bands that either are at high frequencies (5 GHz band) or will be subject to exclusion zones and other restrictions (such as very low power, or preemption by public agencies) that will not fit the business model of commercial networks. Like the TVWS, some of this spectrum may

be best suited for unlicensed sharing – and coordinated through a Database and/or by spectrum sensing and other techniques to protect Federal users from interference. Since the Discussion Draft requires that all shared access bands are to be auctioned, they will be acquired by someone – most likely by spectrum speculators who will plan to warehouse them until a lobbying strategy can free them from some of these constraints.

An example is the Federal band frequencies between 5350-5470 and 5850-5925. It's extremely doubtful that the Defense radar, air telemetry and other Federal systems on these bands will be discarded or relocated. Yet unlike the bipartisan Senate bill, S. 911, which directs the NTIA and FCC to take steps to share these frequencies on a limited basis with low-power unlicensed devices (as other radar systems on other portions of the 5 GHz band already do), the Discussion Draft requires that whatever capacity the Administration decides to share will be auctioned. That will raise little revenue, but could easily sideline this spectrum from highly-productive shared use at low power. While this 5 GHz spectrum has very limited utility compared to the unlicensed TV "white space" spectrum (for example, it's not useful for mobile applications), it would be far better to give the expert agency the authority to decide, based on trends in technology and other considerations, whether the shared usage rights should be auctioned for license, unlicensed, or perhaps subject to some other arrangement, such as micro-payment leasing on secondary markets, or by the FCC itself using the TV Band Database administrators.

A mandatory database for unlicensed use will impose unnecessary costs: The Discussion Draft requires the FCC to "establish and maintain a database to coordinate the unlicensed use" of portions of the spectrum designated unlicensed by competitive bidding. The Draft does not state whether the purpose of this database is to coordinate the exclusive use of the "unlicensed" band by the winning bidders, in order to exclude others; or whether, like the geolocation database providers recently selected by the FCC to govern access to unlicensed TV White Space spectrum, the purpose is to promote greater spectrum efficiency and minimize interference among anyone choosing to use the band. While a database approach to governing spectrum sharing is the wave of the future – and can be very beneficial when needed to avoid interference, which is the rationale behind TV Bands Database – the generic database mandate proposed here will impose

substantial and unnecessary costs on industry and on consumers. For example, the cost of RFID tags and unlicensed chips in a huge range of low-cost consumer devices (e.g., toys, wireless picture frames) would become far more expensive if they needed the ability to contact and coordinate with an FCC database, presumably reporting their location (via GPS), before they could transmit.

In sum, we strongly urge the members of the Subcommittee to drop this untried and unworkable section from the bill. An alternative is the approach taken in the bipartisan Senate bill already reported out of Committee, S. 911, which leaves the FCC with discretion to reorganize the TV band to auction cleared channels for licensed use, while optimizing the remainder of the band's continued use for local broadcasting and for unlicensed "Super Wi-Fi" in the white space channels. S. 911 emphasizes auctions, but it also directs the FCC to "ensur[e] that unlicensed spectrum remains available in these frequency bands, nationwide, and in each local market." This is essentially the same substance as the bipartisan voluntary incentive auction legislation introduced last year by the ranking members of this Subcommittee at that time, Mr. Stearns and Mr. Boucher. We believe this approach – which optimizes use of the TV band for broadcasting and for both licensed *and unlicensed* broadband will generate the greatest gains for the economy in the long-term, while also raising as much or more revenue for the government from auctions in the short term.

Unlicensed Spectrum is Critical to Ubiquitous, Fast, Affordable Mobile Broadband

In addition to incentive auctions for exclusively-licensed spectrum, the Subcommittee can best optimize TV band spectrum for broadband deployment, job creation and economic growth by ensuring that unlicensed access to substantial amounts of TV White Space spectrum will continue to be available in every local market and nationwide. There is no doubt that consumer demand for mobile data applications is exploding worldwide. A national goal of not merely affordable broadband access, but of truly pervasive connectivity – seamless mobile connectivity anywhere and anytime – will require an enormous increase in available spectrum capacity.

Although we focus on mushrooming personal applications such as mobile video, wireless machine-to-machine communication – such as energy monitoring, environmental monitoring and controls, mobile health care monitoring, industrial automation – is also rising rapidly as costs decline. Ericsson has estimated there will be 50 billion connected devices by 2020, leading increasingly to what some already call an "Internet of Things."[8] Unlicensed spectrum as a public resource serves as an incubator of wireless innovation. Far more devices have been certified to use the 2.4 GHz unlicensed band (20,339 by one recent count) than in any other band (the FM band is second with 7,275 devices certified). From wireless local area networks (WLAN) to metro area Wi-Fi networks, Wi-Fi chips have ended up in everything from smartphones and laptops, to portable media players, TVs and cameras,[9] and even bathroom scales.[10] From 2005 to 2008, nearly 1 billion Wi-Fi chipsets were sold.[11] By 2010, Wi-Fi shipments grew to 761 million products – a 29 percent increase from 2009.[12] This growth is likely to continue, with sales likely to exceed 1.5 billion devices a year by 2014.[13] Unleashing an abundance of spectrum and driving down its cost as an input for all things mobile is therefore the single best means by which Congress, the Administration and the FCC can promote innovation and consumer welfare in wireless.

A policy that attempts to meet this surging demand by relying *solely* on clearing and auctioning exclusive licenses that fit the current business model of commercial wireless carriers would be shortsighted and sacrifice future U.S. innovation and competitiveness. Despite the overall abundance of unused spectrum capacity,[14] even in major cities, there

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[8] Hans Vestberg, President and CEO, Ericsson, Address to Shareholders, April 13, 2010, available at http://www.ericsson.com/thecompany/press/releases/2010/04/1403231.

[9] Richard Thanki, *The Economic Value Generated by Current and Future Allocations of Unlicensed Spectrum* (Sept. 2009), at p. 19; http://fjallfoss.fcc.gov/ecfs/document/view?id=7020039036.

[10] http://nexus404.com/Blog/2009/07/28/withings-wiscale-wi-fi-bathroom-scale-monitor-your-weight-loss-and-body-fat-using-iphone-app/

[11] Represent an estimate based on Wi-Fi chipsets sales reported by Wi-Fi Alliance.

[12] Wi-Fi Alliance, "Wi-Fi® expands as the center of leading-edge technologies in 2011," Press Release, Jan. 6, 2011; available at http://www.wi-fi.org/news_articles.php?f=media_news&news_id=1035.

[13] Thanki, *supra note* 9, at p. 18.

[14] Actual spectrum measurement studies have demonstrated that even in the most valuable "beachfront" frequencies below 3 GHz, the vast majority of frequency bands are not being used in most locations and at most times. Spectrum measurement studies by the New America Foundation, by Shared Spectrum Company, the Illinois Institute of Technology and others show that even in Manhattan and in Washington

is a looming limit to the number of frequency bands below 3 GHz that can be reallocated, by auction or otherwise, to exclusively licensed use. This is evident in the National Broadband Plan's recommendation that an additional 500 MHz of spectrum be allocated for mobile broadband. CTIA, the wireless industry association, told the FCC two years ago that carriers will need at least 800 MHz over the next decade. The FCC's National Broadband Plan identified only 270 MHz in non-Federal bands below 3.7 GHz that might possibly be reallocated for auction – and three-quarters of that amount (210 MHz) is in two bands: TV broadcasting (120 MHz) and Mobile Satellite Services (90 MHz). The remaining 230 MHz would presumably come from Federal bands, even though the Administration has subsequently concluded that few Federal bands can be cleared entirely and will be available primarily for shared use or subject to huge exclusion zones.

Based on recent NTIA studies and briefings I've received as a member of the Commerce Spectrum Management Advisory Committee (CSMAC), it is clear that a large share of the Federal bands specified in Section 101 of the Discussion Draft (p. 8) will be available only on at best a shared or conditional basis (such as large exclusion zones and/or power limits) that will make it a poor fit with commercial carrier business models, which are premised on high-power and exclusive use. As a result, while the traditional carrier business model will demand more and more exclusive-use spectrum in the short-run to meet surging mobile data demand, it should be equally clear that this model is not sustainable longer term. Meeting consumer demand for mobile data will require some combination of four strategies:

- Increased spectrum access
- Frequency re-use (smaller cell sizes)
- More efficient wireless technologies
- More effective use of wired backhaul (e.g., fiber to the tower)

Martin Cooper, leader of the team at Motorola that invented the first mobile phone, has calculated that frequency re-use is responsible for roughly 64 times more improvement in

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near the White House, less than 20 percent of the frequency bands below 3 GHz are in use over the course of a business day. Spectrum usage rates are, of course, far lower in suburban and rural areas.

total wireless utilization over the past 45 years than any improvement attributable to making more spectrum available.[15] While the FCC estimates that "mobile data demand is expected to grow between 25 and 50 times current levels within 5 years," the total number of wireless industry cell sites grew only 14% over a recent two-year period.[16] There are practical limits to how close carriers can bring their owned infrastructure (transmitters and backhaul) to the individual consumer. As demand for mobile data increases, the industry's cell site bottleneck is a very real constraint and cost that limits the spectrum efficiency of the dwindling number of prime frequency bands that can be auctioned for exclusive use.

In contrast, one of the many proven benefits of unlicensed spectrum is that it facilitates and encourages spectrum frequency re-use over very small areas (a home, business, or school). The most obvious benefit of unlicensed spectrum has been Wi-Fi networks that permit many different users – in a home, at work, in a coffee shop or other "hot spot" – to share the same wired Internet connection. Because Wi-Fi operates at very low power and is open to all users, there can be a many homes, employees or customers of a retail establishment sharing the same 2.4 GHz band in a relatively small area with little or no interference. Unlicensed Wi-Fi routers, chips and services are a rapidly-growing, multi-billion-dollar industry, but more important for the economy, for education and for other purposes is the tremendous *multiplier effect* that Wi-Fi has on the use and utility of the Internet by making a single wired connection available for shared use on a very low-cost, do-it-yourself basis. This generates enormous consumer welfare. A study by economist Richard Thanki, commissioned by Microsoft, estimated that just three unlicensed applications – Wi-Fi routers in homes, Wi-Fi in hospitals, and RFID tracking inventory in clothing retail stores – together would generate between $16 and $37 billion each year in economic value for the U.S. economy over the next 15 years.[17] The Thanki study also

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[15] Martin Cooper, "Cooper's Law," ArrayComm, *available at* http://www.arraycomm.com/serve.php?page=Cooper

[16] According to CTIA data collected by the Commission, during a two-year period after June 2007, total cell sites increased just 14% (from approximately 210,000 to 246,000). *See* Federal Communications Commission, *Mobile Broadband: The Benefits of Additional Spectrum*, Omnibus Broadband Initiative, Technical Paper No. 6, at pp. 2, 5 (Oct. 2010) ("OBI Paper"), at 12-13, Exh. 8.

[17] *See* Richard Thanki, *The Economic Value Generated by Current and Future Allocations of Unlicensed Spectrum* (Sept. 2009), at p. 19; http://fjallfoss.fcc.gov/ecfs/document/view?id=7020039036.

estimated that Wi-Fi has increased the adoption of broadband by anywhere between 4.3 and 9.8 million households by making it more economical.

Because of its efficiency and low cost, unlicensed spectrum will soon carry more data traffic than either wired lines or licensed carrier bands. Cisco's widely-cited Visual Networking Index (VNI), which projects growth in mobile data demand, concluded in its June 1 forecast that by 2015 Wi-Fi devices will actually use more bandwidth than all wired devices combined.[18] Cisco predicts Wi-Fi devices will consume 37.2 exabytes of data worldwide per month in 2015, carrying more than six times as much total data traffic over the airwaves as commercial mobile networks (with 6.3 exabytes per month).[19]

Unlicensed Spectrum Carries an Increasing Share of Mobile Data Traffic

The more recent development driving this trend is the rapidly rising use of unlicensed spectrum by consumers to offload surging mobile data traffic, as well as to boost the speed of mobile broadband applications. Wi-Fi has been essential to the growth in the popularity of smartphones such as the iPhone and is shouldering an increasing share of the capacity load on often under-provisioned licensed wireless networks. Today half of the page views on Apple iPhones come through a Wi-Fi network, as does 92% of iPad web browsing, according to Nielsen research.[20] Overall, Cisco's VNI estimates that roughly 20% of mobile data traffic was routed over unlicensed Wi-Fi in 2010, a share projected to increase to 30% by 2015.[21] Another recent study by Juniper Research projects that 63% of the data traffic generated by smartphones, tablets and feature phones will be transferred onto the fixed network via Wi-Fi and femtocells by 2015.[22] Currently

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[18] Janko Roettgers, "Wi-Fi to Overtake Wired Network Traffic by 2015," GigaOm, June 1, 2011, available at http://gigaom.com/broadband/cisco-wifi-vni-report/.

[19] Cisco Visual Networking Index: Forecast and Methodology 2010-2015, June 1, 2011; available at http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-481360.pdf

[20] Kevin C. Tofel, "iPhones, iPads thrive on Wi-Fi, Androids on 3G and 4G," GigaOm, June 23, 2011, available at http://gigaom.com/mobile/iphones-ipads-thrive-on-wi-fi-androids-on-3g-and-4g/

[21] John Leibovitz and Robert Alderfer, "Demand for Mobile Broadband," FCC Blog, Feb. 10, 2011.

[22] Juniper Research, "Relief Ahead for Mobile Data Networks as 63% of Traffic to Move Onto Fixed Networks via Wi-Fi and Femtocells by 2015," April 19, 2011; available at http://www.marketwire.com/press-release/relief-ahead-mobile-data-networks-as-63-traffic-move-onto-fixed-networks-via-wifi-femtocells-1503808.htm

Wi-Fi accounts for over 98% of the mobile data offloaded, a proportion that will remain above 90% even assuming a higher take-up rate for femtocells, which re-use carrier frequencies at low power.

The growing importance of unlicensed spectrum for reducing network congestion and boosting consumer welfare is evident in the recent surge in carriers embracing Wi-Fi:

- AT&T Wireless gives its customers access to 24,000 Wi-Fi hotspots and an increasing number of Wi-Fi "hot zones" in congested areas including Times Square and Chicago's Wrigley Field. Consumers made 107 million connections of AT&T's Wi-Fi network just in the third quarter of 2010, more than in all of 2009.[23]
- Towerstream is deploying a Wi-Fi network of 1,000 base stations, covering seven square miles of New York City, and leasing access to wireless carriers and other companies seeking more ubiquitous bandwidth.[24]
- A consortium of major cable companies – Comcast, Cablevision and Time Warner Cable – have blanketed large parts of New York City with a shared Wi-Fi network and are planning to extend the model in other congested areas along the East Coast.
- Japanese telco KDDI is building out a Wi-Fi network of 100,000 hot spots that will integrate seamlessly with its licensed 4G network to proactively reduce congestion and improve speeds for consumers.[25]

Rural WISPs need unlicensed White Space spectrum to expand coverage

The nation's more than 2,500 WISPs serve more than two million mostly rural and small-town homes, businesses and first responders throughout the country. WISPs, as well as hundreds of Rural Local Exchange Carriers (RLECs), rely primarily on unlicensed spectrum to extend Internet connectivity to unserved and underserved areas – and have long advocated access to the TV White Space because the unique propagation qualities allow it to cover far larger rural areas at lower cost. The ability of WISPs to access

[23] PR Newswire, "Third-Quarter Wi-Fi Connections on AT&T Network Exceed Total Connections for 2009," Press Release (2010, October 22), available at http://www.prnewswire.com/news-releases/third-quarter-wi-fi-connections-on-attnetwork-exceed-total-connections-for-2009-105520733.html

[24] Alan Weissberger, "Metro Wi-Fi Reborn: City Wide Mega-Hot Spot for Mobile Data Offload," IEEE, May 29, 2011, available at http://community.comsoc.org/blogs/ajwdct/metro-wifi-reborn-city-wide-mega-hot-spot-mobile-data-offload

[25] Stacey Higginbotham, "Wi-Fi: it's the other cell network," GigaOm, July 1, 2011; available at http://gigaom.com/broadband/wi-fi-its-the-other-cell-network/

unlicensed spectrum without competitive bidding eliminates a significant barrier to entry, thereby benefiting consumers who would not otherwise have access to fixed broadband services. This is why WISPA (the Wireless ISP Association) has been very active in supporting the availability of unlicensed spectrum in the TV bands – ideally a contiguous unlicensed band with wider channels, but at a minimum continued nationwide access to White Space channels, which creates scope and scale to reduce prices for network gear.

Unfortunately, according to WISP operators the uncertainty stemming from incentive auction legislation is already deterring investments and deployments by WISPs in unserved rural areas. For example, a WISP called RCorn applied for and received an experimental license to deploy on TV white space channels in Kearney and Grand Island, Nebraska, where it already has 3,500 customers for fixed wireless broadband service over unlicensed (using the 2.4 GHz and 5 GHz bands). RCorn's CEO, Russ Hillard, told the FCC that the 900 MHz unlicensed band is fully occupied by farmers, who use it to control tractors, combines and irrigation systems; and the 2.4 GHz unlicensed band is increasingly noisy due to heavy residential use. RCorn tries to make due with 5 GHz unlicensed, but with its superior propagation for rural areas, the TV white space spectrum would both reduce the cost of rural broadband service and greatly improve the quality. Despite receiving an experimental license for the wide-open TV bands, RCorn has put a hold on any further investment until Congress decides if it will uphold or undermine the FCC's Order making unlicensed spectrum available in the TV frequencies nationwide.

Broadband Investment and Deployment on TV White Space is Well Underway

Despite the uncertainties surrounding incentive auction legislation, investments in a wide variety of unlicensed devices and services on the TV White Space spectrum has been advancing since the FCC's initial Order in November, 2008, with substantial fixed broadband deployments and mass marketing of devices expected by early 2012. The sort of fixed, higher-power base stations used by WISPs in rural areas are expected to hit the market by the end of this year, which will make it more affordable for small companies like RCorn. The FCC has already approved nine companies to administer competing geolocation database solutions for managing unlicensed access to the band without

interference to broadcasting, a development which has been a prerequisite to certifying devices. These companies obviously anticipate a mass market – both here at home and worldwide – as the unprecedented TV Bands Database tool becomes accepted in the U.S. and around the world to manage access to shared spectrum bands, both unlicensed as well as for secondary market leasing. The Wi-Fi Alliance is projecting that mobile device certification will begin no later than 2013.

In addition, a variety of standards setting groups are close to completing new variations of the IEEE 802.11 Wi-Fi standard to take advantage of the superior TV band propagation characteristics. For example, the 802.22 standard to be published by the end of this year supports the sort of higher-power wide area network deployments in demand by WISPs, whereas the 802.11af standard, expected to be finalized by the end of 2012, enables low-power personal/portable devices and may be the most widely adopted standard as it is built into smartphones, tablets and other mobile computing devices.

After the FCC unanimously adopted the White Space Order, a number of technology companies, cities, universities, utilities, hospitals and other innovators sought experimental licenses to begin testing and demonstrating how "Super Wi-Fi" using the low-frequency spectrum in the TV bands could take unlicensed technologies to the next level. These demonstrations have included:[26]

1) **Rural Unserved Area Deployment: Claudeville, Virginia (population 916)** – Remote Claudeville, in sourthern Virginia, never had a broadband connection until Dell, Microsoft and Spectrum Bridge teamed up, using an experimental license on vacant TV channels. A white space backhaul solution has effectively brought broadband access for the first time ever to this small town where only dial-up Internet access existed until late 2009.[27]

2) **Smartgrid Deployment: Plumas California** – The Plumas-Sierra Rural Electric Cooperative launched the nation's first "Smart Grid" wireless network trial while

[26] More on these and other examples are on the WIA website, http://wirelessinnovationalliance.com/; and were previously included in testimony by Harold Feld, House Subcommittee on Communications, Technology and the Internet, June 1, 2011.

27 Nate Anderson, (2009, October 21) *First White Space Broadband Deployment in Small Virginia Town*, *Ars Technica* (Oct. 21, 2009); retrieved May 28, 2011 from http://arstechnica.com/tech-policy/news/2009/10/first-white-space-broadband-deployment-in-small-virginia-town.ars

simultaneously providing broadband access to the local communities. The Plumas "Smart Grid" wireless network delivers real-time broadband connectivity allowing system operators to manage the electrical system remotely, request critical data from the substations, manage directed power flow, and protect the systems and employees while maintaining the local grid.[28]

3) **Smart City Deployment: Wilmington, North Carolina** - The city is currently relying on white space technology for its "Smart City" initiative, which focused on providing Wi-Fi access to both public safety officials and citizens in public areas with applications that include remote monitoring and management of wetland areas; real-time traffic monitoring to reduce congestion, fuel consumption, travel time and to support local law enforcement during emergency situations.[29]

4) **Hospital Campus Deployment: Logan, Ohio (population 6,704)** - The world's first white space broadband network trial for healthcare providers was launched here, enabling broadband access throughout the hospital, including patient rooms, waiting areas, cafeteria, and meeting rooms.[30]

5) **Public Safety and Tribal Deployment: Yurok Reservation, California** – Until recently the Yurok Reservation in Arcata – California's largest Native American tribe – made due with a single T1 line and connections slower than dial-up. The reservation spans 44-miles of mountainous, heavily forested land presenting many signal obstacles, terrain tailor-made for TV band spectrum, which covers larger areas and penetrates foliage far better that obstructs Wi-Fi at 2.4 GHz. By leveraging its primary public safety use, 70 to 80% of the tribal community now has access to plug and play broadband over White Space spectrum.[31]

6) **Low-Income Housing Deployment: Houston, Texas** – Rice University researchers, with a grant from the National Science Foundation, were able to

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28 Spectrum Bridge (2010, June 23) *Nation's First "Smart Grid" White Spaces Network Trial* [Press release]. Retrieved from http://www.spectrumbridge.com/news/pressreleases/10-06-23/Nation_s_First_%E2%80%9CSmart_Grid%E2%80%9D_White_Spaces_Network_Trial.aspx

29 Anderson, Nate (2010, February 24) *Wilmington, NC Takes White Spaces to Swamp, Ballparks.* [Online] In Ars Technica. Retrieved May 28, 2011 from http://arstechnica.com/tech-policy/news/2010/02/wilmington-nc-takes-white-spaces-to-swamp-ballparks.ars

30 Business Wire, *TV White Spaces Delivering Enhanced Broadband Access and Telemedicine Applications to Healthcare Providers,* Press Release (Sept 14, 2010). Retrieved from http://www.businesswire.com/news/home/20100914005980/en

31 Carlson Wireless, "California's Largest Tribe Deploys First White Space Broadband for Remote Public Safety Environment," Press Release (June 10, 2011), available at http://www.carlsonwireless.com/about/press-release.php?subaction=showfull&id=1307731549&archive=&start_from=&ucat=1

modify an off-the-shelf Wi-Fi card to use TV white space spectrum to achieve point-to-point transmission distance of one mile (compared to its original 400 to 500 feet), allowing affordable broadband connectivity to low-income residents who previously had no broadband.[32]

7) **Super Wi-Fi Network Deployment: Cambridge, England** – Last month Microsoft led a consortium of British telecom firms, including consortium includes the BBC, British Sky Broadcasting, BT, Nokia, and Samsung, to begin trials on a wireless hotspot network using the freed-up TV channels that the UK, following the U.S. lead, is reallocating for unlicensed use.[33]

The Subcommittee should be clear that an incentive auction mechanism that did not permit the FCC to maintain unlicensed channels in every local market would squander this investment and America's lead in both unlicensed and dynamic spectrum technologies. It is not sufficient to maintain unlicensed access to 'white space' in only rural markets, since without the scope and scale of national markets the costs will be far higher and the degree of innovation much lower.

H.R. 3019: The Spectrum Relocation Improvement Act[34]

Although a comprehensive spectrum inventory would greatly facilitate the identification of bands that can be reallocated for more intensive and efficient use, the process of unlocking unused spectrum capacity should begin immediately on a band-by-band basis. Nowhere is spectrum underutilization more evident than in many of the bands reserved for use by the federal government itself.[35] According to the Commerce Department's Office of Spectrum Management, federal agencies have exclusive use of 18.1% (629

32 Nate Anderson, *Extending Wi-Fi to one mile, thanks to empty TV channels.* [Online] In Ars Technica. (April 26, 2011), available at http://arstechnica.com/tech-policy/news/2011/04/extending-wifi-to-one-mile-thanks-to-empty-tv-channels.ars

33 Andrew Parker and Paul Taylor, "Microsoft steps into the spectrum space race," *Financial Times* (June 26, 2011), available at http://www.ft.com/cms/s/0/09864858-a02a-11e0-a115-00144feabdc0.html#ixzz1QQ2BjS7V

34 This section is adapted from testimony by Michael Calabrese, to the House Subcommitee on Communications, Technology and the Internet, "Legislative Hearing on H.R. 3125, the Radio Spectrum Inventory Act and H.R. 3019, the Spectrum Relocation Improvement Act of 2009," Dec. 15, 2009.

35 For an in-depth discussion of the utilization of federal spectrum and policy recommendations for reallocation of this underutilized spectrum, *see* Victor Pickard and Sascha D. Meinrath, "Revitalizing the Public Airwaves: Opportunistic Reuse of Government Spectrum," Wireless Future Working Paper, New America Foundation (June 2009); forthcoming in *International Journal of Communications* (2009).

MHz) of the "beachfront" frequencies between 225 and 3700 MHz, while non-federal users have exclusive licenses to 30.4% (1058 MHz). The remaining 51.5% is shared, with federal use primary and private sector use secondary.[36] Of the roughly 2400 MHz of federal spectrum allocations below 3.7 GHz, over 1700 involves radar, radionavigation and air telemetry systems, the effective operation of which are indeed critical to national security. At the same time, actual spectrum measurement studies indicate that the military and other agencies are actually using very little if any of that capacity on most days and in most geographic locations, particularly at ground level and in more densely populated metro areas where more spectral capacity is most needed.[37]

It is important to be clear that just because a frequency band is not fully or frequently utilized in a particular geographic area – which is what the New America and Shared Spectrum Company measurements indicate – this does not mean it is not serving its assigned purpose, or that its incumbent users can be relocated. Many military bands in particular are assigned for mission-critical training and emergency purposes that are episodic or geographically limited in nature. While in many such cases "clearing" a band of its current licensee and reassigning it exclusively to private sector licensees cannot be justified, or could occur only subject to massive exclusion zones (based on an assumption of high-power private use), there is nevertheless tremendous communications capacity that could be productively used without harmful interference to the incumbent – just as the military today shares several radar bands with unlicensed users of low-power unlicensed devices.[38] At the same time, even a band that is "occupied" over the course of a day or week may still have tremendous unused spectrum capacity. A band of frequencies can be "white" (underutilized) and potentially shared on a number of different dimensions, including geography, time, power level, altitude and angle of reception.

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[36] Karl Nebbia, Director, NTIA Office of Spectrum Management, presentation to the Commerce Spectrum Management Advisory Committee (CSMAC), December 9, 2009.

[37] Mark McHenry, "NSF Spectrum Occupancy Measurements: Project Summary," Shared Spectrum Company (August 2005)), available at http://www.sharedspectrum.com/measurements/. McHenry's 2005 study collected frequency use data in six locations along the East coast in 2004 and documented an average total spectrum use of between 0 and 3% at rooftop level across hundreds of MHz of federal spectrum.

[38] *See* Michael J. Marcus, "New Approaches to Private Sector Sharing of Federal Government Spectrum," Wireless Future Program Issue Brief #26, New America Foundation (June 2009).

A band-by-band approach will be necessary to determine the best means by which an underutilized band can be made available for more intensive use with minimum risk of harmful interference to incumbent services. In some bands, Congress or the FCC, in consultation with NTIA, may determine that it is feasible to relocate incumbent federal users to accommodate reassignment of frequencies on an exclusively-licensed basis, as occurred with the 45 MHz of federal spectrum at 1710 to 1755 MHz that was cleared for auction under the Commercial Spectrum Enhancement Act of 2004.[39] In a far larger number of bands, where it is not practical to relocate military or other federal users, or where that would take many years, spectrum capacity can be made available more rapidly by opening the bands to "opportunistic access" on a secondary basis that requires the user to avoid causing harmful interference with the incumbent use.

While we support the improvements to the CSEA that are proposed in H.R. 3019, we believe the legislation should be broadened to address a critical opportunity to free up far greater spectrum capacity for mobile broadband services and innovation. H.R. 3019 would continue to limit eligibility for reimbursements toward the cost of radio system modernization to agencies actually clearing off a set of frequencies scheduled for auction. While only a tiny fraction of federal spectrum could be cleared and auctioned in the near future – primarily because most bands serve critical national security and other functions – a far greater number of bands could be shared more intensively by taking advantage of advances in smart radio technologies. Technologies such as spectrum sensing, dynamic frequency selection, geolocation databases and priority-in-use beaconing can enable a far greater degree of band sharing with non-federal users.

Federal spectrum incumbents need the resources to take affirmative steps to enable more intensive access and band-sharing by other users. This could be a win-win for the military. Although the DoD, for example, has begun sharing military radar bands (at 5 GHz) with low-power unlicensed operations, government users are entirely passive and take no affirmative steps to facilitate private sector use of lightly-used bands. Michael

[39] On December 23, 2004, President Bush signed into law the Commercial Spectrum Enhancement Act (CSEA), Title II of Pub.L. No. 108-494; 47 U.S.C. 928(d)(2). CSEA created the Spectrum Relocation Fund through which federal agencies can recover the costs associated with relocating their radio communications systems from bands designated by Congress for reallocation to exclusive commercial use.

Marcus, a career-long chief spectrum engineer at the FCC, has argued that with the right incentives "a third generation of sharing could be based on new technologies for federal government radio systems that are designed with sharing in mind and that can actually *facilitate* sharing."[40] New and upgraded federal systems could be designed and procured with the broader public interest in spectrum access in mind – and not only in the very limited case of a band being cleared entirely of federal use.

We therefore suggest that the provisions in H.R. 3019 be amended to broaden the purpose of the Spectrum Relocation Fund – turning it into a sort of revolving fund for modernizing federal systems not only to migrate off a band entirely, but to facilitate the shared or more efficient use of other federal bands. Enhancing agency budgets with revenue tied to the purpose of upgrading to state-of-the-art equipment, we believe, would prove to be a far stronger and more focused incentive than giving agencies the option to lease unused capacity on secondary markets (which, if it ever generated more than trivial amounts of revenue, could not be counted on to increase the agency's overall resources). Funding federal agency relocation plans could remain the priority – and retain access to a guaranteed set-aside within the Fund. But in addition the residual revenue, or some portion, should be made available to applications from agencies that could be recommended to OMB for approval – on an annual, competitive basis – by the new Technical Advisory Panel that would be appointed under H.R. 3019. Moreover, if there were any legitimate concern about auction revenues being insufficient for such purposes, Congress could revise the CSEA to direct that devices certified to operate on the newly-shared bands opened due to expenditures from the Fund pay a one-time certification fee to help replenish the Fund.

Opportunistic Access to Unused Spectrum Capacity

Opportunistic access to unused federal spectrum could be particularly useful given the lumpiness of spectrum demand by geography and population density (e.g., rural vs. suburban vs. urban). The greatest needs for capacity are not nationwide, or around the

[40] *See* Michael J. Marcus, "New Approaches to Private Sector Sharing of Federal Government Spectrum," Issue Brief #26, New America Foundation (June 2009).

clock, but primarily urban and during peak use periods. Rather than an entire network needing additional spectrum, it may be a few cells that are substantially oversubscribed and would benefit from having access to additional spectrum for short period of time.

We believe the most promising mechanism for freeing up large quantities of spectrum capacity needed for wireless broadband deployments and other innovation is to build on the TV Bands Database, which the FCC has certified as the mechanism by which consumers identify and get permission to access "white space" channels not in use in discrete geographic locations across the nation's 210 local TV markets. There appears to be no reason to limit the functionality of this Database to the TV band frequencies – and no reason not to add more fallow bandwidth to this "common pool." If a potentially useful frequency band is not being used at particular locations (e.g., used in New York City but not in West Virginia), or is used only at certain times or at certain altitudes or angles of reception, then that wasted spectrum capacity could at a minimum be listed in the Database for opportunistic access, subject to whatever power limits or other conditions are necessary to avoid harmful interference to sensitive incumbent operations.

Adding other bands to the TVWS Database could ultimately increase available spectrum capacity by hundreds of megahertz or more, particularly in rural areas where measured spectrum usage below 3 GHz is less than 10 percent in most areas today. The FCC's access rules for TV white space anticipates the use of frequency-hopping, multi-band radios, which are increasingly common and affordable in commercial mobile systems. Device makers and service providers would simply choose the combination of frequencies most appropriate to their needs. Devices scan and select the clearest frequency from among those that their devices can be tuned to utilize. Both federal and non-federal bands should be added to the Database, with access to each band subject to conditions that are tailored to avoid harmful interference to existing, licensed use. And to the extent that either a federal agency or private sector incumbents truly need compensation or incentive to facilitate shared access, a permission Database mechanism provides one means by which to collect "user fees." Another means would be to impose a one-time equipment certification fee on devices tuned to operate in bands governed by the Database, since the FCC must certify devices in any case.

Conclusion

Spectrum policy that keeps the United States at the forefront of wireless innovation and ubiquitous, affordable mobile connectivity will need to be about more than raising some short-term auction revenue for the Treasury. U.S. telecommunications policy can best promote innovation, job creation and economic growth over the long term with a policy that keeps the U.S. in the lead on further developing the unlicensed technologies we invented here thanks to forward-looking FCC policies years ago. Unlicensed access to the TV band has already spurred investment by dozens of companies and communities eager to deploy "Wi-Fi on steroids." The consumer, public interest groups, WISPs, entrepreneurs and leading technology companies that comprise the Wireless Innovation Alliance urge the Subcommittee to adopt affirmative provisions that do not auction unlicensed spectrum, but which affirmatively confirm the FCC's authority and obligation to reorganize the TV band to ensure continued unlicensed access to unlicensed spectrum in every local market and nationwide. In addition, many lightly-used Federal bands are particularly well-suited for increased sharing with private sector uses, but this will require more than streamlining the CSEA's Spectrum Relocation Fund process. While H.R. 3019 would be a positive step, an updated version should also broaden eligibility so that Federal agencies have the resources to upgrade systems and other steps needed to share capacity with the private sector on a far greater number of bands.

Thank you again for the invitation to testify. I look forward to answering your questions.