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FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of)
)
A National Broadband Plan for Our Future) GN Docket No. 09-51

**COMMENTS
OF
THE NEW AMERICA FOUNDATION,
PUBLIC KNOWLEDGE
AND
MEDIA ACCESS PROJECT**

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SUMMARY

On behalf of the New America Foundation, Public Knowledge, and Media Access Project we are pleased to submit to these comments regarding the Commission's development of a national broadband plan. In developing a national broadband plan to move the U.S. ahead in the 21st century Federal Communication Commission (FCC) has an unprecedented opportunity to put in place policies that can both bring essential high-speed connectivity to those with limited or no access, and serve as the foundation for long-term broadband and technological innovation. It is critical that a forward-looking national broadband plan focus on the underlying infrastructures necessary to spur ubiquitous high-speed broadband.

NAF *et al.* believe that a national effort to invest in the essential fiber infrastructures that interconnect all broadband networks are essential to high-capacity connections, along with innovative 21st century spectrum policies to tap into the enormous, underutilized capacity of our national spectrum resources, is vital to providing universal access to high-speed broadband. Public investment in fiber and public access to airwaves ("fiber in the sky") can serve as foundation for high-speed broadband deployment in communities across the country.

As the Commission recognized in its recent proceeding on rural broadband, lack of access to affordable and high-capacity fiber backhaul links, e.g. the middle-mile, as well as related "special access" lines serve as formidable obstacles to bringing high-speed broadband to rural areas across the country. But such challenges are not limited to rural communities. Deregulation of "special access" lines and consolidation of major interconnection points and facilities also limit the ability of non-incumbent broadband providers, both wired and wireless, to compete and scale up their broadband networks. An integral part of any national broadband plan is public investment in these underlying high-speed fiber infrastructures that facilitate connectivity for all last-mile broadband networks and to the Internet backbone. NAF *et al.* believes a paramount goal of a national broadband effort is to ensure that every community has access to affordable, high-capacity and open fiber-optic infrastructure.

Similarly, spectrum is the underlying infrastructure for wireless broadband. Wireless remains the most cost-effective and rapid means to bring broadband access to rural and unserved urban residents. But as mobile broadband connectivity and wireless communication continues its rapid increase, demand for spectrum will outpace availability under current spectrum management policies. Moreover, in urban, suburban and rural areas across the country, large swaths of valuable spectrum are vacant or unused for the majority of the time. This underutilized spectrum represents enormous, untapped, public capacity for high-speed and pervasive broadband connectivity. Therefore it is vital to a national broadband plan to consider policies that will encourage more intensive and efficient use of the nation's spectrum resources.

To that end, NAF *et al.* have focused these comments on the policy priorities it believes will serve as essential building blocks to spur ubiquitous and pervasive high-speed broadband connectivity:

- *Prioritize Open Fiber Networks Connecting Community Anchor Institutions*

NAF *et al.* believes a key goal of the national broadband plan should be to deploy high-capacity fiber into every community with points-of-presence (POPs) at community anchor institutions including schools, libraries, hospitals, municipal/county buildings, and public safety operations. In order to maximize the benefits of these publicly funded fiber POPs, community anchor networks must be required to provide open, wholesale access to excess capacity to any for-profit or non-profit provider – allowing the infrastructure to spur high-speed connectivity into the rest of the community.

- *Leverage Public Investment in Surface Transportation and Smart Grid to Extend Middle-Mile Fiber Access*

The U.S. can leverage the continuous construction and repair of infrastructure (e.g. highways, roads, bridges, tunnels, and railways) to extend the necessary to fiber infrastructure to every community across the nation. As part of this effort, NAF *et al.* proposes a plan to fund and mandate the installation fiber-optic conduits and dark fiber bundles along all federally-subsidized and direct federal highway projects. We can further integrate the build-out of neutral fiber-optic infrastructure into public investment in the smart grid – taking advantage of the efficiency of using a single infrastructure to facilitate connectivity for a multiplicity of services and applications.

- *Map and Open Excess Capacity on Public Sector Fiber Networks*

Broadband deployment, competition and affordability would also benefit enormously from a mapping of the public sector fiber networks used by federal, state and local public agencies nationwide. Dark fiber and/or excess capacity on the public sector's own fiber line infrastructure, opened for wholesale access to any provider – commercial or non-commercial – including non-vertically-integrated cell phone carriers, WISPs, Rural LECs and muni- or community WiFi networks, could help to substantially increase middle-mile options in areas across the country.

- *The Government as a Provider of Last Resort in Unserved Rural Areas*

In many cases, particularly in high-cost and sparsely populated rural areas, even with affordable access to high-speed middle-mile fiber and the Internet backbone, and ample access to underutilized spectrum, there may be an insufficient rate of return to induce commercial providers to deploy high-speed broadband. In the past, the U.S. has focused on providing a fair-rate return to a monopoly provider or subsidizing build-out and operational costs through programs such as the Universal Service Fund. An alternative, for those areas where private sector broadband deployment will not occur, the

government could serve as a provider of last-resort in a model similar to the successful electrification of the rural Tennessee River Basin by the Tennessee Valley Authority.

- *ARRA Broadband Mapping Should Include a Mapping of Public Spectrum Capability*

NAF *et al.* recommends the Commission perform an *Inventory of the Airwaves* that maps how our public spectrum resource is being utilized or underutilized in various bands, by both commercial and government users. Actual spectrum measurement data should be included in this White House-led initiative. The Commission could draw upon funding from the American Recovery and Reinvestment Act to complete this inventory.

- *Build on the TV White Space Database to Open Access to Unused and Underutilized Frequency Bands*

Although spectrum mapping 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. We believe that the most promising mechanism for making substantial new allocations of spectrum available for wireless broadband deployments and other innovation is to leverage the TV Bands Database that will be certified by the FCC for unlicensed access to vacant TV channels. There appears to be no reason to limit the functionality of the TV Bands Database to solely the TV band frequencies. If a potentially useful frequency band is not being used at particular locations (e.g., in New York City but not in West Virginia), or is being used only at certain times or at certain altitudes or angles of reception, then that currently wasted spectrum capacity could at a minimum be listed in the Database for opportunistic access, subject to whatever power limits or other conditions would be necessary to avoid harmful interference with sensitive incumbent operations.

- *Open Inquiries into More Efficient Spectrum Use Technologies*

In the mid-1980s, the FCC authorized low-power, unlicensed use of spread spectrum technologies on a very limited number of bands, rejecting the engineering staff's recommendation that the technology could be used across most of the spectrum. Since the Commission's Spectrum Policy Task Force recommended a renewed look at spread spectrum and other reforms, however, the FCC has closed or abandoned a number of inquiries into more efficient spectrum use technologies. We urge the Commission to include in its national broadband plan a renewed inquiry into the technological feasibility of opening most spectrum to a far greater degree for unmediated, low-power broadband and innovation.

Together, the recommendations can provide a springboard for expanding high-speed broadband to all communities; benefiting a wide variety of providers, business models, and broadband solutions, while also promoting competition, increased speeds and lower prices, and ensuring the U.S. continues to be a leading innovator in the communication technologies of the 21st century.

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I. INTRODUCTION

On behalf of the New America Foundation, Public Knowledge and Media Access Project, we are pleased to submit to these comments regarding the Commission's development of a national broadband plan. As the Commission itself acknowledged in its recent report on rural broadband, there are considerable gaps in areas across the country in terms of broadband availability, access, affordability and adoption.¹ Unfortunately, these gaps are not limited to rural areas but exist urban and suburban areas where lower-income, older Americans, minority communities continue to lag behind other in terms of broadband adoption.² Although, broadband usage and adoption is widespread among non-low income and suburban households, both low-income urban and rural households are largely disconnected from the high-speed Internet. As Consumers Union and Consumer Federation of America noted in recent comments, "urban non-low income households are 2.5 times as likely to have broadband as urban low-income households and 4.7 time likely as rural-low income households." While the NAF *et al.* believe that federal policy should actively pursue the ultimate goal of ubiquitous broadband and pervasive connectivity, at a very minimum the nation needs to aggressively pursue policies of digital inclusion that at a minimum provide affordable broadband access to all.

Beyond these underserved or unserved groups, the U.S. is more generally lagging behind its peers in terms of broadband speeds and prices. As Special Assistant to the President for Science, Technology and Innovation Policy, Susan Crawford, recently noted, "The nation's broadband connections are 'slow and expensive' compared to the rest of the world. . . . We are not

¹ See Bringing Broadband to Rural America (hereinafter referred to as "FCC Rural Broadband Report"), Federal Communication Commission, May 22, 2009, ¶ 72, http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-291012A1.pdf.

² See John B. Horrigan, "Home Broadband Adoption," Pew Internet and American Life Project (July 2008), http://www.pewinternet.org/~media/Files/Reports/2008/PIP_Broadband_2008.pdf.

falling behind,” she warned. “We are definitely behind.”³ In nations such as South Korea, Japan, and France download speeds beyond 50 Mbps have become the norm, whereas in the U.S. resident are fortunate if they can access download speeds up to 10 Mbps.⁴ As of 2008, 5 million Koreans or 39 percent of Internet subscribers were using a 100 Mbps connection.⁵ In the U.S., consumers pay more for less than in the much of the developed world, with residential users paying on a monthly basis nearly \$10 on average per Mbps of connectivity – compared to \$0.85 in South Korea, \$3.30 in France, and \$4.79 in Japan.⁶

In developing a national broadband plan to move the U.S. ahead in the 21st century the FCC has an unprecedented opportunity to put in place policies that can both bring essential high-speed connectivity to those with limited or no access, and serve as the foundation for long-term broadband and technological innovation. It is critical that a forward looking national broadband plan focus on the underlying infrastructures that can spur ubiquitous high-speed broadband in communities across the country. Public investment in fiber and public access to airwaves (“fiber in the sky”) can serve as the foundation for high-speed broadband deployment across the country. NAF *et al.* provide the following policy recommendations it believes will serve as essential building blocks to spur ubiquitous high-speed broadband for all.

³ Andrew Feinberg, “Tech Policy, Broadband Still at Top of Obama’s List, Says Crawford,” Broadband Census.com, June 2, 2009, <http://broadbandcensus.com/2009/06/tech-policy-broadband-still-at-top-of-obamas-list-says-crawford/>.

⁴ See OECD Broadband Portal, “Average advertised download speeds, by country (Sept. 2008),” Organisation for Economic and Co-Operation and Development, http://www.oecd.org/document/54/0,3343,en_2649_34225_38690102_1_1_1_1,00.html.

⁵ See “Over Five Million Subscribers Enjoy 100 Mbps Internet in Korea,” Telecoms Korea, May 28, 2009, http://www.telecomskorea.com/index.php?option=com_content&task=view&id=7371&Itemid=2.

⁶ See OECD Broadband Portal, “Average broadband monthly price per advertised Mbit/s, by country, USD PPP (Oct. 2008),” Organisation for Economic and Co-Operation and Development, http://www.oecd.org/document/54/0,3343,en_2649_34225_38690102_1_1_1_1,00.html

II. PUBLIC INVESTMENT IN OPEN ACCESS FIBER INFRASTRUCTURE

Broadband networks require both local (last mile) access and a backhaul component.⁷

Although the former has received most of the attention, a rising obstacle to both wired and wireless universal high-speed broadband access is the backhaul connection of those local access networks to the Internet backbone. Increasingly access to the high-speed middle-mile links or related infrastructure that carry Internet traffic to the backbone, and the escalating costs associated with transporting traffic among networks, have become fundamental barriers to spreading connectivity, promoting broadband competition, improving speeds and lowering prices. The issue has implication both for rural broadband deployment as well as broadband competition and quality in urban and suburban areas.

As the Commission observed in its recent report on rural broadband, in rural areas across the country “middle-mile facilities may have insufficient capacity, causing the transmission speed on otherwise adequate last-mile broadband facilities to come to a crawl or stall before the data reach the Internet backbone,” and “even when the last-mile provider acquires access to adequate middle-mile facilities, that access may be prohibitively expensive.”⁸ As another commenter noted, most rural local access networks have access to exactly one provider to connect to the backbone.⁹ As a result, total capacity costs are increasing much faster than the razor thin profit margins of many rural ILECs and WISPs. As network usage increases, these small rural broadband providers are buying more and more capacity to handle the increased traffic. Without a substantial investment to bring both adequate and affordable middle-mile fiber connectivity to rural communities, rural networks will hit a wall in terms of speed and pricing as

⁷ FCC Rural Broadband Plan, ¶ 114, *supra* note 1.

⁸ FCC Rural Broadband Report, ¶ 114, *supra* note 1.

⁹ *See* footnote 286, *Id.*

the capacity costs associated with increased traffic to the backbone will grow faster than profits.¹⁰

However the increasing cost of transporting traffic from local access networks to the Internet is not just isolated to rural areas. Given the substantial consolidation over the past decade, control of the vital interconnection points and routes in urban and suburban areas, has become consolidated into the hand of a few large telecommunications companies. In addition, deregulation of the “special access” lines in markets across the country is forcing competitive broadband providers (those that do not own their own transport facilities), to deal with excessive fees and unreasonable terms of service by special access providers.¹¹ This problem has implications not just for the wired world but also increasingly for next-generation wireless “4G” cellular networks, WiMax and Wi-Fi networks – where, for example, wireless providers such as T-mobile and Sprint-Nextel, who lack their own wireline infrastructure, often must utilize backhaul and special access links that are controlled by their main competitors, AT&T and Verizon.¹²

Many of these issues have been raised in the Commission’s *Special Access Reform* proceeding. The FCC’s Rural Broadband Report recommended the Commission consider the impact that special access prices have on rural broadband deployment and affordability as part of its overall review on *Special Access Reform*.¹³ The Commission should further consider the impact of *Special Access Reform*, on national broadband deployment and competition more

¹⁰ Also see Consolidated Comments of Microsoft Corporation, GN Docket No. 09-40, April 13, 2009, at 7, http://fjallfoss.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6520211388, “We understand from some network operators, for example, that the local cost of upgrading wires and distributing broadband is not a hurdle. The marginal cost of adding subscribers to broadband systems can be more than covered by subscriber fees. However, rural or remote providers cannot take advantage of those economics, because the cost of acquiring high-capacity facilities between the Internet backbone and the community is too high.”

¹¹ See FCC Rural Broadband Report, ¶ 114, *supra* note 1.

¹² See T-Mobile, “Reply Comments,” Federal Communications Commission, WC Docket No. 05-25, August 15, 2007, <http://www.usdoj.gov/atr/public/workshops/telecom2007/submissions/227837.htm>.

¹³ See FCC Rural Broadband Report, ¶ 152, *supra* note 1.

generally. We believe that reasonable, non-discriminatory access to these essential broadband infrastructures is vital to promoting ubiquitous high-speed broadband, competition, and lower prices.

At the same time, both rural and urban/suburban high-speed broadband networks would substantially benefit from having access to alternative backhaul fiber infrastructures, an increase in the number of interconnection points and routes, and improved competition in the middle-mile. Thus, an integral part of a national broadband plan is a substantial investment in these underlying broadband infrastructures that would benefit a large number of broadband providers and business models.

To accomplish this goal, NAF *et al.* recommend the following:

- 1) public investment in open fiber networks connecting community anchor institutions;
- 2) leverage public investment in surface transportation, smart grid and intelligent transportation to extend middle-mile fiber access;
- 3) inventory and open excess capacity for backhaul transport and interconnection on public sector fiber networks; and,
- 4) the federal government act as a provider of last resort in un-served rural areas.

A. Public Investment in Open Fiber Networks Connecting Community Anchor Institutions

From distance learning, to electronic medical records and tele-health services, to facilitating a more efficient, open, and inclusive e-government applications and solutions will require access to high-speed broadband beyond what is currently available in most communities. Although, programs like E-Rate have succeeded in getting the vast majority of the nation's schools and libraries connected to the Internet, in many areas these connections are not sufficient

to handle future, high-capacity Internet applications and demand, particularly given the extensive sharing of access on these institutions connections. Nor does the E-Rate program encourage, or even allow, schools, libraries and rural health clinics to acquire high-capacity connections and open those to the private sector as jumping-off points for additional broadband access within their local communities. For example, Internet access today at public libraries is in many cases a minimally useful T-1 connection or an increasingly strained DSL or cable-modem connection.¹⁴ Similarly, a school may have as little as a T-1 connection; in others, they may have a first-generation DSL or cable-modem connection.¹⁵

NAF *et al.* therefore believes a key goal of the national broadband plan should be to deploy high-capacity fiber into every community with points-of-presence (POPs) at community anchor institutions including every school (K-12, community colleges, and universities), library, hospital, as well as municipal/county buildings, public housing complexes and public safety operations that local jurisdictions want to include on the public fiber network.

The benefits of this approach are two-fold. First, these community anchor institutions gain access to future-proof broadband facilities, allowing them to provide advanced services and applications to benefit to their local communities – including the greatest benefits to those who are most likely to lack access, including low-income, disabled, and elderly residents. Libraries and schools can become community hubs for high-speed connectivity, providing opportunities for education and employment help. In addition, schools and libraries can also become community “hot spots,” utilizing WiFi or WIMAX technology to provide broadband access to nearby households.¹⁶ Hospital and medical facilities will need access to high-speed fiber to

¹⁴ See Microsoft Comments, at 7, *supra note* 10.

¹⁵ *Id.* at 5.

¹⁶ See Comments of the Consumer Federation of America and Consumers Union, GN Docket No. 09-29, at 4, http://fjallfoss.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6520203357.

connect patients with specialists across the country as well as moving towards electronic medical records. For example, WellPoint provides telehealth funding to connect 60 sites in California and 55 sites in Georgia with live-video teleconferencing, helping to provide access to specialists for rural and underserved patients.¹⁷

Second, communities can leverage the excess capacity on these fiber infrastructures to provide essential middle-mile, and other interconnection access for all broadband providers in a local community. In order to maximize the benefits of any federal subsidies for high-capacity fiber POPs to community anchor institutions networks should be required to provide open, wholesale access to excess capacity to any for-profit or non-profit broadband provider – allowing the infrastructure to spur high-speed connectivity into the rest of the community. As much as it would benefit the general public to have these community hubs connected with high-capacity lines, these institutions also need to be able to reach their constituents at home. Telehealth applications such as remote patient monitoring and e-visits will require high-speed in-home connectivity. Such applications are integral to driving broadband adoption among older residents. Similarly, in home broadband access is essential for students to utilize web-based curriculum or homework from their primary school or community college.

As a result, public investment in bringing high-capacity fiber connections to community anchors should be conditioned on upon open, wholesale access to the publicly subsidized fiber infrastructure. These anchor institutions could further serve as interconnection hubs, providing co-location space for broadband providers in the community. In addition, in rural areas where the fiber infrastructure will need to be newly constructed, it may be the only available high-capacity infrastructure to facilitate broadband connectivity in the area. A similar proposal was

¹⁷ Delivering Care Anytime Anywhere: Telehealth Alters the Medical Ecosystem, California HealthCare Foundation, November 2008, 7, <http://www.chcf.org/documents/policy/TelehealthAltersMedicalEcosystem.pdf>.

put forth by Consumer's Union and Consumer Federation of America in the FCC rural broadband proceeding, which called for a priority on projects that bring middle-mile fiber "down the major roads of rural America," where the middle-mile end points or POPs could be local government buildings, public housing, schools, and libraries.¹⁸

As part of this effort, the federal government should prioritize some of the \$7.2 billion allocated for broadband deployment as part of the American Recovery and Reinvestment Act of 2009 (ARRA) for the purposes of providing high-speed fiber connections of no less than 100 Mbps, symmetrical to libraries, schools, hospitals and other community anchor institutions. This proposal has received support from a broad range of groups including Microsoft, the American Library Association, and Educause.¹⁹ In addition to funding from ARRA, we further suggest expanding the very successful E-Rate program to allow for capital expenditures and ongoing operational expenditures associated with the fiber connection or POPs.

B. Leverage Public Investment in Surface Transportation and Smart Grid Infrastructure to Extend Middle-Mile Fiber Access

The Commission smartly recommended in its recent report on a rural broadband strategy, "that federal agencies review their non-broadband programs regarding rural issues to see if those programs provide opportunities to promote rural broadband deployment."²⁰ As the Commission provided in report, the opportunities for leveraging federal spending on other infrastructure and other efforts to spur broadband deployment are plentiful including offering collocation space in federally-owned buildings to foster interconnection among providers, expediting the process for

¹⁸ Comments of Consumer Federation of America, at 2 – 4, *supra note* 16.

¹⁹ See Microsoft Comments, *supra note* 10. See also Comments of the American Library Association, GN Docket No. 09-29, http://fjallfoss.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6520203459 and Notice of Ex Parte Presentation, Educause, GN Docket No. 09-40, April 6, 2009, http://fjallfoss.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6520205454.

²⁰ See FCC Rural Broadband Report"), ¶ 72, *supra note* 1.

broadband providers to access rights-of-way on public lands, or wiring government government-supported housing for broadband.²¹ As part of this effort and a national broadband plan is integrating fiber conduits and fiber itself into the ongoing construction and repair of infrastructure (e.g. highways, road, bridges, tunnels, and railways) to facilitate high-speed broadband connectivity through the nation. In leveraging this process, the U.S. can start to bake broadband into our nationwide investment in infrastructure just as we do for other essential services and utilities such as water and electricity, rather than view it as a distinctly separate endeavor.

Leveraging Public Investment in Surface Transportation

New America released a paper in January calling on Congress to leverage future federally-funded surface transportation including highways, roads and bridges to fund and mandate the installation of conduit and high-speed fiber bundles along all federally-subsidized and direct federal highway projects.²² This approach would utilize the continuous construction, reconstruction, and resurfacing of roadways in the national highway system to systematically and efficiently bring the necessary middle-mile fiber-connections to nearly every community in the country. For example, given that the vast majority of the cost associated with bringing fiber and conduit into a community along public rights-of-way is associated with digging up and repairing a roadway to bury the fiber and conduit, it is both expedient and significantly cheaper to install conduit and fiber while a roadway is already being substantially repaired, reconstructed or

²¹ *Id.*

²² See Benjamin Lennett and Sascha Meinrath, "Building a 21st Century Broadband Superhighway," Issue Brief, *New America Foundation*, January 2009, http://www.newamerica.net/publications/policy/building_21st_century_broadband_superhighway.

built.²³ Such an effort would benefit both rural and urban areas, bringing high-speed fiber infrastructure to where it does not exist, while upgrading capacity and promoting alternative backhaul and interconnection fiber infrastructure to promote competition and drive innovation.

In order for this public investment to offer the greatest benefit and serve as building-block to spur last-mile connectivity by a multitude of broadband providers, there should be conditions designed to provide for open, wholesale access to the fiber infrastructure including: 1) easily accessible interconnection points and specific community connection points to provide local ISPs, municipalities, and businesses with access to the infrastructure; 2) common carriage and wholesale access on these links must be mandated and 3) fiber operator must provide AUP-free use of these fiber assets and any additional links necessary to reach an open interconnection point to lessees.²⁴ Any qualified entity could contract to build and/or operate the publicly-funded fiber links, but should be subject to the conditions above to ensure that all facilities remain open, accessible, and transparent.

We further recommend similar conditions be placed upon any federal funding or mandates to include conduit along federally funded highway projects to further ensure publicly subsidized fiber-optic infrastructure can benefit a multitude of service providers.²⁵ In addition, states and localities could follow a similar model by incorporating, at minimum, open and easily accessible conduit, into the construction of highways, bridges, roadways, and new housing

²³ The Federal Highway Administration (FHWA) estimates that 90 percent of the cost of deploying fiber in public rights of way along roadways is associated with digging up and repairing the road to install the buried fiber. See "Telecommunications Handbook for Transportation Professionals," U.S. Department of Transportation, Federal Highway Administration, September 2004, p. 41, available at http://ops.fhwa.dot.gov/publications/telecomm_handbook/telecomm_handbook.pdf

²⁴ For further conditions designed to maximize the public benefits of this proposal, see "Building a 21st Century Broadband Superhighway," *supra note 22*.

²⁵ See Broadband Conduit Deployment Act of 2009, H.R. 2428, 111th Cong. § 2 (2009) (requiring the installation of broadband conduit in highway construction projects).

subdivisions – thereby reducing build-out costs both for middle-mile fiber providers as well last-mile broadband service providers.²⁶

Among the added benefits of this approach is its potential to also serve as accessible, high-capacity fiber infrastructure on advancing smart or intelligent transportation technology. The Department of Transportation (DOT) has expressed serious interest in utilizing wireless communications for an intelligent transportation system to manage traffic flows and improve safety.²⁷ With fiber running along highways and interstates across the country, DOT would have ample capacity for next-generation transportation infrastructures, while also lessening disruption and dramatically decrease the overall costs of these necessary upgrades in coming years. Similarly, state and localities could utilize the ample capacity provided by fiber running along roadways to support their intelligent transportation systems and technologies such as smart transportation pricing²⁸, wireless video traffic monitoring²⁹, along with a variety of technological solutions designed to reduce congestion and improve road safety.³⁰

Leveraging Public Investment in the Smart Grid

In a similar and possible parallel effort, we can also leverage current and ongoing investment to modernize the nation’s electrical grid to deploy broadband infrastructure. The idea was recently put forth in a paper from the Center for America Progress that called for the

²⁶ For example *see* Recommendation 4. Coordinate Conduit Deployment, “Preliminary Broadband Report,” California Broadband Task Force, at 11 – 14, http://www.calink.ca.gov/pdf/CBTF_Prelim_Report.pdf.

²⁷ *See* CNS/Traffic Management/Command and Control,” Research and Innovative Technology Administration, Department of Transportation, http://www.rita.dot.gov/communities_of_interest/cns_traffic_management/.

²⁸ *See*, “Smart Transportation Pricing,” Cisco Systems, Inc., http://www.cisco.com/web/about/ac79/docs/cud/STP_Fact_Sheet_051309_SM_TKv2_FINAL2.pdf.

²⁹ For example *see*, “Motorola Wireless Broadband Video Surveillance Solutions,” Motorola Inc., http://www.motorola.com/staticfiles/Business/Products/Wireless%20Broadband%20Networks/Intelligent%20Transportation%20Systems/Documents/_Static%20files/Video%20Surveillance%20Solutions_Bro.pdf?localeId=33.

³⁰ For example *see* “Motorola Intelligent Transportation Systems (ITS) Solutions,” Motorola Inc. (2008), http://www.motorola.com/staticfiles/Business/Products/Wireless%20Broadband%20Networks/Intelligent%20Transportation%20Systems/Documents/_Static%20files/Intelligent%20Transportation%20Systems_Bro.pdf?localeId=33.

agencies to coordinate “within the planning, mapping and design phase of these project” in an effort “to increase the efficiency of these efforts by sharing costs across agencies and treating broadband and energy IT as related components of an advanced information backbone for our economy.”³¹

A number of both private and public electric utility providers already offer middle-mile transport to backbone POPs and many more will likely invest in the fiber-optic infrastructure to facilitate smart grid technology. There is a clear efficiency to leverage this fiber as a neutral transport infrastructure for both smart grid applications as well to provide backbone connectivity and serve as local interconnection points for access networks in the local area. As such utilities, whether private or public, should be encouraged open their existing and new fiber infrastructures to all broadband providers.

C. Map and Open Excess Capacity on Public Sector Fiber Networks

In much the same way that the nation should both prioritize and leverage public investment in open fiber networks connecting community anchor institutions (schools, libraries, hospitals) to provide middle-mile connectivity to broadband providers, we can leverage excess capacity on existing public sector fiber networks to improve access to middle-mile connectivity. Dark fiber and/or excess capacity in public sector fiber networks, including those used by federal, state and local public agencies nationwide, is a broadband capability that is owned by the public. Excess capacity on the public sector’s own fiber line infrastructure, opened for wholesale access to any provider – commercial or non-commercial – including non-vertically-integrated cell phone carriers, WISPs, Rural LECs and muni- or community WiFi networks, would help to

³¹ Peter Swire, “Smart Grid, Smart Broadband, Smart Infrastructure,” Center For America Progress (April 8, 2009), at 4, http://www.americanprogress.org/issues/2009/04/pdf/smart_infrastructure.pdf.

substantially increase middle-mile options. However, currently these public fiber networks are not only stove-piped and not open for wholesale access by other broadband providers – but in most cases their locations and capacities are not widely or easily known.

To take advantage of this existing and often underutilized fiber infrastructure, we recommend that the FCC and NTIA include a mapping of the public sector fiber network along with other broadband service capabilities as provided in ARRA. We further encourage the Commission, as part of a national broadband plan, to reach out to federal agencies to develop plans and policies to encourage open, wholesale access of excess capacity on federal fiber networks. Also, the Commission should consider the impact of local and state regulations that may prohibit municipalities and state government from even offering interconnection or wholesale access to local broadband providers.

D. Government as a Provider of Last Resort in Un-served Rural Areas

In its filing in the FCC’s rural broadband proceeding, the Minority Media and Telecommunications Council presented the case of Weirwood, Virginia, an isolated rural community on Virginia’s Eastern Shore. On the site of a former cotton plantation, Weirwood is only a mile and a half from U.S. Route 13, along which lies a broadband Internet backbone. However residents of this impoverished community have no access to broadband. As MMTC provided, Weirwood has “absolutely no ability to raise internally” the funds needed to build a broadband node to the community from the existing backbone line.³²

Weirwood is a textbook example, that even in areas where sufficient broadband infrastructure may be accessible, the community may be unable to either attract private providers

³² See Rural Broadband Comments, ¶ 31, *supra note 1*. Also see Comments of the Minority Media and Telecommunications Counsel, GN Docket No. 09-29, March 25, 2009, at 2 – 3, http://fjallfoss.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6520203620.

or be able to raise the community funds to self-provision. In many cases, particularly in high-cost and sparsely populated rural areas, even with affordable access to high-speed middle-mile fiber and the Internet backbone, and ample access to spectrum, there may be an insufficient rate of return to induce providers to deploy high-speed broadband. Large telecommunication providers are often publicly-traded companies under considerable pressure to maintain or increase their profit margins or rate of profit. Given the high deployment cost for broadband in sparsely populated, and difficult terrain areas, along with the limited income of the subscriber base, means the rate of return in some rural areas is just too small to lure incumbent providers. In a forthcoming paper from the New America Foundation, economist Gregory Rose estimates that in as much as 8-to-10 percent of rural areas, publicly-traded providers will in principle not provide broadband service because they offer too little service – even if the government subsidizes the costs of deployment.³³

To bring telephone service to areas such as these, the U.S. in the past has focused on providing a fair-rate return to a monopoly provider or subsidizing build-out and operational costs through programs such as the Universal Service Fund. An alternative as proposed by Rose is allowing the federal government to serve as a provider of last-resort in a model similar to the successful electrification of the rural Tennessee River Basin by the Tennessee Valley Authority.³⁴ This new effort would federally finance the deployment costs and allow the government to become a provider of last resort in rural areas where private providers do not have the incentives to deploy.

This may entail the establishment of a National Broadband Authority that would be responsible for two projects:

³³ See Gregory F. Rose, “Serving the Rural Unserved: Time for a Broadband TVA,” Working Paper, New America Foundation (forthcoming).

³⁴ *Id.*

- Construction and maintenance of a national “middle mile” fiber broadband network contiguous to the approximately 163,000-mile National Highway System (NHS) which will serve as the broadband backbone for deployment to rural areas, as well as provide additional connectivity for underserved urban areas;³⁵
- Construction and maintenance of a fiber-to-the-home, fiber-to-the-business, wireless broadband, and satellite broadband “last mile” network for currently unserved rural areas from the NHS “middle mile” fiber network, including wholesale and retail provision of broadband service in these rural areas.

III. INVENTORY AND REALLOCATE UNDERUTILIZED SPECTRUM

Wireless remains the most cost-effective and rapid means to bring broadband access to rural and underserved urban residents. Already, thousands of locally-grown Wireless Internet Service Providers (WISPs), Rural ILECs, public utilities, NGO’s and local governments are utilizing wireless technology and unlicensed spectrum to bring affordable wireless broadband to un-served and underserved rural areas across the country. A substantial obstacle for these small and local providers to expand and scale-up their networks is access to additional spectrum. As part of that effort, NAF *et al.* recommend that the Commission embrace an agenda of open access to the nation’s “vast wasteland” of unused spectrum capacity.

A. Mapping and Reallocating Unused and Underutilized Spectrum Bands for Opportunistic Access is Essential to Facilitate Pervasive Connectivity in the Emerging Wireless Broadband World

³⁵ This would be similar to the “middle mile” broadband fiber proposal involving the National Highway System was put forward above and by the New America Foundation paper, “Building a 21st Century Broadband Superhighway: A Concrete Build-Out Plan to Bring High-Speed Fiber Connections to Every Community.” *See supra note 22.* However, the federal government (or National Broadband Authority) would retain control of the “middle mile” fiber network rather than passing authority to states and localities.

1. Spectrum for Wireless Broadband is Abundant, if Citizens Could Only Use It

A national goal of not merely affordable broadband access, but of truly pervasive connectivity – with seamless and mobile connectivity anywhere and anytime – will require an enormous increase in available spectrum capacity.³⁶ Unfortunately, despite the Commission’s acknowledgment that traditional “command and control” spectrum management is outdated and inefficient;³⁷ the federal government has continued to approach spectrum allocation in a piecemeal fashion that reinforces the conventional wisdom that spectrum is a scarce resource that needs to be centrally managed.

The reality is that it is government permission to use spectrum that is scarce. Spectrum capacity itself is abundant. Indeed, while actual spectrum measurement studies are difficult to find, those in the public domain have demonstrated that even in the so-called “beachfront” frequencies below 3 GHz, the vast majority of frequency bands are not being used in most locations and at most times. In spectrum measurement studies for the New America Foundation (2003), and in a larger study funded by the National Science Foundation (2004), Mark McHenry, the former director of DARPA’s NeXt Generation spectrum program, found that even in Manhattan and in D.C. near the White House, less than 20 percent of the frequency bands below 3 GHz were in use over the course of a business day.³⁸ Spectrum usage rates are, of course, far

³⁶ A Motorola white paper examining the spectrum requirements for future LTE (4G) deployments notes that an ITU report (ITU-R M.2078) “projects overall spectrum requirements for the future development of IMT-2000 and for IMT-Advanced. The results assert that additional spectrum demand of between 500 MHz and 1 GHz will be needed in all ITU Regions by 2020. [The ITU] report expresses traffic growth factors of 2 to 3 by 2010 for Europe compared to today. It is clear that existing bands will not be enough for IMT services approximately after the year 2015 and additional bands are needed. In order to deliver a true broadband experience, large blocks of spectrum will need to be identified and allocated.” Motorola, “Spectrum Analysis for Future LTE Deployments,” White Paper (2007).

³⁷ See “Principles for Reallocation of Spectrum to Encourage the Development of Telecommunications Technologies for the New Millennium,” *Policy Statement*, 14 FCC Rcd 19868 (1999).

³⁸ Mark McHenry, “Dupont Circle Spectrum Utilization During Peak Hours, A Collaborative Effort of The New America Foundation and The Shared Spectrum Company,” New America Foundation Issue Brief (2003), available at http://www.newamerica.net/files/archive/Doc_File_183_1.pdf. Mark McHenry, “NSF Spectrum Occupancy Measurements,” Project Summary of six site reports, Shared Spectrum Company (August 2005), available at

lower in suburban and rural areas. McHenry's NSF study demonstrated in a mix of urban, suburban and exurban areas that large swaths of valuable spectrum are vacant or unused for the majority of the time.³⁹ For example, the average spectrum use in rural Limestone, Maine was just 1.7 percent.⁴⁰ The highest occupancy rate on the prime beachfront spectrum below 3 GHz was just 13 percent in New York City, while the average across locations studied was just 6 percent. Across the country, this underutilized spectrum represents an enormous untapped capacity for rural broadband.

The gross underutilization of the nation's spectrum resource should be an urgent concern for national broadband policy. Spectrum is not only an immensely valuable and publicly-owned resource, but one that is infinitely renewable: every millisecond that a frequency band is not used for communication, that capacity is wasted forever. In that respect, when former FCC Chairman Newt Minow famously called television a "vast wasteland," he could have been describing more literally the nation's spectrum resource under the prevailing exclusive zoning (licensing) system.

Nowhere is this vast spectrum wasteland more evident than in many of the bands reserved for use by the federal government itself.⁴¹ It is estimated that the federal government exclusively controls over 13% of all allocated spectrum bands and has primary access to shared

<http://www.sharespectrum.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 less than 10%. Specific findings over a day-long period included: 3.4% in Great Falls, Virginia; 6.9% in Vienna, Virginia (location 1); 11.4% in Arlington, Virginia; 13.1% in New York City; 1.0% in Green Back, West Virginia; and 11.7% in Vienna, Virginia (location 2). The New York City measurements were taken during a national party convention (when a far higher-than-average use of law enforcement and federal agency spectrum would be expected), yet the vast majority of the public airwaves still remains unused

³⁹ See "Spectrum Occupancy Measurements," Shared Spectrum Company, available at

<http://www.sharespectrum.com/measurements/>.

⁴⁰ See Tugba Erpek, Mark Lofquist, and Ken Patton, "Spectrum Occupancy Measurements Loring Commerce Centre Limestone, Maine September 18-20, 2007" Shared Spectrum Company (2006), available http://www.sharespectrum.com/measurements/download/Loring_Spectrum_Occupancy_Measurements_v2_3.pdf.

⁴¹ 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," *International Journal of Communications* (forthcoming, June 2009).

bands comprising 56% of all other bands, which translates to 270,000 frequency assignments to federal agencies.⁴² Although it is imprecise about which agencies control what spectrum, one NTIA chart estimates that 81.8% of the spectrum between 3MHz-30MHz is allocated to the federal government.⁴³ Research by the New America Foundation estimated that federal government exclusive and shared bands account for 64% of all allocations below 3.1 GHz.⁴⁴

One of the biggest blocks is found between 225-400 MHz, which, according to *Spectrum Finder*, “is devoted to military aircraft, tactical and training communications, satellite links for ground, air, surface and subsurface users, rocket test and telemetry, position location networks and Presidential communications.”⁴⁵ While the military maintains that the 225-400 MHz band is among the most critical spectrum bands for tactical and training missions both at home and overseas, the McHenry measurements noted above also indicate that at least in the urban and suburban areas where most Americans live and communicate, the military is utilizing very little if any of that capacity on most days and in most places (McHenry’s measurements showed activity on a maximum 3% of those 175 MHz in the six locations measured). Federal spectrum bands between 902 and 1850 MHz (particularly 1755 to 1850 MHz) and smaller bands between 108-174 and 400-450 MHz, appear similarly unused in most areas at most times, particularly in the more densely populated areas of the country with insufficient capacity for future demand for wireless broadband data services.

⁴² Jonathan E. Nuechterlein & Philip J. Weiser, *Digital Crossroads: American Telecommunications Policy in the Internet Age*, MIT Press: Cambridge, MA (2005).

⁴³ For an overview, see the new CED chart: www.cedmagazine.com/WorkArea/downloadasset.aspx?id=157960

⁴⁴ New America Foundation, “The Citizen's Guide to the Airwaves: A Graphic Depiction of the Uses – and Misuses – of the Radio Frequency Spectrum” (Washington, DC 2003).

⁴⁵ Bennett Z. Kobb, *Wireless Spectrum Finder: Telecommunications, Government, and Scientific Radio Frequency Allocations in the U.S. 30 MHz-300 GHz*. (New York: McCraw-Hill, 2001).

Federal government documents obtained under the Freedom of Information Act by the New America Foundation in 2004 and 2005 revealed a list of government agency frequency assignments that, with greater transparency and scrutiny, could prove to be reserving bands that could be opened for at least shared commercial use. For example, the Supreme Court has been given 13 “assignments” of spectrum; the Library of Congress has been given 9; the National Archives 6; the National Gallery of Art, 12; the Smithsonian, 73. The precise measurement of “no. of spectrum” is still unclear, and pales in comparison to the Department of Energy’s 9,312 and the air force’s 28,227. Nonetheless, despite its ambiguity, this data raises questions about how intensively or wisely the government is reserving bands of the most valuable spectrum for exclusive use.

A presidential task force was formed in 2003 to develop recommendations for federal agencies to utilize spectrum more efficiently.⁴⁶ Two promising reports came out making recommendations for ascertaining underused federal spectrum.⁴⁷ The task force also helped create the Commerce Spectrum Management Advisory Committee (CSMAC).⁴⁸ A report came

⁴⁶ In 2003, President Bush announced the “Spectrum Policy Initiative,” establishing a “U.S. spectrum policy for the 21st Century that will foster economic growth; ensure our national and homeland security; maintain U.S. global leadership in communications technology and services; and satisfy other vital U.S. needs in areas such as public safety, scientific research, Federal transportation infrastructure, and law enforcement.”

⁴⁷ For example, recommendation #7 called for “spot compliance checks and signal measurement surveys to verify the accuracy of the records of the Government Master File (GMF), identify congestion and instances of duplicative operations that could be combined, and evaluate the utility of underutilized spectrum. NTIA should use the results of these reviews in the development of new and improved spectrum management policies, and the Federal Strategic Spectrum Plan.” See http://www.ntia.doc.gov/reports/specpolini/pressspecpolini_report1_06242004.htm and see also http://www.ntia.doc.gov/reports/specpolini/pressspecpolini_report2_06242004.htm

⁴⁸ The CSMAC “advises the Assistant Secretary of Commerce for Communications and Information at NTIA on a broad range of issues regarding spectrum policy and on needed reforms to domestic spectrum policies and management to enable timely implementation of evolving spectrum-dependent technologies and services to benefit the public. The members are spectrum policy experts, appointed as ‘Special Government Employees’ from the private sector and balanced in terms of their points of view. Committee members offer expertise and perspective on reforms to enable new technologies and services, including reforms that expedite the American public’s access to broadband services, public safety, digital television, and long-range spectrum planning.” The CSMAC held its first meeting in 2006. See <http://www.ntia.doc.gov/advisory/spectrum/>

out in March 2008 with some very constructive recommendations (discussed below), but thus far little actual progress has been made.

2. Step One: A Comprehensive and Transparent Inventory of Unused Spectrum Capacity

The best first step toward making substantially more spectrum capacity available for wireless broadband services and innovation is to determine and disclose how, where and when this publicly-owned resource is currently being used – or not used – by current public agency and private sector licensees. As we recommended in comments on the Broadband Technology and Opportunity Program, filed jointly with the Public Interest Spectrum Coalition, NAF *et al.* urges the Commission to endorse an *Inventory of the Airwaves* that maps and makes publicly available how our public spectrum resource is being utilized or underutilized in at least the most valuable bands below 6 GHz.

The Commission and the public need to have a more complete, comprehensive inventory of what frequencies are *actually* in use, for what purpose, with what technology, at what locations, frequencies and times. Both government and private sector assignments and uses should be included in the map. Actual spectrum use measurements in a large and regionally diverse sampling of markets should be part of the Commission’s broadband mapping exercise. As Dale Hatfield, former NTIA director and chairman of the Commerce Spectrum Management Advisory Committee, has observed, “the government cannot efficiently manage a resource it doesn’t measure.” Spectrum mapping would help facilitate expanded access to rural broadband providers in at least three ways:

- First, more complete and transparent frequency-by-location data online will improve the functioning of secondary markets for spectrum license transfers and leasing.

- Second, it will provide information on what will be required to clear some heavily underutilized bands, so that they can be reassigned for commercial use.
- Third, it will reveal the far greater number of frequency bands that could be made available for opportunistic access in discrete geographic areas, at certain times of day or year, or at certain altitudes or directions of arrival (azimuth, elevation).

We believe that rural areas will be the most likely beneficiaries of a mapping of the U.S. spectrum capabilities. It will quickly become clear that particular frequency bands are either completely unused or grossly underutilized in particular rural markets. This could provide the Commission or Congress with the information it needs to reallocate or at least to open these frequencies for non-interfering use by rural broadband providers.

Wireless remains the most cost-effective and rapid means by which to bring broadband access to rural residents in particular. Already, thousands of locally-grown Wireless Internet Service Providers (WISPs), Rural ILECs, public utilities, NGOs and local governments are utilizing wireless technology in conjunction with unlicensed spectrum to bring wireless broadband to unserved and underserved rural areas across the country. A substantial obstacle these small and local providers face in attempting to expand and scale-up their networks is access to additional spectrum.

We recommend that spectrum mapping should be adopted as a presidential initiative coordinated from the White House under the guidance of the President's Chief Technology Officer and in coordination with the National Economic Council. In addition to signaling the importance of pervasive connectivity to the economy and American competitiveness, White House leadership is necessary to secure the full cooperation of departments and agencies across the government. Federal agencies hold the rights to the majority of the spectrum frequency

bands best suited for broadband services and applications. These rights are spread across dozens of agencies and coordinated by an office within NTIA (the Office of Spectrum Management) this is notoriously conflicted by its primary role as protector of federal agency prerogatives, with a culture shaped by dependence on spectrum management fees budgeted by these agencies.⁴⁹ The FCC, meanwhile, is an independent regulatory agency that can neither command, nor be commanded by, the NTIA or other executive branch departments. Therefore, while the NTIA and FCC are the essential co-partners in this effort – and show promising signs of being able to work in tandem under their respective new leaderships – it will be critical for the entire executive branch to respond to this initiative as a presidential broadband imperative.

Fortunately, Congress has already authorized and appropriated adequate resources to begin this mapping immediately. The American Recovery and Reinvestment Act authorizes funds for developing and maintaining “a comprehensive nationwide inventory map of *existing broadband service capability* [italics added].”⁵⁰ Just as fiber is the essential conduit for advanced wired connectivity, spectrum is the publicly owned conduit for wireless broadband. Spectrum is “wireless fiber” – the fundamental pipeline for wireless broadband service capability and we believe it would be in the public interest to have a clear and transparent mapping of those capabilities between 30 MHz and at least 6 GHz. In short, the government cannot manage this essential broadband conduit – nor can the public match its availability to local needs, or hold our

⁴⁹ Headed by the Assistant Secretary for Communications and Information, NTIA relies on the assistance of one of the oldest federal agencies, the Interdepartmental Radio Advisory Committee (IRAC), which NTIA now chairs. IRAC, which helps coordinate federal use of spectrum, is composed of representatives from 20 federal agencies that rely on spectrum in carrying out their various responsibilities. Like the FCC, NTIA allocates spectrum on the basis of an exclusive use by a licensee. There are some exceptions where government agencies share frequencies and networks. For example, NTIA literature notes that the USDA runs a National Interagency Fire Center where emergency replies can be utilized during emergencies and the Treasury Department operates a “Federal Commons” as an interoperable frequency assignment to be shared among all Federal agencies for law enforcement and coordination with state and local police during emergencies. See Federal Strategic Spectrum Plan, p. 3. For a GAO overview of IRAC, see GAO-0401028. IRAC Representatives Effectively Coordinate Federal Spectrum but Lack Seniority to Advise on Contentious Policy Issues. September, 2004.

⁵⁰ See Sec. 6001, The American Recovery and Reinvestment Act of 2009, Pub. L. No. 111-5, 123 Stat. 115 (2009).

government accountable – when nobody knows what frequencies are actually being used or unused at any given place or time.

3. Step Two: Identify Spectrum Capacity to Open Opportunistically by Leveraging the TV Bands ‘White Space’ Database and/or by Clearing Current Users for Licensing

Although spectrum mapping 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. Although we believe the Commission should also renew its forward-looking but aborted inquiries into the potential for allowing spread spectrum overlays across most of the spectrum, it should be indisputable that a variety of “smart radio” technologies (e.g., sensing and dynamic frequency selection), protocols (e.g., listen-before-talk) and spectrum management tools (e.g., the forthcoming TV Bands Database) will allow the opportunistic use of a large number of federal and non-federal bands. A band-by-band approach will be necessary to determine the best means by which a band can be made available for more intensive use with minimum risk of harmful interference to incumbent services. In some bands, Congress or the Commission may determine that it is feasible to relocate incumbent users to accommodate reassignment of frequencies on an exclusively-licensed basis, as occurred with the 90 MHz of federal and broadcast auxiliary spectrum cleared under the Commercial Spectrum Enhancement Act of 2004 for reassignment by relocating incumbent federal users with auction revenue.⁵¹ In a far larger number of bands, where it is not

⁵¹ In December 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 (SRF), which earmarked spectrum auction revenue to provide a centralized and streamlined funding mechanism 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. On September 18, 2006, the FCC concluded an auction of licenses for Advanced Wireless Services (AWS), on radio spectrum in the 1710 megahertz (MHz) to 1755 MHz band that had been assigned primarily to federal agencies, which was paired with the 2110 MHz to 2155 MHz band (Broadcast Auxiliary Services) in the auction.

practical to relocate current band 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.

We believe that the most promising mechanism for making substantial new allocations of spectrum available for wireless broadband deployments and other innovation is to leverage the TV Bands Database, which the Commission’s Office of Engineering and Technology will certify as means of identifying and accessing available “white space” channels not in use in discrete geographic locations across the nation’s 210 local TV markets. Under the Report & Order adopted unanimously by the Commission last November,⁵² both fixed and mobile broadband devices will be allowed to operate on an unlicensed basis on unused DTV channels (“white space”) provided 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 (WSDs) will be required to query a national database to determine available channels at their current location before transmit capabilities are engaged. There appears to be no reason to limit the functionality of the TV Bands Database to the TV band frequencies. If a potentially useful frequency band is not being used at particular locations (e.g., in New York City but not in West Virginia), or is being used only at certain times or at certain altitudes or angles of reception, then that currently wasted spectrum capacity could at a minimum be listed in the Database for opportunistic access, subject to whatever power limits or other conditions would be necessary to avoid harmful interference with sensitive incumbent operations.

⁵² Federal Communications Commission, 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 08-2360 (released November 14, 2008).

The FCC’s Office of Engineering and Technology proposed the feasibility of a geolocational database back in the original 2004 Notice of Proposed Rulemaking as one means of allowing unlicensed but non-interfering access to unassigned TV channel frequencies. After extended testing, that option was adopted unanimously by the Commission (although without excluding the possibility of certifying systems relying on spectrum sensing and DFS, without reliance on geolocational database lookup, in the future). Under the Order, the White Space Database is likely to rely on a Repository Service (a data repository that contains information on all the Protected Entities – licensed users – as well as on the registered devices and systems seeking access to the band) and on one or more Query Services (which will refer to a daily or even real-time copies of the Database to give operators of devices and systems a list of channels available for use at their GPS coordinate).⁵³

Although location and time are not the only dimensions along which underutilized frequency bands can be shared dynamically by “smart” radio technologies and protocols,⁵⁴ adding other bands to the TVWS Database over time could ultimately increase available spectrum capacity by hundreds of megahertz or more, particularly in rural areas where measured spectrum usage below 3 GHz is in the low single digits today. In addition, while a straightforward use of the TVWS Database to list and grant geographic- and time-based permission to access additional bands would by itself be a huge boost to spectrum access and efficiency, the Database could also evolve to ensure that there is no “tragedy of the commons” on a particular band; or, if necessary, to record micro-payments to certain licensees that need to

⁵³ See *Ex Parte* Filing of the White Spaces Database Group, in ET Docket No. 04-186, April 10, 2009, which outlines a potential architecture for the Database as proposed by a broad-based industry and consumer consortium that includes Comsearch, Dell, Fox, Google, Microsoft, Motorola, MSTV, NetLogix, Neustar and the Public Interest Spectrum Coalition.

⁵⁴ See, e.g., Robert J. Matheson, “The Electrospace Model as a Tool for Spectrum Management,” presentation slides to ISART 2003.

be compensated for offering opportunistic access (e.g., as an incentive or compensation for a licensee's investment in more interference-resistant receivers, or for other affirmative measures to facilitate shared access).⁵⁵

Kevin Werbach, a professor at the Wharton School and a former FCC technologist, suggests that “properly designed, this system [the TVWS Database] could be the basis for a distributed dynamic routing database, analogous to the DNS (Domain Name System) on the wired Internet.”⁵⁶ He also correctly observes that:

To achieve such a result, however, the database must not be limited to White Space devices alone. The FCC and industry must also take care to avoid the mistakes and failings of the current DNS infrastructure. These include the imposition of artificial scarcities, the creation of a private monopolist, and the bureaucratization of technical management functions.

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. For example, the ability to opportunistically share military radar bands is technically very different than sharing a band used primarily for fixed services, such as satellite or point-to-point microwave links, or a trunked land mobile radio system. One feature that facilitates the

⁵⁵ It's important to note in this regard that licensing under the Communications Act does not contemplate exhaustive rights to the spectrum capacity on a band, but rather the right to use the designated frequency to the extent needed to provide a communications service that serves the public interest. Unused spectrum capacity on any band, in any location, remains public property. Therefore, even without waiting for license renewal, the Commission can at any time permit use of the otherwise wasted spectrum capacity on a non-interfering basis.

⁵⁶ Kevin Werbach, “A Domain Name System (DNS) in the Air,” blogpost at CircleID.com, May 21, 2009, http://www.circleid.com/posts/20090521_addressing_system_for_next_wireless_internet/. Professor Werbach is currently writing a more indepth paper on this topic for publication by the New America Foundation (forthcoming) and presentation at the Telecommunications Policy Research Council this fall.

Pentagon's willingness to allow dynamic sharing of radar frequencies in 5 GHz band, is that unlike television reception, for example, radar poses no "hidden node" challenge to spectrum sensing and Dynamic Frequency Selection technologies because the transmitter and receiver are co-located. In a fixed service band, by contrast, sensing may be less reliable than simply calculating the availability of frequencies in discrete locations based on the listing of protected transmit sites.

By tailoring and listing the means by which a user can gain opportunistic access to unused capacity on a particular band, almost any underutilized band could be opened for some degree of access. Even if the location of radar sites cannot be listed in a Database (to facilitate access by geolocational lookup), sensing alone can facilitate opportunistic access, particularly if federal users adopt a more pro-active posture toward facilitating shared use (viz., by "turning on the headlights" so that other users can more easily detect and avoid causing interference to them).

Bands reserved for federal agency use seem particularly well-suited for opportunistic access for a variety of reasons. Among these are that federal bands are at least nominally controlled by NTIA and, unlike a private sector licensee, the Department of Commerce and other federal users can be expected to balance their own needs with the public interest in expanding available wireless broadband capacity. The military in particular has both very wide bands of spectrum that are unused in most places on most days – and the ability of enforce priority-in-use over opportunistic private sector users during the occasional emergency that justifies reserving those bands.

Moreover, moving toward a system of regulated, opportunistic access is ultimately in the best of interest of the military in particular. There are two reasons for this. One is that federal users, particularly DOD, occasionally need access to *more* spectrum capacity – or at different frequencies – than they currently reserve. This need for access to greater capacity at a particular location or time will increase as the military’s electronic war-fighting capabilities proliferate. Opportunistic access can work both ways: DOD can use the TVWS Database, sensing and other methods to both contribute unused spectrum capacity to the social “pool” – and, in return, gain its own opportunistic access to non-federal bands as needed. Indeed, the ability to dynamically utilize available frequencies to establish secure, ad hoc mesh networks in the field, globally, is what DARPA’s XG program was all about.

More importantly, as exclusively-licensed spectrum access becomes more valuable and scarce in the rest of the world – and more rapidly in potential operational zones such as Southeast Asia, the Middle East, and central and eastern Europe – the U.S. military is likely to begin to lose the privileged access it has had to the same specific frequencies it reserves here in the U.S. Harmonizing a regime of *opportunistic access* to the bands it will need most in the future, with priority-in-use access – both domestically and overseas – may be the most pragmatic way to ensure adequate spectrum access in a diplomatically-sustainable arrangement. In addition, to the extent that DARPA’s XG technology suggests that it will be increasingly necessary outside the U.S. to dynamically detect and use unused bands (in order to avoid disrupting civilian communications), it would seem to make sense to move steadily toward shared, opportunistic access to spectrum domestically as well.

Although certain federal bands offer the greatest near-term potential, unused broadband capacity on non-federal bands should likewise be added to the TVWS Database and made

available for opportunistic sharing. It's important in this context to realize that one great advantage of the geolocate Database approach is that access to a band can be added or withdrawn – or limited to a particular location or time – at any time. Opportunistic access virtually presumes that devices will increasingly be multi-band and capable of frequency hopping. That is, what the Database generates is a list of frequencies that device can access at a discrete place and time. This list of available frequencies, like TV white space channels, can change over time. This means that it should be possible, for example, to provide at least temporary access to unassigned bands that could be limited later if they are licensed. An example would be the unassigned Educational Broadband Service (EBS) license areas in the 2.5 GHz band.

Opportunistic access using a geolocate database could also address the vexing problem of valuable licenses that are not built out, particularly in rural areas, even after many years. For example, there are PCS and AWS frequency blocs that are not being used – and may never be built out for economic reasons – in rural and small town areas that could be made available to local broadband providers, such as local WISPs and community networks, on an opportunistic basis. Under this scenario, the Commission would not even need to go as far as a “use it or lose it rule” if it allowed opportunistic access until a licensee gave notice of the date when it would build out and begin operating in a specific area. In addition to expanding available spectrum capacity, this would have the additional benefit of making licensee build-out and spectrum usage more transparent.

‘Smart Radio’ Technologies Allow Dynamic Spectrum Sharing

Advances in smart or cognitive radio (CR) and software defined radio (SDR) technologies have fundamentally expanded options for spectrum use in ways that have yet to be

acted upon by regulatory agencies. Traditionally, the artificial scarcity of government licenses to utilize spectrum has led to quandaries in finding frequencies to support wireless broadband Internet. However, these new developments have created opportunities for dynamic spectrum sharing, thus potentially ending the persistent problem of artificial spectrum scarcity by shifting the spectrum paradigm from static to dynamic.⁵⁷ Dynamic spectrum access using cognitive radio technologies holds particular promise for utilizing unused or underutilized spectrum, referred to as “white spaces.” Changing technologies have expanded the potential for non-interfering shared access to spectrum bands based on time, direction of arrival, frequency, and the physical location based on latitude, longitude and altitude.⁵⁸ “Smart, agile systems can evade interference if there is spectrum available somewhere,” observed Robert Matheson, a recently retired NTIA spectrum engineer at the Institute for Telecommunications Sciences in Boulder, Colorado.⁵⁹

Of course, among radio engineers in the government and private sector it is already well-established that various cognitive radio technologies and protocols permit dynamic sharing of underutilized bands for opportunistic use by non-licensed users. The military has been testing dynamic spectrum sharing technology for years and has run successful field tests demonstrating its feasibility as part of the DARPA NeXt Generation (XG) program.⁶⁰ In October, 2008 the FCC’s Office of Engineering and Technology released its report concluding that White Space

⁵⁷ See Kevin Werbach, “Radio Revolution: The Coming a Age of Unlicensed Wireless,” New America Foundation (2002).

⁵⁸ See Robert J. Matheson, “Flexible Spectrum Use Rights,” http://www.its.blrdoc.gov/pub/ntia-rpt/05-418/05-418_matheson.pdf.

⁵⁹ Robert J. Matheson, “The Electrospace Model as a Tool for Spectrum Management,” presentation slides to ISART 2003, which – in addition to specifying the seven dimensions along with spectrum capacity can be shared, makes the important technical point that: “Interference occurs only in receivers. Interference is always caused by an inadequate receiver and could be fixed by .good-enough. receiver (though .good-enough. might be very complex and expensive).”

⁶⁰ Shared Spectrum. Press Release for Successful Demo of Next Generation Wireless (2006), http://www.sharedspectrum.com/inc/content/press/XG_Demo_News_Release_060918.pdf.

Devices had satisfied the “proof of concept” to operate on a non-interfering basis on vacant channels adjacent to licensed TV transmissions.⁶¹ This followed the Pentagon’s approval of Dynamic Frequency Selection (DFS) as a means by which fixed WiFi backhaul systems could operate on the same frequencies as military radar in the 5 GHz band.⁶² Cognitive radio sensing (DFS), for example, allows devices to rapidly scan and process spectrum use in real time, identifying underutilized frequencies. In essence, these systems are aware of their radio frequency (RF) environment and can adapt to changes in this electromagnetic space. Earlier, the FCC’s Spectrum Policy Task Force’s (SPTF), in its “Unlicensed Devices and Experimental Licenses Working Group” proposed another method of introducing commons to exclusive-use bands by introducing “underlay” rights, thereby allowing unlicensed users to access the exclusive use bands in such a way that prevents interference with the license holder.

These technological developments underscore the fact that our contemporary moment marks 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,” capable of adapting to changing environments and maximizing efficient use of available spectrum to deliver mobile, affordable broadband connectivity. Advances in cognitive radio technology will continue to promote innovation in spectrum use and efficiency, while also leading to more reliable and faster wireless networks. Research is ongoing to develop wireless devices that can dynamically select available frequencies that will provide for the greatest throughput – allowing wireless devices and

⁶¹ FCC, Office of Engineering and Technology, “Evaluation of Prototype TV-Band White Space Devices – Phase II” (2008), http://hraunfoss.fcc.gov/edocs_public/attachmatch/DA-08-2243A3.pdf.

⁶² See Federal Communications Commission. Report and Order, “Amendment of the Commission’s Rules to Provide for Operation of Unlicensed NII Devices in the 5 GHz Frequency Range” (January 9, 1997), http://www.fcc.gov/Bureaus/Engineering_Technology/Orders/1997/fcc97005.txt

networks to adjust to the unique RF environment of an area.⁶³ By focusing on increasing spectrum sharing and smart radio technology the Commission can help to expand wireless broadband access while also promoting the U.S. as a global leader in wireless technology and innovation.

B. FCC and NTIA Should Conduct an Overall Review of Policies to Facilitate More Efficient Spectrum Use by Licensed Federal and Commercial Users

In addition to an inventory of the airwaves and a band-by-band opening of underutilized frequencies for opportunistic access on an unlicensed basis, we recommend that the Commission open a number of other inquiries and/or rulemakings aimed at making spectrum more accessible and wireless broadband markets more competitive. As noted in greater detail below, we believe that the Commission should return again to an inquiry into whether much larger and contiguous portions of the spectrum can be opened to spread spectrum technologies that can operate without causing harmful interference to incumbent services. We also urge the Commission to better optimize the utility of the TV white space channels, particularly for rural broadband deployments, by adopting a variable power limit that allows WISPs and other providers to take advantage of the larger number of contiguous channels available in many markets.

Finally, we also want to reiterate recommendations made in companion comments filed today by Public Knowledge, on behalf of public interest groups, including the New America

⁶³ For example, *see* Tamer Nadeem, “Mobility Control for Throughput Maximization in Ad Hoc Networks,” Department of Computer Science, University of Maryland, available at [http://domino.research.ibm.com/comm/research_people.nsf/pages/sri.pubs.html/\\$FILE/wcmc.pdf](http://domino.research.ibm.com/comm/research_people.nsf/pages/sri.pubs.html/$FILE/wcmc.pdf).

Foundation. In particular, we want to emphasize our support on two issues critical to wireless broadband competition:

First, we urge the Commission should re-adopt a spectrum cap to mitigate increasing market power and anti-competitive practices in a rapidly consolidating wireless market. The 45 MHz cap adopted in the mid-1990s instituted a competition policy that facilitated new national and regional entrants, avoiding a market overly dominated by the wireline incumbents. Unfortunately, the repeal of those caps and a laissez-faire approach to mergers has led to increasing consolidation in favor of the more vertically-integrated wireline ISPs. The Commission should reset a spectrum cap at roughly 95 MHz and also implement a “spectrum screen,” on spectrum above 2.3 GHz, as a guideline and rule for spectrum holdings.⁶⁴

Second, to increase consumer choice, innovation and competition among wireless service providers and in adjacent markets for devices and applications, we urge the Commission to ensure a level playing field between wireless and wireline networks by clarifying that its Internet Policy Principles impose on CMRS providers the same so-called *Carterfone* rules requiring that network operators must permit consumers to attach any device, run any application, or access any Web-based service or content, that does not harm the network. Whether by taking up the Skype Petition filed in 2007 (and which is still pending), or as part of a broader proceeding to clarify that network openness rules include a “5th principle” of non-discrimination, the Commission should make it clear that its network openness and consumer protection principles are platform neutral.

1. Reopen Inquiries into the Feasibility of Spread Spectrum Underlays

⁶⁴ New America Foundation, “Reply Comments of The Public Interest Spectrum Coalition,” [December 22, 2008], available at http://www.newamerica.net/files/PISC_RTG_Reply_Comments_122208.pdf [accessed: June 2, 2009].

Although not widely known or remembered today, the Commission’s May 1985 Report & Order authorizing unlicensed, low-power use of spread spectrum technologies on the Industrial, Scientific and Medical (ISM) bands at 900, 2400 and 5700 MHz – paving the way for the then-unimagined innovation we know today as WiFi – was at the time a victory for incumbent special interests determined to stymie the much more open and efficient spectrum policy recommended by the FCC’s inhouse engineering staff.⁶⁵ The R&O adopted as a compromise in 1985 had begun as an objective and technically robust Notice of Inquiry on spread spectrum technology in 2001.⁶⁶ The NOI stated that its “focus was on finding a technical framework for permitting the use of spread spectrum without interfering with other users, while at the same time not specifically requiring use of this technology.”⁶⁷ The basic logic, even more valid today, was articulated at an FCC hearing back in 1939 by the Commission’s Chief Engineer Ewell Jett:

What we are concerned with immediately is the problem of interference. If certain low power devices can be used without interfering with radio communication, there would appear to be no engineering reason for suppressing their use.⁶⁸

Although every major equipment manufacturer opposed the commercial use of spread spectrum, the Commission issued a Notice of Proposed Rulemaking in 1984 that proposed low-power underlays (then called overlays) “on an unlicensed basis on *all* bands above 70 MHz,

⁶⁵ FCC, First Report and Order, Docket 81-413, 101 F.C.C.2d 419 (May 9, 1985), available at <http://www.marcus-spectrum.com/documents/81413RO.txt>. The history related here draws primarily from a firsthand recollection presented by Michael J. Marcus, former FCC/OET chief spectrum engineer and the spread spectrum project leader at that time. See Michael J. Marcus, “Wi-Fi and Bluetooth: The Path from Carter and Reagan-Era Faith in Deregulation to Widespread Products Impacting Our World, a paper presented at the George Mason University School of Law conference on The Genesis of Unlicensed Wireless Policy, April 4, 2008.

⁶⁶ FCC, Notice of Inquiry, Docket No. 81-413, 87 F.C.C.2d 876 (June 30, 2001), available at <http://www.marcus-spectrum.com/documents/SpreadSpectrumNOI.pdf>.

⁶⁷ Marcus, “WiFi and Bluetooth, op. cit. at 11.

⁶⁸ *Ibid.*

except on 28 specific bands to which NTIA refused to agree during interagency coordination.”⁶⁹ NTIA and IRAC even agreed that federal systems could tolerate spread spectrum (except on the excluded bands) at powers up to 7 Watts, which is considerably above the current 1 Watt Part 15 limit later adopted.⁷⁰ However, the unlicensed spread spectrum access to all non-federal and some federal bands recommended by the Commission’s engineering staff fell victim to a concerted lobbying campaign by industry interests. Yet, despite this setback, the R&O had approved the use of spread spectrum on an unlicensed access under Part 15 on the ISM bands, which within a decade led to many innovations, including a wireless low-power LAN standard known today as WiFi.

It took another 17 years before the feasibility of a more widespread authorization of spread spectrum was taken up by the FCC’s Spectrum Policy Task Force under Chairman Michael Powell.⁷¹ The Task Force report recommended an inquiry into the concept of underlays that would be subject to a variable “interference temperature” calibrated to avoid harmful interference with incumbent operations. The Commission adopted a Notice of Inquiry on the topic shortly thereafter, but it was later terminated after incumbent industry licensees once again reacted with what Marcus and others remember as the classic “NIMBY” (“not in my backyard”).

We do not have the technical expertise to assert with confidence that much wider-band authorizations of spread spectrum technologies are feasible and would once again spur the sort of innovation and consumer welfare that have sprung from the limited and very low-power access permitted since 1985 on the ISM bands. We do know, as Marcus put it, that the “rules adopted in Docket 81-413 had a much greater impact than any of its advocates could ever have imagined

⁶⁹ *Id.* at 14. See FCC, Further Notice of Inquiry and Notice of Proposed Rulemaking, Docket 81-413, 98 F.C.C.2d 380, available at <http://www.marcusspectrum.com/documents/SpreadSpectrumFNOINPRM.pdf>, at 16-18.

⁷⁰ Marcus, *Id.* at 16.

⁷¹ Federal Communications Commission, *Spectrum Policy Task Force Report*, ET Docket No. 02-135 (November, 2002), available at www.fcc.gov/sptf/reports.html.

at the time. They enabled the development of WiFi, Bluetooth, the majority of cordless phones now sold in the US, and countless other lesser known niche products.”⁷² We also agree with his conclusion, which notes that:

These new products did not come from the classic ‘command and control’ approach to spectrum management with its endless delays and preferences for big players. . . . A key factor was leadership at FCC that had the confidence to look at technical issues on both their own merits and public interest considerations; not necessarily picking the most common viewpoint of powerful industry players.⁷³

In that spirit, we urge the Commission to include as part of any national broadband plan a renewed inquiry into the technological feasibility of opening most spectrum to a far greater degree for unmediated, low-power broadband and innovation.

2. TV White Space Rules Should Allow Variable Power for Rural Broadband

The Commission’s Second Report & Order granting unlicensed access to vacant spectrum (“white spaces”) in the TV band (Docket 04-186) were a great step forward. However, in its effort to address the objections of those opposed to any use of the broadcast white spaces, the Commission adopted overly conservative rules that may limit the potential of TV band devices (TVBDs) to increase broadband in rural areas. The Commission placed a unitary power limit of fixed and mobile TVBDs to protect incumbent broadcasters, even in rural areas where

⁷² *Id.* at 24.

⁷³ *Id.* at 25.

the vast majority of TV band is currently unused. As the Public Interest Spectrum Coalition (PISC) noted in its Petition for Reconsideration in the Commission's white spaces proceeding:

This limitation is clearly contrary to the clear Congressional and public interest in promoting more affordable wireless broad deployment in rural areas where commercial and non-commercial Wireless Internet Service Providers (WISPs) could use this fallow white space spectrum to operate at power levels substantially above 4 watts EIRP – and do so without any risk of harmful interference to TV reception in areas where there are four, five, six or even more consecutive unassigned and available TV white space channels.⁷⁴

For example, in the media market surrounding Pierre, South Dakota, there are no licensed TV stations above channel 39. A rural WISP could potentially operate a high-capacity and higher-power broadband service while maintaining a buffer of three or four empty channels (18-24 MHz guard band) between its service and any licensed incumbent service. As the Commission's Order acknowledged "there are advantages, such as reduced infrastructure costs and increased range, to operation of unlicensed TVBDs at even higher power levels." Yet, although recognizing the advantages of variable power limits, the Commission declined at this time to permit fixed TVBDs to operate at power levels greater than 4 watts EIRP regardless of proximity to incumbent services – and instead opted to "further explore in a separate Notice of

⁷⁴ See *Petition for Reconsideration*, Public Interest Spectrum Coalition, FCC 04-186, March 19, 2009 at 11.

Inquiry whether higher powered unlicensed operation might be accommodated in the TV white spaces in rural areas.”⁷⁵

While the Commission must guard against reasonable risks of harmful interference, it should strike a proper balance that furthers the goal of encouraging broadband deployment. The Commission has determined that the TV bands database will be a reliable means of identifying and operating in a channel immediately adjacent to a television station, or at even higher power with a one channel separation (n+1). The same database can therefore reliably report that a TVBD can operate with a n+2, or n+4, or even greater separation from a licensed service in certain geographic locations – and hence can operate at a higher power level without any increased risk of harmful interference. For the same reason, the Commission should also permit mobile devices to operate at higher and variable power when separation distances permit.

IV. CONCLUSION

NAF *et al.* appreciates the opportunity to submit the above policy recommendations to the Commission in its effort to develop a national broadband plan. We believe that public policies that prioritize investments in high-capacity, open-access fiber connections deep into every community and that open underutilized spectrum for opportunistic access, represent the essential building blocks for expanding high-speed broadband to all Americans. Putting a priority on supplying these essential fiber and spectrum conduits will ultimately benefit the broadest array of providers, business models and broadband solutions, while also promoting further innovation, competition, and increased speeds and lower prices for consumers. We urge the Commission to prioritize open access to these fiber and spectrum assets as a means of

⁷⁵ See *Second Report and Order and Memorandum Opinion and Order*, FCC 04-186, adopted Nov. 4, 2008 at ¶ 106.

ensuring that the U.S. continues to be a leading innovator in the telecommunication technologies of the 21st century.

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