



**Broadband Spectrum:
The Engine for Innovation, Job Growth,
and Advancement of Social Priorities**

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TABLE OF CONTENTS

<u>EXECUTIVE SUMMARY</u>	ii
I. RISING DEMAND FOR WIRELESS BROADBAND INTERNET ACCESS HAS CREATED A SPECTRUM SHORTFALL	1
II. ALLOCATING ADDITIONAL SPECTRUM FOR WIRELESS BROADBAND WILL PRODUCE NUMEROUS ECONOMIC BENEFITS	3
III. ADDITIONAL SPECTRUM FOR WIRELESS BROADBAND WILL RESULT IN NUMEROUS SOCIETAL BENEFITS	4
A. Public Safety and Personal Security	4
B. Healthcare	5
C. Education	6
IV. MECHANISMS SHOULD BE ESTABLISHED TO PERMIT FAST AND FLEXIBLE SPECTRUM REALLOCATIONS	7
CONCLUSION.....	8

EXECUTIVE SUMMARY

The Internet has been referred to as the information superhighway and has become an essential component of business and society. The increasing demand for anytime, anywhere broadband access has created a spectrum crisis, with demand for bandwidth-intensive mobile access to the Internet outpacing the capacity of existing wireless broadband networks.

- A recent FCC staff technical paper noted that the average projection for wireless data growth by 2014 was 3,506%.
- The Commission has noted that the number of wireless transmitters authorized *annually* has increased fourfold in the last 10 years and that the number of devices with three or more transmitters has grown by 700% since 2008.
- Cisco recently concluded that mobile data traffic will grow at a compound annual growth rate of 92 percent from 2010 to 2015.

The International Telecommunications Union estimated that the United States would need up to 1,720 MHz of spectrum to satisfy this demand for wireless broadband in 2020. Yet the United States only has a fraction of that spectrum currently available for such use.

In responding to this spike in demand, government must move swiftly to repurpose spectrum for wireless broadband use. Such action will have significant economic benefits. For example:

- The spectrum reallocations to mobile services that occurred from 1994 to 2000 led to a 250% increase in investment and a 300% increase in jobs in the mobile market.
- A 1% increase in broadband deployment could result in as many as 300,000 new jobs.
- It has been estimated that new wireless broadband investments of \$17.4 billion will increase gross domestic product by up to \$184.1 billion and create up to 6.3 million jobs within 24 months.

The accelerated deployment of wireless broadband technologies and applications will generate productivity gains of almost \$860 billion by 2016, including:

- Cost savings of almost \$73 billion from more efficient management and documentation;
- Annual cost savings of \$16.5 billion due to improvements in field service automation;
- Savings of approximately \$3.6 billion due to improved inventory management and inventory loss reductions; and
- Savings of almost \$2.4 billion due to sales force automation.

In addition to these economic benefits, repurposing spectrum for wireless broadband use will produce numerous societal benefits in areas such as public safety and personal security, healthcare, and education. Each of these benefits requires access to spectrum and the reliable, timely transmission of data.

Without the quick reallocation of spectrum for wireless broadband, consumers could begin to experience wireless data gridlock. The demands for access to the information superhighway will exceed the capacity of the wireless “access road,” which will result in the inability of consumers to send and receive information in the manner in which they are accustomed. Accordingly, TIA supports the creation of mechanisms that will facilitate the fast, flexible repurposing of spectrum for wireless broadband use.

BROADBAND SPECTRUM: THE ENGINE FOR INNOVATION, JOB GROWTH, AND ADVANCEMENT OF SOCIAL PRIORITIES

The Internet has been referred to as the “information superhighway” and has become an essential component of business and society. Thanks to the Internet, people now are accustomed to exchanging data instantly – whether it is critical information, such as financial data or confirmation that your child has arrived home safely, or information that grows our businesses or simply makes our lives easier and better. Whereas people in the 1990s were accustomed to accessing the Internet from a few fixed locations, such as the home or office, people today demand anytime, anywhere access via wireless technologies. Moreover, whereas people in the 1990s were primarily focused on exchanging email and browsing websites, people today generally demand broadband Internet access that permits video downloads, streaming video, gaming, and other capacity intensive uses.

As discussed below, the increasing demand for mobile broadband access has created a spectrum crisis¹ that jeopardizes economic productivity, job growth, innovation, and societal gains. Without the reallocation of spectrum for wireless broadband quickly, U.S. consumers could begin to experience wireless data gridlock. The demands for wireless access to the information superhighway will exceed the capacity of the wireless “access road,” which will result in the inability of consumers to send and receive information in the manner in which they are accustomed. As venture capitalist and former Wall Street technology and internet analyst Mary Meeker points out, as a corporation, the U.S. has underinvested in technology, a tool essential for competing in the global marketplace.² Policymakers can change that by investing in the future of mobile broadband, driving innovation and prosperity. Accordingly, TIA supports granting the Federal Communications Commission (FCC) the authority to conduct voluntary incentive auctions and encourage policymakers to utilize other mechanisms that will rapidly and dramatically increase the amount of spectrum for wireless broadband.

I. RISING DEMAND FOR WIRELESS BROADBAND INTERNET ACCESS HAS CREATED A SPECTRUM SHORTFALL

The demand for mobile connectivity in the U.S. is growing exponentially. The increased demand for capacity-intensive access to the Internet can be seen in the rapid growth of smartphone devices, which essentially are handheld computers integrated with a mobile telephone. The smartphone share of wireless handset unit sales increased from 21.8 percent in 2008 to 37.5 percent in 2010, and is expected to reach 54.9 percent by 2014.³ These devices permit consumers to utilize their phones in much the same manner as their home computers. Innovation and growth have also gone well beyond the smartphones; demand for bandwidth-consuming devices such as netbooks and tablets is skyrocketing. Analysts expect a 224%

¹ Julius Genachowski, Chairman, Federal Communications Commission, Remarks at CTIA Wireless IT & Entertainment: America’s Mobile Broadband Future, 1-2 (Oct. 7, 2009) (Chairman Genachowski CTIA Remarks).

² See Mary Meeker, *USA Inc.: Red, White, and Very Blue*, Bloomberg Businessweek (Fe. 24, 2011) available at http://www.businessweek.com/magazine/content/11_10/b4218000828880.htm

³ See 2011 TIA Market Review & Forecast (“TIA Market Review”) at 4.

growth in the tablet market in 2011,⁴ with 147.2 million tablets shipping in 2015, up from 16.1 million units in 2010.⁵ Further, sales of notebooks and netbooks have risen from an estimated 62 million in 2005 to around 203 million in 2010.⁶ Additionally, wireless machine-to-machine (M2M) connections continue to show steady growth. M2M services improve safety and efficiency in areas including manufacturing, energy conservation, consumer alerts on products needing service or recall, or updating digital billboards to inform drivers of road conditions or nearby services. Wireless M2M connections are expected to exceed 232.5 million in 2014 and 297 million in 2015.⁷ Thus, capacity-intensive uses such as video, which are now available to mobile users, will rapidly be sharing bandwidth with innovative M2M services - further straining wireless networks that are already near capacity.

A recent FCC staff technical paper on mobile broadband analyzed three separate studies and noted that the average projection for wireless data growth by 2014 was 3,506%.⁸ The Commission also has noted that the number of wireless transmitters authorized *annually* has increased fourfold in the last 10 years, and that the number of devices with three or more transmitters has grown by 700% since 2008.⁹ Cisco recently concluded that “[m]obile data traffic will grow at a compound annual growth rate (CAGR) of 92 percent from 2010 to 2015, reaching 6.3 exabytes per month by 2015.”¹⁰

This growth, fueled by consumer demand, cannot be sustained without adequate spectrum. As Chairman Genachowski has stated: “Spectrum is the oxygen of our mobile networks. . . . In fact, I believe that the biggest threat to the future of mobile in America is the looming spectrum crisis.”¹¹ Consistent therewith, the International Telecommunications Union (ITU) has estimated that the United States needs between 760-840 MHz of spectrum to satisfy

⁴ See Steven M. Sears, *A Research in Motion Tablet Play*, Barron’s (Feb. 23, 2011) available at http://online.barrons.com/article/SB50001424052970204395804576162343528105956.html?mod=BOL_da_spd

⁵ See *Worldwide Tablet Market Forecast Report*, Infinite Research, available at <http://www.infiniteresearch.net/research/tabletmarketforecast.html>

⁶ See *Growing Notebook & Netbook Market Will Boost Dell’s PC Business*, Trefis (Feb. 11, 2011) available at <http://www.trefis.com/articles/38164/growing-notebook-netbook-market-will-boost-dells-pc-business/2011-02-11>

⁷ See *Cellular M2M Connections Will Show Steady Growth to Top 297 Million in 2015*, ABI Research (Oct. 10, 2010) available at <http://www.abiresearch.com/press/3528-Cellular+M2M+Connections+Will+Show+Steady+Growth+to+Top+297+Million+in+2015>

⁸ *Mobile Broadband: The Benefits of Additional Spectrum*, OBI Technical Paper Series, Federal Communications Commission (Oct. 2010) at 18, available at <http://download.broadband.gov/plan/fcc-staff-technical-paper-mobile-broadband-benefits-of-additional-spectrum.pdf>.

⁹ *From the FCC Lab: Report on Trends in Wireless Devices*, Federal Communications Commission (Jan. 2011), available at <http://www.fcc.gov/oet/info/documents/reports/wirelessdevices.pdf>.

¹⁰ Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2010–2015 (Feb. 1, 2011) at 2, 5, 19, available at http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-520862.html.

¹¹ Julius Genachowski, Chairman, Federal Communications Commission, Remarks at CTIA Wireless IT & Entertainment: America’s Mobile Broadband Future, 1-2 (Oct. 7, 2009) (Chairman Genachowski CTIA Remarks).

demand for broadband in 2010, and between 1,280-1,720 MHz by 2020.¹² Yet the United States only has a fraction of that spectrum currently available for such use.¹³ Thus, the Commission has recommended that an additional 500 MHz of spectrum be made available for broadband use within the next 10 years, with 300 MHz being made available for such use within the next five years.¹⁴

II. ALLOCATING ADDITIONAL SPECTRUM FOR WIRELESS BROADBAND WILL PRODUCE NUMEROUS ECONOMIC BENEFITS

Repurposing spectrum to wireless broadband will not merely satisfy consumer demands, but also will net significant economic benefits. Past efforts to make spectrum available for wireless services reflect the job-growing power of repurposing spectrum; the spectrum reallocations between 1994 and 2000 led to a 250% increase in investment and a 300% increase in jobs in the mobile market.¹⁵ It also has been noted that a mere 1% increase in broadband deployment – which is inevitable should a substantial amount spectrum be repurposed for wireless broadband – could mean the creation of as many as 300,000 new jobs.¹⁶ Further, it has been estimated that new wireless broadband investments of \$17.4 billion will increase U.S. gross domestic product (GDP) by between \$126.3 billion and \$184.1 billion and create between 4.5 million and 6.3 million jobs within twenty-four months of making the investment.¹⁷ Such investments, and associated GDP and job growth, would be facilitated by the reallocation of spectrum for wireless broadband.

It also has been forecast that accelerated deployment of wireless broadband technologies and applications will generate productivity gains of almost \$860 billion by 2016.¹⁸ For example, the following savings could be generated in 2016 from increased reliance on wireless technology and applications:

¹² See International Telecommunication Union, *Report ITU-R M.2078: Estimated Spectrum Bandwidth Requirements for the Future Development of IMT-2000 and IMT-Advanced*, at 25, Table 25 (2006) (ITU Report).

¹³ For example, only approximately 410 MHz of spectrum is currently allocated for commercial wireless use. See Letter from Christopher Guttman-McCabe, Vice President, Regulatory Affairs CTIA – The Wireless Association® to Marlene H. Dortch, Secretary, Federal Communications Commission at 9 (May 12, 2009).

¹⁴ Connecting America: The National Broadband Plan, Recommendation 5.8, at 86 (2010), available at <http://www.broadband.gov/plan/> (National Broadband Plan).

¹⁵ See Wendy Wigen, *Betting on Wireless Broadband Access to Push the U.S. Forward*, available at <http://www.educase.edu/blog/wwigen/BettingonWirelessBroadbandAcce/207128>.

¹⁶ See Brookings Institute, *The Effects of Broadband Deployment on Output and Employment: A Cross-sectional Analysis of U.S. Data* at 2, 12 (July 2007) available at <http://www.brookings.edu/views/papers/crandall/200706litan.pdf>.

¹⁷ See Alan Pearce and Michael S. Pagano, *Accelerated Wireless Broadband Infrastructure Deployment: The Impact on GDP and Employment*, New York Law School, Media Law and Policy Law Journal, vol. 18 at 11-12 (Spring 2009) available at http://www.nyls.edu/user_files/1/3/4/30/84/187/245/Pearce%20&%20Pagano,%20SPRING%202009%20&%20Pagano,%2018%20MEDIA%20L.%20&%20POL%E2%80%99Y.pdf.

¹⁸ Roger Entner, *The Increasingly Important Impact of Wireless Broadband Technology and Services on the U.S. Economy* at 4 (2008), available at http://files.ctia.org/pdf/Final_OvumEconomicImpact_Report_5_21_08.pdf (Entner Paper).

- A cost savings of almost \$73 billion in 2016 due to more efficient management and documentation;¹⁹
- Annual cost savings of \$16.5 billion due to improvements in field service automation;²⁰
- Savings of approximately \$3.6 billion due to improved inventory management and inventory loss reductions;²¹ and
- Savings of almost \$2.4 billion due to sales force automation.²²

This data clearly demonstrates that the rapid repurposing of spectrum for wireless broadband will dramatically increase our nation’s GDP, employment, and productivity.

III. ADDITIONAL SPECTRUM FOR WIRELESS BROADBAND WILL RESULT IN NUMEROUS SOCIETAL BENEFITS

In addition to the aforementioned economic benefits, repurposing spectrum for wireless broadband use will produce substantial societal benefits. There are numerous wireless broadband applications that are currently being deployed which have significant societal benefits in areas such as public safety and personal security, healthcare, and education. The continued success of these deployments will be tied to the continued availability of additional spectrum resources.

A. PUBLIC SAFETY AND PERSONAL SECURITY

The importance of wireless broadband for public safety cannot be understated. Efforts have been underway for over a decade to create a nationwide, interoperable public safety broadband network. Few question that this is a critical and timely policy debate and one which needs to be resolved. However, in the meantime, commercial wireless providers currently offer bandwidth intensive services to satisfy a variety of public safety needs. For example, first responders can currently use a commercial wireless device to receive files that could assist in an emergency, such as blueprints, pictures, video, *etc.* Nearly five years ago, AT&T demonstrated a wide variety of public safety/national security applications possible over commercial UMTS/HSDPA networks via a commercial IP multimedia subsystem (“IMS”). This demonstration showed how a first responder could utilize a variety different media during a single transmission — *i.e.*, applications such as voice communications, video feeds, and file transfers. These applications demand large amounts of bandwidth; widespread adoption will require additional spectrum to satisfy demand.²³

¹⁹ *Id.* at 12.

²⁰ *Id.*

²¹ *Id.*

²² *Id.*

²³ Indeed, the FCC is currently exploring whether wireless carriers should be required to incorporate video, pictures, and other capacity-intensive applications into their next generation E911 systems so that emergency callers can transmit more data to first responders. See *Framework for Next Generation 911 Deployment*, PS Docket No. 10-255, *Notice of Inquiry*, FCC 10-200 (Dec. 21, 2010).

Moreover, broadband wireless technology also is playing an increasingly important role in ensuring personal security. For example, Motorola partnered with the University of Delaware to deploy an advanced video security system utilizing a high-speed, point-to-point wireless broadband network. The system offers video surveillance in high-traffic campus areas and permits coverage in student housing areas located on the fringes of the campus where it is difficult to provide a continuous security presence.²⁴ Rave Wireless also offers an application that can be loaded onto student mobile phones on certain campuses that transforms the phones into personal safety devices.²⁵ Once the application is installed, it can be triggered in an emergency by the user in which event the user's picture, mobile number and personal information is instantly transmitted to campus police.

The foregoing applications rely on instant communications over a wireless broadband network and their viability is threatened without substantial increases in the amount of spectrum available for broadband.

B. HEALTHCARE

Wireless technology has improved healthcare management in the United States. First, wireless devices have expanded the availability of medical services into previously unserved areas. Physicians can utilize mobile tablets to access patient data wirelessly, in real-time from a portable medical chart.²⁶ Similarly, medical workers can now utilize a high-magnification microscope attachment (the "CellScope") for cell phones to take images for analysis.²⁷ This device takes pictures at up to 50x magnification, enough to see red blood cells and the parasite that causes malaria. Newer versions of the scope will diagnose tuberculosis, skin conditions, dangerous insect bites and abnormal mole growth.

Second, wireless technology has empowered patients to monitor their health. Examples of such healthcare improvements include:

- **Glucose Meters:** These meters transmit daily glucose readings to a patient's caregiver and relays daily coaching to the patient.²⁸

²⁴ See "University of Delaware Partners with Motorola Solutions to Enhance Campus Safety," Public Safety Communications (Sept. 22, 2010), available at <http://psc.apointl.org/2010/09/22/university-of-delaware-partners-with-motorola/#>. The Higher Education Opportunity Act of 2008 requires that higher education institutions have procedures to "immediately notify the campus community upon the confirmation of a significant emergency or dangerous situation involving an immediate threat to the health or safety of students or staff occurring on the campus." Pub. L. No: 110-315.

²⁵ http://newsreleases.sprint.com/phoenix.zhtml?c=127149&p=irol-newsArticle_Print&ID=996420&highlight=; <http://www.ravewireless.com/news/10/30/2008>.

²⁶ See <http://mobilhealthnews.com/1112/ctia-verizon-on-mhealth-4g>.

²⁷ See <http://mobihealthnews.com/3345/white-house-we-are-excited-about-wireless-health>; <http://blumcenter.berkeley.edu/global-poverty-initiatives/mobile-phones-rural-health/remote-disease-diagnosis>.

²⁸ See <http://www.diabetesmine.com/2009/05/announcing-our-winners-the-2009-diabetesmine-design-challenge.html>.

- **Monitoring Asthma:** A wireless peak flow meter for asthma combines monitoring technology with wireless communications.²⁹ Physicians can be alerted when a patient falls below respiratory flow safe levels or when a patient stops testing.
- **Medicine Compliance:** Programs can remind patients by email or text to take medicines and conduct remote monitoring.³⁰ Voice-interactive systems can also ask questions key to treatment and deliver the answers to a care provider.

Third, wireless technologies can be used to protect the public from epidemics and to monitor for chemical and biological agents. The Center for Disease Control is using emerging mobile technologies to increase the dissemination and potential impact of CDC’s information and tailoring specific health messages to meet unique challenges, such as the response to H1N1 and natural disasters such as hurricanes.³¹ New technology also will permit wireless devices to “sniff” for chemical or biological agents in the air and alert homeland security and medical officials before patients become symptomatic from exposure.³²

Each of these health-related applications generally depends upon the timely exchange of information and could be jeopardized by wireless data gridlock, a critical problem that can only be solved by providing additional spectrum for broadband.

C. EDUCATION

Wireless broadband technology is improving educational opportunities around the world through mobile learning (“mLearning”) applications. Innovative MLearning applications allow students in remote areas to participate in classes taking place virtually anywhere in the world. When the applications are loaded onto a mobile device, a student can receive a broadcast of a class lesson and participate interactively with a teacher and other students via the mobile device. Everything from textbooks to quizzes to homework assignments can be obtained via the same device.

In a recent speech, President Obama extolled the virtues of wireless broadband for education. The President noted that wireless broadband in Northern Michigan helped create “new online learning opportunities for K-12 students.”³³ As an example, he noted that snowfall in Northern Michigan often prevented students in remote areas from travelling to their schools located as far as 30 miles away. Wireless broadband deployment has enabled those students to

²⁹ See http://news.cnet.com/8301-17938_105-10234750-1.html.

³⁰ See, e.g., <http://www.inrangesystems.com/index.php?page=understanding-emma>; see also CA Health Study at 8; <http://mobilhealthnews.com/4153/harvard-pilgrim-to-pikot-pillbox-for-ckd-patients>.

³¹ See <http://www.cdc.gov/eid/content/16/9/1488.htm>; <http://www.cdc.gov/mobile>.

³² See http://www.dhs.gov/files/programs/gc_1268073038372.shtm; <http://www.wired.com/dangerroom/2010/04/homeland-security-seeks-bio-agent-sniffing-cell-phones/#>; <http://www.geek.com/articles/mobile/nasa-and-dhs-demonstrate-air-sniffing-mobile-phones-20091030>.

³³ Remarks by the President on the National Wireless Initiative in Marquette, Michigan (Feb. 10, 2011) *available at* <http://www.whitehouse.gov/the-press-office/2011/02/10/remarks-president-national-wireless-initiative-marquette-michigan>.

participate in class remotely, rather than miss class due to weather and fall behind their classmates.³⁴

Wireless broadband also connects field studies to the classroom. For example, Chesapeake Bay FieldScope is a collaborative high school science project that combines fieldwork, web-based geospatial technology, and other tools to help students investigate water quality issues involving the Chesapeake Bay. Under this approach, students receive traditional “in classroom” learning for basic scientific knowledge and then are put into the field to use that knowledge to gather scientific observations. These observations are then uploaded into a database where the students can compare their findings against those of scientists and other students.³⁵

Wireless broadband also allows parents geographically separated from their children – whether due to military deployments, business travel, or other reasons – to assist their children with homework in real time through online video and chat applications. Thus, a parent located on the West Coast can utilize flash cards to help a child study for a class.

As with the other applications discussed above, however, the success of mLearning is tied to reliable, real-time access to information. If a student is regularly unable to attend a class remotely due to mobile data gridlock, the value of the mLearning experience is diminished.

IV. MECHANISMS SHOULD BE ESTABLISHED TO PERMIT FAST AND FLEXIBLE SPECTRUM REALLOCATIONS

Recognizing the critical importance of broadband for the U.S economy and the substantial societal benefits that flow from such applications, Congress in 2009 directed the FCC to develop a National Broadband Plan to ensure every American has “access to broadband capability.”³⁶ Consistent with this mandate, the FCC drafted the National Broadband Plan which called for the reallocation of 500 MHz of spectrum for wireless broadband by 2020.³⁷ President Obama subsequently issued a Presidential Memorandum directing the National Telecommunications and Information Administration (NTIA) to collaborate with the FCC to make available a total of 500 MHz of Federal and nonfederal spectrum over the next 10 years for wireless broadband use.³⁸

³⁴ *Id.*

³⁵ See <http://www.fieldscope.us>; Transforming American Education: Learning Powered by Technology, National Educational Technology Plan 2010, Office of Educational Technology, U.S. Department of Education (Nov. 2010) at 16, available at <http://www.ed.gov/technology/netp-2010>.

³⁶ American Recovery and Reinvestment Act of 2009, Pub. L. No. 111-5, § 6001(k)(2)(D), 123 Stat. 115, 516 (2009).

³⁷ See National Broadband Plan, Recommendation 5.8, at 84.

³⁸ Presidential Memorandum: Unleashing the Wireless Broadband Revolution (Jun. 28, 2010) available at <http://www.whitehouse.gov/the-press-office/presidential-memorandum-unleashing-wireless-broadband-revolution>.

NTIA, in turn, has begun analyzing domestic spectrum allocations to determine what could be repurposed for wireless broadband within 10 years.³⁹ NTIA identified over 2200 MHz of Federal and non-Federal spectrum that potentially could be used for wireless broadband within the next 10 years and indicated that it would further analyze this spectrum in an attempt to identify as much as 500 MHz for such repurposing.

TIA applauds these efforts but notes the substantial period of time – approximately 10 years – that likely will elapse before the full 500 MHz of spectrum can be repurposed for wireless broadband use. Moreover, this additional spectrum would represent a mere “down payment” on the amount of spectrum the ITU estimates the U.S. will need – up to 1,720 MHz – by 2020.⁴⁰

Given the rapidly increasing demand for bandwidth-intensive applications and the economic and societal benefits associated with wireless broadband applications, mechanisms should be created to permit the fast and flexible reallocation of spectrum to satisfy these demands. In this regard, President Obama’s 2011 Budget proposes legislation to provide authority for “voluntary incentive auctions.”⁴¹ Congress should move quickly to authorize the FCC to utilize such auctions. Voluntary incentive auctions permit the marketplace to drive spectrum use because the auction places a value on the spectrum and the incumbent licensee can relinquish its rights to the spectrum in return for a portion of the auction proceeds.⁴²

The FCC also should expedite its efforts to move away from the traditional command-and-control process for assigning spectrum to a new a flexible use regime. Flexible use permits market forces, rather than often archaic regulations, to determine how spectrum will be used. Thus, if there is demand for wireless broadband, spectrum subject to a flexible use regime can be easily repurposed for that use without the need for a lengthy, contentious rulemaking.

Other mechanisms also should be identified and studied as possible ways to expedite the reallocation of spectrum for wireless broadband use and prevent the wireless gridlock associated with an environment where demand for wireless broadband access greatly outstrips capacity.

CONCLUSION

Without the reallocation of spectrum for wireless broadband quickly, U.S. consumers could begin to experience wireless data gridlock. Accordingly, TIA supports the creation of mechanisms, such as voluntary incentive auctions, that will facilitate the fast, flexible repurposing of spectrum.

³⁹ See U.S. Department of Commerce, “An Assessment of the Near-Term Viability of Accommodating Wireless Broadband Systems in the 1675-1710 MHz, 1755-1780 MHz, 3500-3650 MHz, and 4200-4220 MHz, 4380-4400 MHz Bands” (Oct. 2010) (Fast Track Report); U.S. Department of Commerce, “Plan and Timetable to Make Available 500 Megahertz of Spectrum for Wireless Broadband” (Oct. 2010) (Spectrum Timetable Report).

⁴⁰ See ITU Report at 25, Table 25 (2006).

⁴¹ See generally <http://www.whitehouse.gov/omb/budget/Overview>.

⁴² See National Broadband Plan, Recommendation 5.4, at 81.